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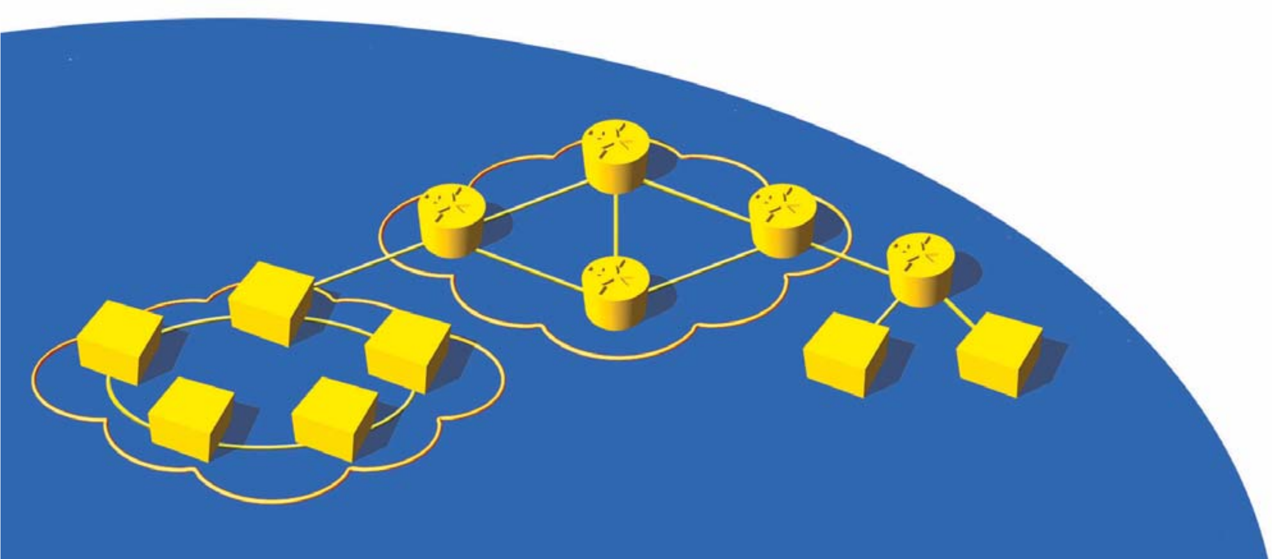
User Guide

SmartWindow

April 2008



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Contents

About this Guide

In About this Guide...

This section presents introductory information, including the following:

Introduction

This user guide provides information on all procedures required to perform tests using SmartWindow software. This includes details on software installation, test setup, and test result interpretation.

It is assumed that users of this guide are familiar with Microsoft Windows and SmartBits equipment, and have an intermediate-level knowledge of data communications theory.

About SmartWindow Documentation

You can obtain the maximum benefit from SmartWindow by using this guide together with the SmartWindow online *Help* system. They are complementary in the information they provide:

- This *SmartWindow User Guide* gives a series of case studies for setting up and using your SmartBits device as a Performance Analysis System.
- The *SmartWindow Online Help* covers SmartWindow terminology, procedures, and parameter definitions, and contains the most recent information about SmartWindow.

Note: Refer to the *Release Notes* included on your distribution CD for the latest information on product features. The *Release Notes* also list the chassis firmware and card firmware supported by the current software release.

Using SmartWindow Online Help

SmartWindow provides online Help for all windows and dialog boxes and their associated tabs. You can access online Help in two ways:

- Press the **F1** key from the active dialog/window for which you want information.
- From the menu bar, select **Help** > **Contents** to view the entire contents of the *Help* file, or **Help** > **Search for Help On** to search by a specific topic or word.

SmartBits Hardware Handling/Cleaning Practices

SmartBits cards and modules contain electronic components that are sensitive to Electrostatic Discharge (ESD) damage. To prevent premature component failure or latent product damage, it is crucial that you handle this equipment following industry standard ESD handling practices. Refer to *Appendix E, "ESD Requirements,"* for further information.

Some SmartBits equipment contains fiber optic components that are very susceptible to contamination from particles of dirt and dust. Product performance may be damaged if these components are not kept clean. Refer to *Appendix F, "Fiber Optic Cleaning Guidelines,"* for proper cleaning practices for these components.

How to Contact Us

To obtain technical support for any Spirent Communications product, please contact our Support Services department using any of the following methods:

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The latest versions of user manuals, application notes, and software and firmware updates are available on the Spirent Communications Customer Service Center website at http://support.spirentcom.com.

Information about Spirent Communications and its products and services can be found on the main company websites at http://www.spirentcom.com and http://www.spirentcom.com.cn (China).

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Chapter 1
SmartWindow Overview

SmartWindow is a flexible virtual front panel for the SmartBits® system. Like other test applications for SmartBits systems, it contains numerous preprogrammed tests. But it is unique in that it offers access to the full functionality in each SmartCard and module, and it enables you to configure frame content down to the bit.

SmartWindow enables you to put any combination of SmartCards or modules into a SmartBits chassis, then work with a virtual interface that identifies each card and port. You can run simple or complex tests on routers, switches, bridges, NIC cards, servers, cable modems, VLANs, firewalls, live networks, and multimedia scenarios, saving the system configuration for later use.

In this chapter...

Version Information and Compatibility

To determine the version level of the software that you are using, review the CD label or select the **Help > About SmartWindow** option from the menu bar of the SmartWindow main window. This opens the *About SmartWindow* window (*Figure 1-1*).

Note: The *About SmartWindow* window in Figure 1-1 shows many software/firmware specifications. This illustration is a sample screen that is used to assist you in locating these specifications. It does not give the specifications of your system.

If SmartWindow is currently connected to a chassis, this window identifies:

- The SmartWindow software build (located at the top of window)
- Controller, serial number, and firmware revision number (located at the bottom of window).

Select Show Card Versions *to display version information for the chassis and its installed cards. Note: This screen shows a sample set of version/ serial number information. Your screen will necessarily display information specific to your system.*

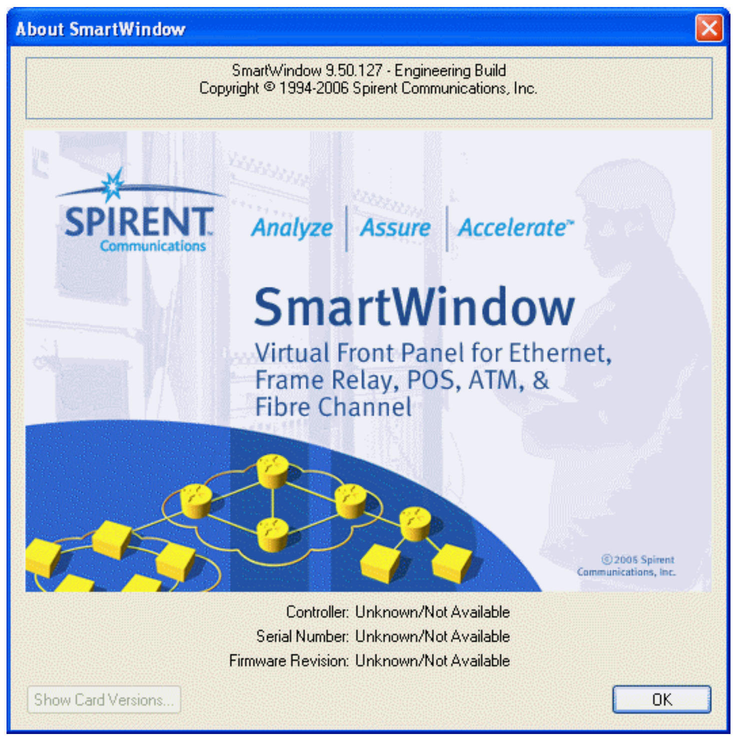

Figure 1-1. About SmartWindow Information

Card versions

To obtain more detailed information on the SmartBits chassis and installed cards, click the **Show Card Versions** button. The *SmartBits Version Information* window opens (*Figure 1-2 on page 19*).

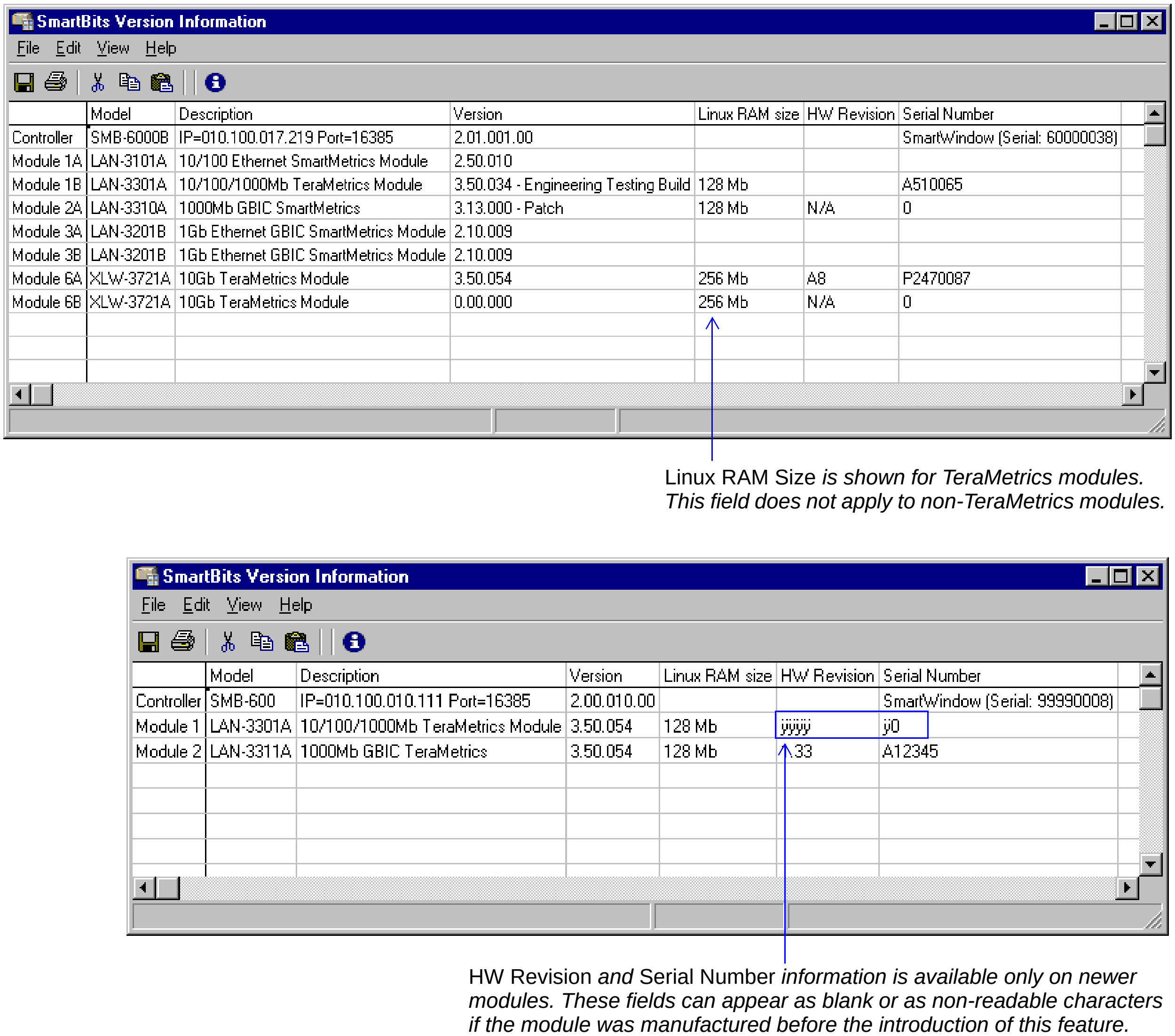

Figure 1-2. SmartBits Version Information Window

Note: In the multi-user interface, SmartWindow does not display card information unless the chassis is connected and the specified card is reserved. Only the component firmware version numbers are displayed in SmartWindow *Help About*, not the overall firmware release number.

What Are SmartCards and Modules?

SmartCards and modules are custom-designed Printed Circuit Boards (PCBs) that are installed in a SmartBits chassis to generate, capture, and track network packet data.

- *SmartCards* are designed for the SmartBits 10, SmartBits 1000, and SmartBits 200/2000 chassis.
- *Modules* are designed for the SmartBits 600x/6000x chassis. Modules have a higher port density than SmartCards.

In many instances, the term *card* is used in this document to refer to any SmartCard or module in a SmartBits system.

SmartCards and Modules Supported

This version of SmartWindow software supports the SmartCards and modules listed in *Appendix A, "Supported Cards and Modules."* Refer to the following for technical information on cards and chassis:

- *SmartBits System Overview & Reference Guide*
- *SmartBits 200/2000 Installation Guide*
- *SmartBits 600x/6000x Installation Guide.*

As additional cards and modules are developed for SmartBits systems, SmartWindow is updated to include support for those items.

Disk Space Requirements for Large Tests

You can simulate a large amount of network traffic by using multiple streams per card and linked SmartBits chassis. A large-scale tests consists of many ports (80 for the SmartBits 2000 and 96 for the SmartBits 6000B/6000C) and many streams (1,000 or more per port). In this case, there should be half a gigabyte of free hard disk space available.

The greater the number of streams per port and number of cards in the test, the more hard disk space is needed to store the configuration on your PC. Allow about 4.5 MB per stream.

Running histograms also adds to disk space requirements. If you plan to download histogram (chart) data, it is recommended that your PC is connected to the Ethernet port on the SmartBits chassis.

Important: Do not run other applications while running SmartBits tests since test performance might be affected.

Tests Described in this Guide

USB Packet Loss Test using ML-7710 and ML-5710/A

"Testing Packet Loss in Traditional Mode" on page 205
To perform this same test in Ethernet mode, an ML-7710, SX-7410/B, or other SmartCard can be substituted for the ML-5710/A.

VLAN Tagging ML-7710A and GX-1420B

"Testing VLAN Tagging Across a Gigabit Uplink" on page 214
LAN-3100A can be substituted for the ML-7710, and the LAN-3201B/C can be substitued for the GX-1420B.
SX-7410/B can be substituted for the ML-7710.

Testing QOS using Two GX-1420B SmartCards

"Testing QOS for Gigabit Routers" on page 228
Two LAN-3100A modules can be substituted for the GX-1420B SmartCards to perform the same QOS test for fast Ethernet.

Single Stream Layer 3 Testing using the LAN-3321A

"Test Using the LAN-3321A TeraMetrics Module"
Two ML-5710/As can be substituted for the ML-7710s.

Single Stream Layer 3 Testing using Two ML-7710s

"Testing Using ML-7710 SmartMetrics SmartCards"
Two ML-5710/As can be substituted for the ML-7710s.

Multiple Stream Layer 3 Testing using Two ML-7710s

"Setting Multiple Streams per Card" on page 273
Two ML-5710/As can be substituted for the ML-7710s.

10 Gigabit Testing using XLW-3721A

"Tests Using the XLW-3721A/XFP-3731A TeraMetrics Modules" on page 318
XLW-3720A/3721A XENPAK MSA modules support XENPAK interface functionality.

10 Gigabit Testing using LAN-3710AL/AE/AS

"Test Using the LAN-3710AL/AE/AS 10GbE Module" on page 355
LAN-3710AL/AE/AS modules support traditional testing at 10Gbps.

SmartMetrics Gigabit Testing using LAN-3311A

"Test Using the LAN-3311A TeraMetrics Module" on page 374
Use WN-3415/3420 over frame relay, LAN-3200A/As, and ML-7710 as a ping target.

SmartMetrics Gigabit Testing using LAN-3201B/C

"Test Using the LAN-3201B/C SmartMetrics Module" on page 380
Use WN-3415/3420 over frame relay, LAN-3200A/As, and ML-7710 as a Ping target.

Throughput Capacity of a Frame Relay Switch

"Test Using the WN-3445A Channelized DS3 SmartCard" on page 454
The WN-3415 or WN-3420 can be substituted for the WN-3405.

"Test Using WN-3405 T1 SmartCards" on page 492
The WN-3415 or WN-3420 can be substituted for the WN-3405.

Establishing PVCs using AT-9155

"Establishing PVCs" on page 525
All other ATM SmartCards can be substituted for this test.

Testing PPP over ATM using ML-7710 and AT-9155

"PPP over ATM" on page 532
The AT-9622 ATM SmartCard can be substituted for this test.

Establishing SVCs using AT-9155

"Establishing SVCs" on page 538
All other ATM SmartCards can be substituted for this test.

QOS Testing with Packet over SONET

"Test Using the POS-3519As/Ar Module" on page 560
"Test Using the POS-3500B/Bs Module" on page 581

xDSL Test Setup using ML-7710 and AT-9155

"Configuring xDSL Tests" on page 606
Connected to the DSLAM, the AT-9015, AT-9020, AT-9034, AT-9045, or AT-9622 SmartCards can be substituted for AT-9155 in this test.
Connected to the xDSL modem, the AT-9025, SE-6205, ST-6410, SX-7210, or SX-7410/B SmartCards can be substituted for ML-7710 in this test.

Fibre Channel / SAN Testing

"Test Using the FBC-3601A Module" on page 633
The FBC-3602A module can also be used in this test setup.

Basic Terminology in SmartBits Testing

Here is a brief list of important terms used in SmartBits testing. Refer to the SmartWindow online Help for more detailed information.

ARP

Address Resolution Protocol. For IPv4-protocol data streams to be sent through a router, the SmartBits card must know the MAC address of the router port, and the router must know the MAC addresses of the SmartBits port. This information is learned by using Address Resolution Protocol (ARP) packet exchanges.

ARP maps an IP address to a MAC address. For the SmartBits port, this IP address is the address of the connected router port, not the IP destination of a packet. The router port address is specified as the *default gateway*. Once this value has been set (i.e., not zero), ARPs generated by the card go to this address instead of the specified IP destination address. If the gateway address is not set, the test runs as a Layer 2 test rather than a Layer 3 test.

The router also issues ARP requests to the SmartBits port. These are replied to either by the local stack or by the protocol stream, if the target IP address in the ARP request packet matches the source IP address in the stream or stack.

IP Version 6 (IPv6) streams rely upon a similar protocol (*neighbor discovery*) to learn the MAC addresses of neighboring routers and Layer 3 switches. Refer to “Internet Protocol, Version 6 (IPv6) Specification,” RFC 1883, December 1995 plus related RFCs and specifications for detailed information on IPv6.

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background pattern

Defines the default contents of transmitted packets. It may be overwritten by Variable Field Data (VFD) fields in the frame. The default pattern is all zeros. Other patterns include *incrementing, decrementing,* and *byte patterns* such as 8-Fs / 8-0s. For example, the resulting pattern for 8-Fs / 8-0s is:

0xFF FF FF FF FF FF FF FF 00 00 00 00 00 00 00 00…

---

backoff truncation exponent

Used to establish how long an Ethernet port waits after a collision before attempting transmission again. By default, all Ethernet SmartBits cards are configured for a backoff truncation exponent value of 10 in accordance with IEEE 802.3 standards. Smaller values result in the test port being more aggressive in a collision situation, since the truncation for backoff times starts at a lower number of successive collisions.

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burst

Test traffic transmitted as a set of frames followed by a period of no transmission. On a SmartBits card, bursty traffic is produced by setting an interburst gap, which is a gap size inserted in the traffic at specified intervals. Bursty test traffic simulates network traffic characterized by instances of heavy traffic interspersed with lulls. It is often used to test the buffer capabilities of a device.

jitter

The variation in latency between packets in a flow. Low jitter is important in voice transmissions.

latency

The time interval between the transmission and reception of a frame.

multilayer SmartCards

SmartBits cards that enable you to test the performance and interoperability of both Layer 2 (frame-based) and Layer 3 (stream-based) devices as well as Layer 4 operations. A multilayer card can generate mixed-protocol traffic equivalent to one fully loaded LAN with up to 1000 end-user devices. Multilayer cards include the ML-7710 and ML-5710/A.

transmit modes

The method for sending test traffic.

- **Continuous Mode**
  Transmits a constant stream of packets at the user-selected interpacket gap.
- **Single Burst Mode**
  Transmits a single burst at the user-selected interpacket gap.
- **Multiburst Mode**
  Repetitive bursts with a user-adjustable delay between each burst.
- **Echo Mode**
  Sends one packet when a trigger occurs.
- **Continuous Multiburst Mode**
  Runs multiburst mode continuously.

triggers

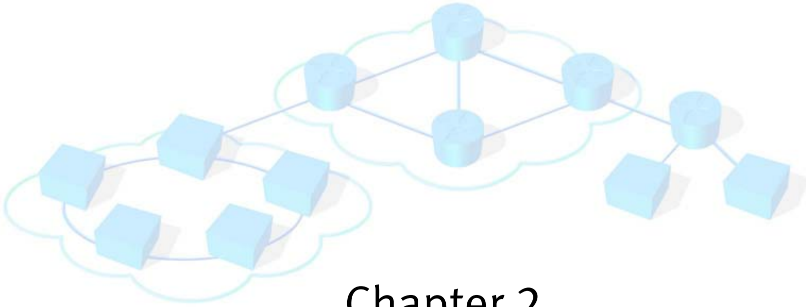
A pattern-counting tool used by the receiving SmartBits card to mark any packet that contains a specified trigger pattern. SmartBits applications automatically insert triggers and can also insert user-selectable errors.

VFD

Variable Field Definition. A field within the test frame whose contents and value can be manipulated—for example, incremented, decremented, or used in segments, frame by frame. Variable Field Definitions (VFDs) are written over the specified background fill pattern and can change on a per-frame basis at wire speeds. VFDs are used in the traditional mode and are available on Ethernet cards and WAN cards.

VTE

Virtual Transmit Engine. A configurable software “engine” that generates one stream of test traffic. It is “network-protocol aware” and can conform to any standard network protocol, such as IP or UDP, or have a user-defined protocol assignment. A Virtual Transmit Engine (VTE) and its related stream are interdependent; the VTE is the software mechanism that creates the stream. The stream is the generated output.



Chapter 2

Install and Connect

Install SmartWindow over a network or from a CD.

In this chapter...

Installing SmartWindow

An executable file on the installation disk handles the details of the installation.

PC Workstation Requirements

To install and use SmartWindow, the following PC hardware and software are required. Review these requirements carefully to ensure successful installation.

Note: For detailed SmartBits system requirements, refer to the *SmartBits 200/2000 Installation Guide* or *SmartBits 600x/6000x Installation Guide,* as appropriate.

- IBM compatible PC (400 MHz Pentium III recommended) with the following:
  - One 10/100Base-T UTP cable and a 10/100 Mbps Ethernet NIC installed in the PC
  - Minimum 128 MB RAM; 1 GB RAM recommended (128 MB is acceptable if tests involve a small number of streams)
  - Minimum 50 MB hard drive space; minimum 4 GB hard drive recommended

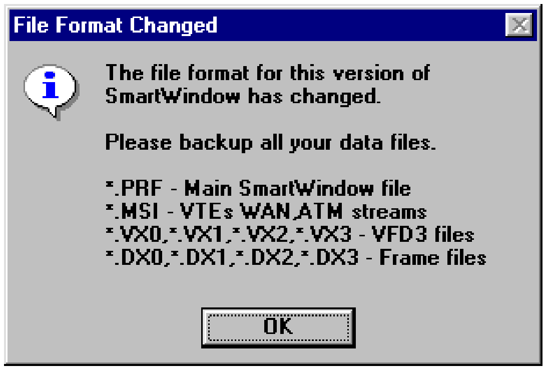
  Note: For disk space requirements for tests, see *"Disk Space Requirements for Large Tests" on page 47*.

  - A 3.5-inch high-density floppy disk drive, a mouse, and an SVGA color monitor or equivalent
  - Serial port capable of running at least 38,400 bps
  - RS-232 straight-through cable with a DB-25 female connector to attach to the SmartBits chassis, and either a DB-9 or DB-25 female connector to attach to the PC
  - CD-ROM drive
- Microsoft Windows 2000 Pro SP4 or Windows XP SP1, 1a, or 2
- Microsoft Terminal, HyperTerminal, or other communications program
- Adobe Acrobat Reader 5.0 or later, to print user documentation

Note: To connect the SmartBits chassis directly to a PC via Ethernet, an Ethernet crossover cable (available as a SmartBits accessory or at any computer store) is required.

Software Installation

SmartWindow is provided on one CD-ROM disk. It is recommended to back up any configuration files from older versions of SmartWindow before installation. During installation, the following dialog box appears.



See *"Backing up Configuration Files from a Previous Version" on page 99* for more information.

To install SmartWindow, perform the following steps:

1. Insert the SmartWindow installation CD into the CD-ROM drive.
2. Follow the instructions until all related software is installed.

Alternative installation Procedure

If your PC does not support the automatic install process, perform the following procedure:

1. Choose **Start** > **Run**.
2. When the **Run** dialog box appears, type **<*cd-rom drive*>:\SETUP** in the command line, then click **OK**.
3. Follow instructions as the installation program installs the software.

Installation Error Messages

Two error messages may appear during installation:

- **Insufficient Disk Space**
  SmartWindow requires about 7 MB of disk space to load and run properly. Check the available system disk space before attempting to load SmartWindow.
- **Interruption of the Installation Process**
  An interruption of power during the install process should not cause any unrecoverable problems. Simply begin the process again after power is restored.

Testing with Multiple SmartBits Chassis

Important: When using a multiple chassis arrangement that contains SmartBits 600x/6000x chassis, you must use a synchronous, CAT-5, straight-through (not crossover) cable to connect the chassis together. The cable should be 1m or less in length. (An appropriate synchronous, CAT-5, straight-through cable is shipped with your SmartBits chassis.) The use of the synchronous cable is required for overall test results to be accurate (not just latency test results, but all test results).

In addition, all chassis in the arrangement must be booted in the proper order. First boot the chassis that contains the master clock. Next, wait 10 seconds and then boot the next chassis in the chain. Wait another 10 seconds and then boot the next chassis, etc. It is important to wait 10 seconds before booting the next chassis in line.

For detailed information on multiple chassis operation, refer to the *SmartBits 200/2000 Installation Guide* or the *SmartBits 600x/6000x Installation Guide*.

Starting SmartWindow

Once SmartWindow is installed, the program can be launched in two ways:

- Double-click the SmartWindow icon on your desktop OR
- Choose the **Start** button on the task bar. Select **Start** > **Programs** > **SmartBits Applications** > **SmartWindow**.

Note: To learn about SmartWindow menus and structure, refer to *Chapter 3, "SmartWindow Menus."*

SmartWindow Launcher

When SmartWindow opens, it displays the *SmartWindow Launcher.* Use the *Launcher* to select the target SmartBits chassis.

Note: Use a single mouse-click to select any icon from the *Launcher.*

SmartBits tab

The *SmartBits* tab (*Figure 2-1*) displays icons for each type of SmartBits chassis:

- SmartBits 200
- SmartBits 2000
- SmartBits 600x
- SmartBits 6000x

When you select a chassis, the *Launcher* displays the GUI for that chassis type. It opens a default configuration file. This tab can be used to set up a test configuration offline, before connecting to the SmartBits chassis to run a test.

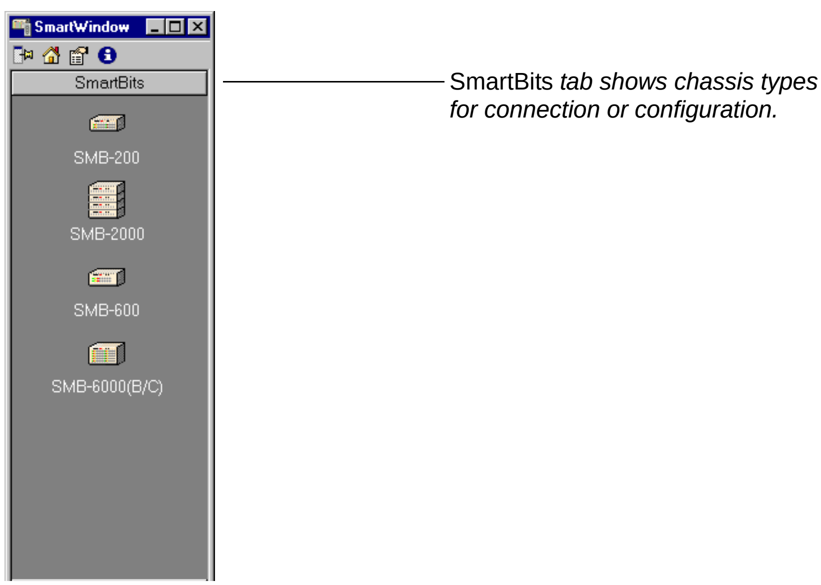


Figure 2-1. SmartBits Tab (on the SmartWindow Launcher)

Connecting to the SmartBits

When an icon is selected on the *SmartBits* tab, SmartWindow tries to find an accessible SmartBits of the selected type and connect to it.

The *Launcher* informs you of its progress (*Figure 2-2*). If it cannot find a chassis, you may need to set up the connection by evaluating the cabling and addresses of the devices. See *"Setting up a Connection" on page 42*.

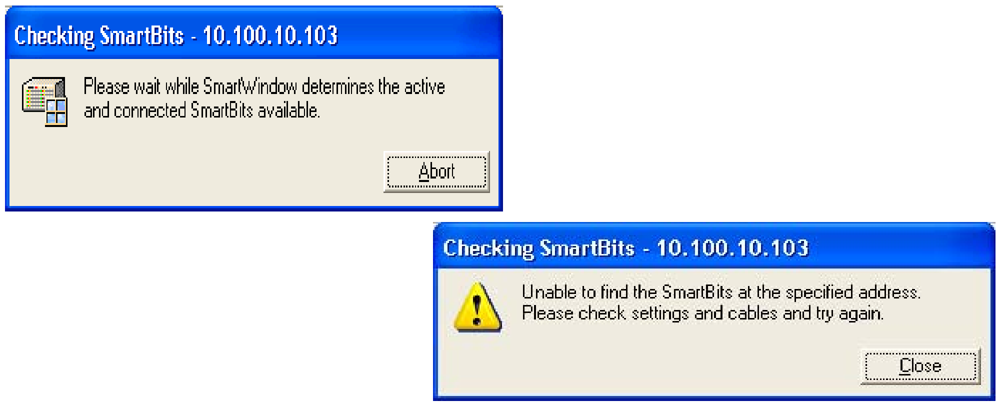


Figure 2-2. Connection Status Messages (SmartBits Tab)

If the cabling and address structure is correct, the *Launcher* then validates the configuration file to determine where the mismatch is occurring. At this point in the connection process, one of two screens appears, depending upon the type of mismatch.

- If you are connecting to a different chassis from the one specified in the configuration file, this message appears: *Chassis not the same type*. (See *Figure 2-2* and *Figure 2-3*.)
- If you are connecting to the same chassis type, but the card configurations are different in the offline configuration and online configuration, the *Adaptation Grid* dialog box appears. (See *Figure 2-4 on page 33*.)

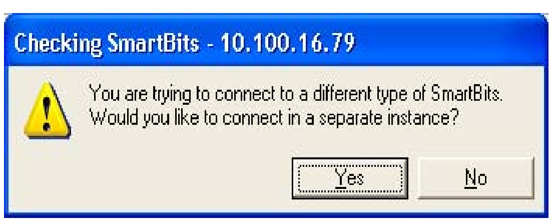


Figure 2-3. Different Chassis Connection

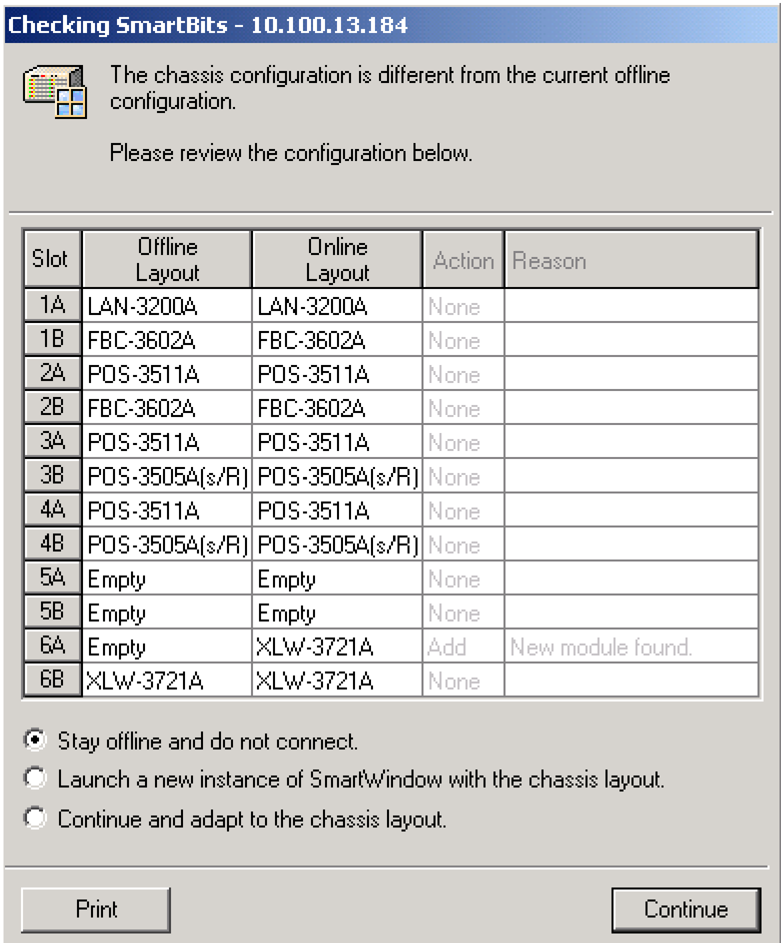


Figure 2-4. Adaptation Grid Dialog Box

This dialog box displays the status of the configuration layouts and actions during the launching process. Pressing the **Print** button at the bottom of the screen prints the grid shown in the middle of the dialog. This printout is useful when determining what tasks to perform during the launch.

The offline configuration file defines the existing configurations and is also called the application layout. The online configuration file defines the layout of the new device found in the slot. The reasons for the changes (or no changes) in the offline configuration file are listed in the far right column of the grid.

The *Table 2-1 on page 34* describes the types of actions that are assigned to each slot of the chassis.

Table 2-1. Adaptation Grid Dialog Box Actions

Action	Description
Adapt	The existing offline application is adapted to the new device layout (online configuration). This occurs when there is a difference in the online and offline configurations and both configurations are part of the same family group. If the configurations are significantly different (not from same family), then the Replace action is shown.
Eject	This occurs when the offline layout shows a module selected for a specific slot and that slot is empty. If the connect operation continues, the offline layout adapts by ejecting the online layout and the offline layout shows the slot being empty.
Replace	The new module, online configuration does not match the family of the existing offline application. The existing offline configuration has precedence.
Add	The offline configuration shows an empty slot and there is a module (online configuration) in that slot.
None	The online layout and offline layout are equal. No changes are made to the offline layout.

At the bottom of the dialog box are three options (*Table 2-2*). Select one option before the connection process can continue. The results of these connection options depend upon the configuration of the device and application layouts discussed in the previous table.

Table 2-2. Definition of Adaptation Actions

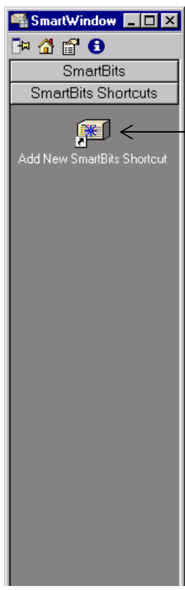
Option	Description
Stay offline and do not connect	Stay offline and do not connect. Layouts are not impacted. (This is the default configuration.)
Launch a new instance of SmartWindow with the chassis layout	Launch instance of SmartWindow with online layout. Original offline layout does not change.
Continue and adapt to the chassis layout	The offline layout is adapted to the online layout. Adaptation can have several forms, depending on the nature of the online and offline layouts. Does the online configuration come from a different family, or does the offline configuration show the slot as empty?(Refer to the descriptions of actions in *Table 2-1* for a discussion of the status during the launching process.)

Defining Shortcuts

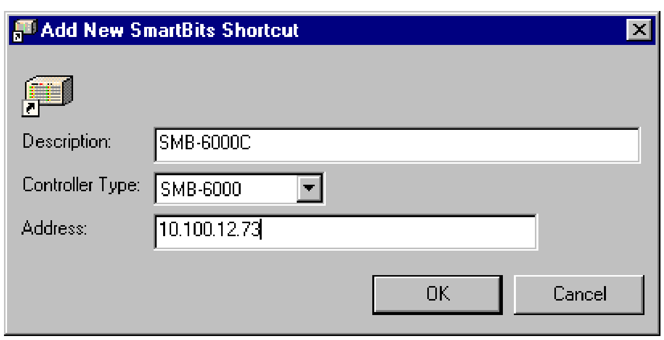
When a SmartBits chassis is used frequently, the *Shortcuts* tab enables you to set up quick access to the chassis.

To add a shortcut:

1. Click the **Shortcuts** tab.
2. Click the **Add New SmartBits ShortCut** icon.
   The *Add New SmartBits Shortcut* dialog box opens.



3. Enter a name or description for the SmartBits, its type, and its IP address.

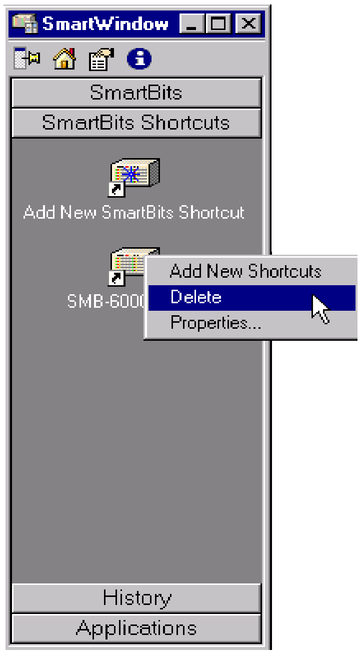


Note: See *"Configuring SmartWindow for an Ethernet Connection" on page 45* for the steps to define a chassis IP address.

To delete a shortcut:

1 Right-click the icon to be deleted.

2 Select **Delete** from the drop-down menu.



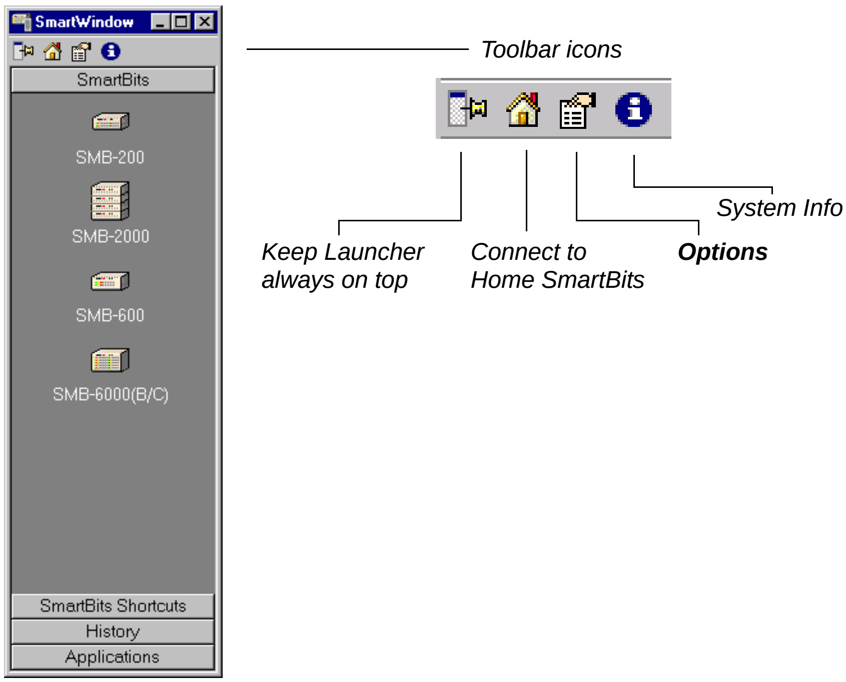
Setting up a Home SmartBits

If one SmartBits chassis is used primarily, it can be defined as your *Home SmartBits.*

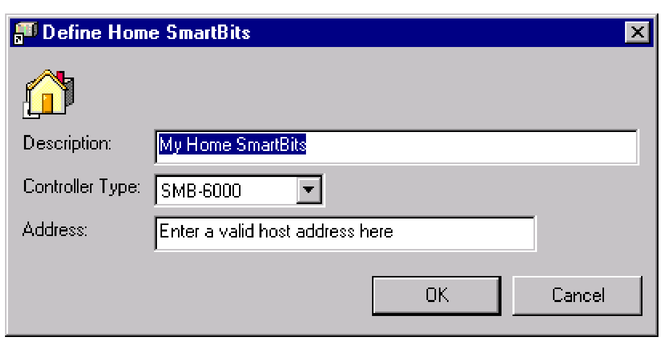
Once defined, the *Home SmartBits* is quickly accessible. Click the **Connect to Home SmartBits** icon on the toolbar.

To define a Home SmartBits:

1 Click the **Options** icon on toolbar.



2 Use the *Define Home SmartBits* dialog box to name or provide a description for the *Home SmartBits*, its type, and its IP address.



History Tab

Use the *History* tab to review recent connections.

Click an icon to open the history list for a specified day or week.

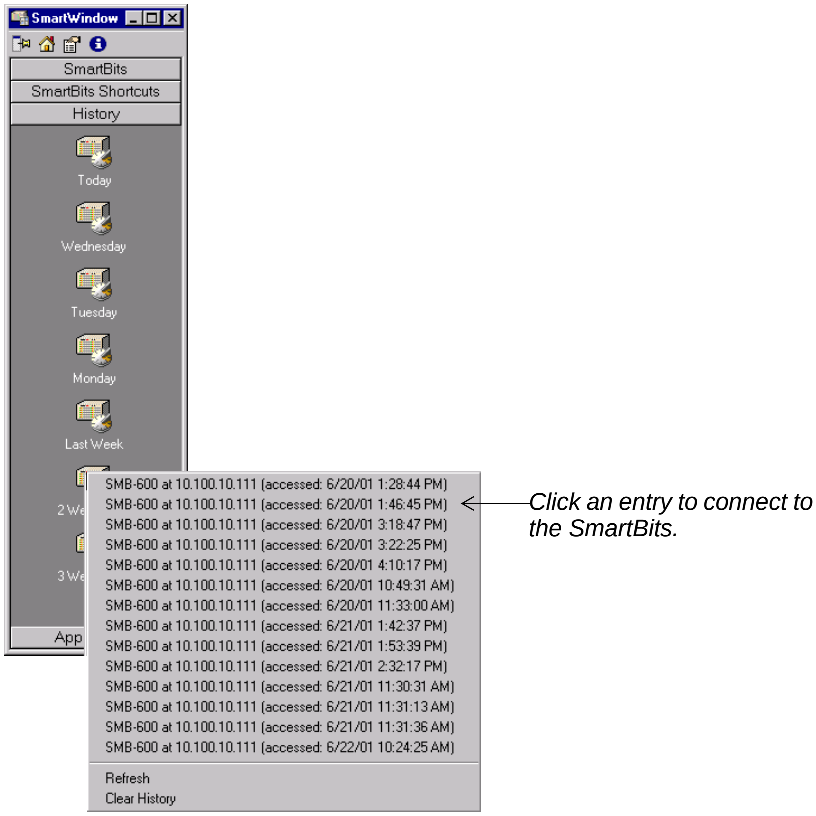


Figure 2-5. History Tab

Applications Tab

Use the *Applications* tab to set up quick access to other SmartBits applications.

Drag a SmartBits application shortcut from the desktop to the tab.

The application can be opened from the *Launcher*.

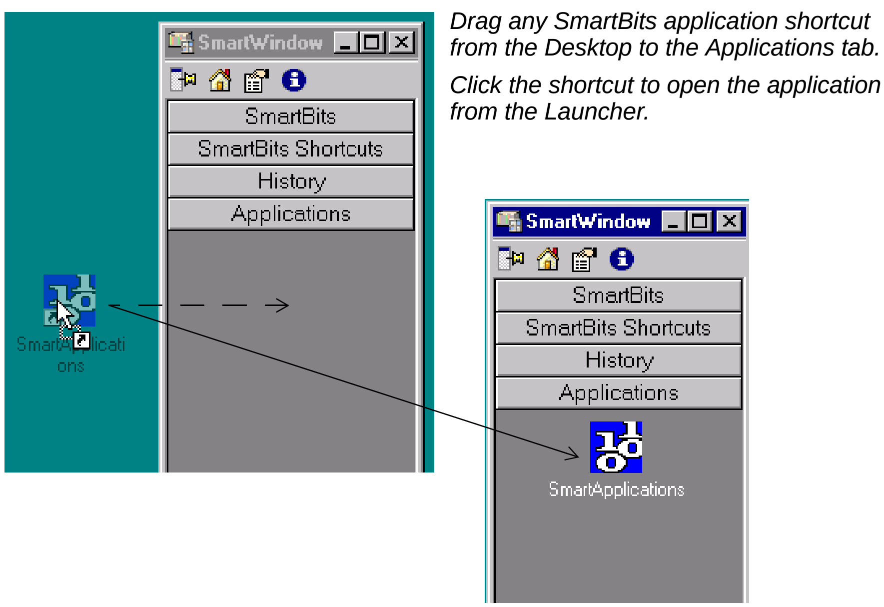
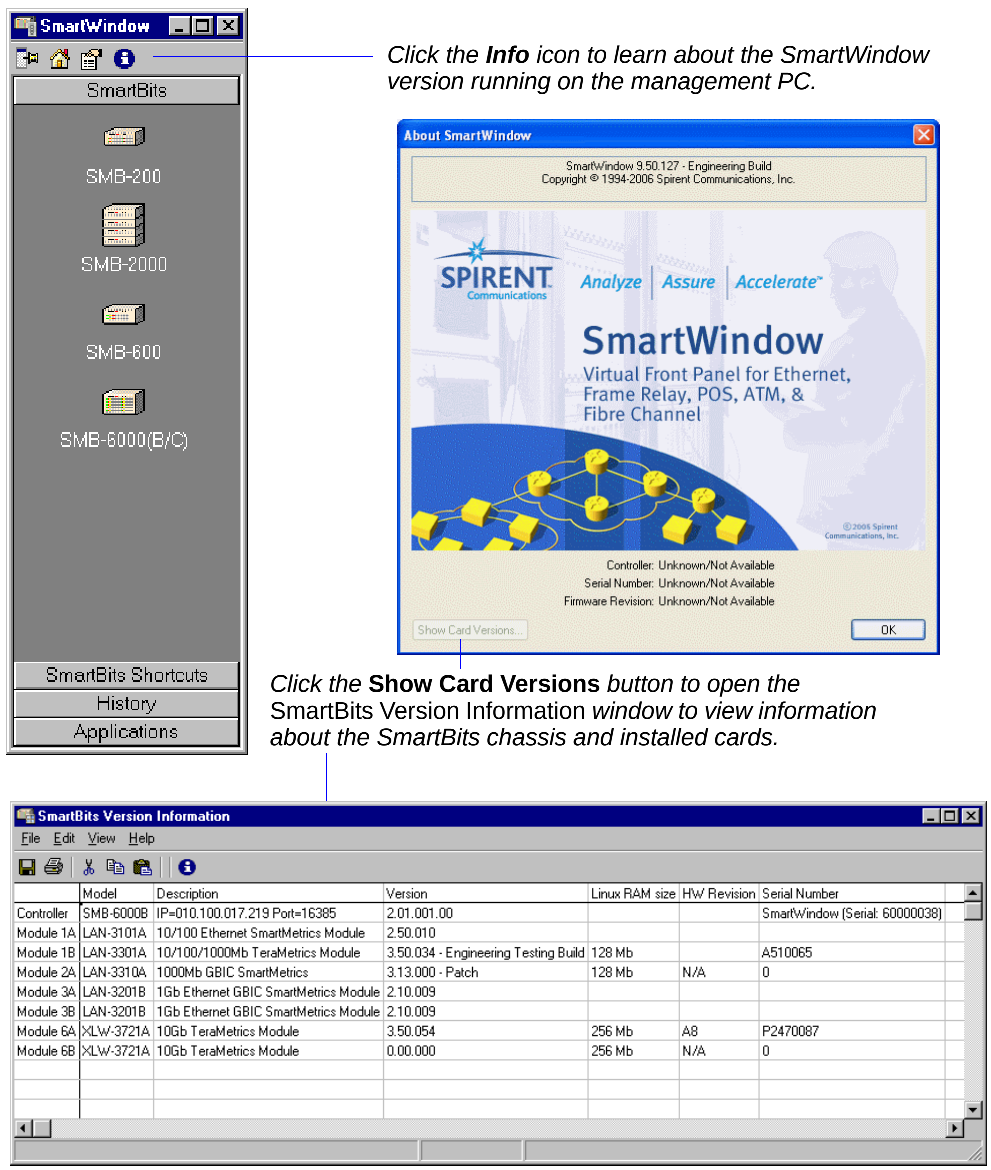


Figure 2-6. Applications Tab

Getting System Information

Click the **Info** icon on the toolbar to get information about the version of SmartWindow running on the management PC.

Note: The release versions depicted in the following screens are examples only. Refer to the Product Release Notes for a list of supported firmware versions.



Managing *.prf Configuration Files in the Launcher

SmartWindow settings are saved to configuration files with an extension of *.prf. The *Launcher* creates or opens these files as follows (*Figure 2-7*):

- Each time a SmartBits chassis type is selected on the *SmartBits* tab, SmartWindow opens a new, default *.prf file. Save the file at the end of your session by selecting **File** > **Save** or **File** > **Save As** from the main menu.
- When a SmartBits chassis is selected on the *Shortcuts* tab, SmartWindow opens the *.prf file that was saved from the last connection to the chassis.
- Connecting to your *Home SmartBits* opens its related *.prf file.

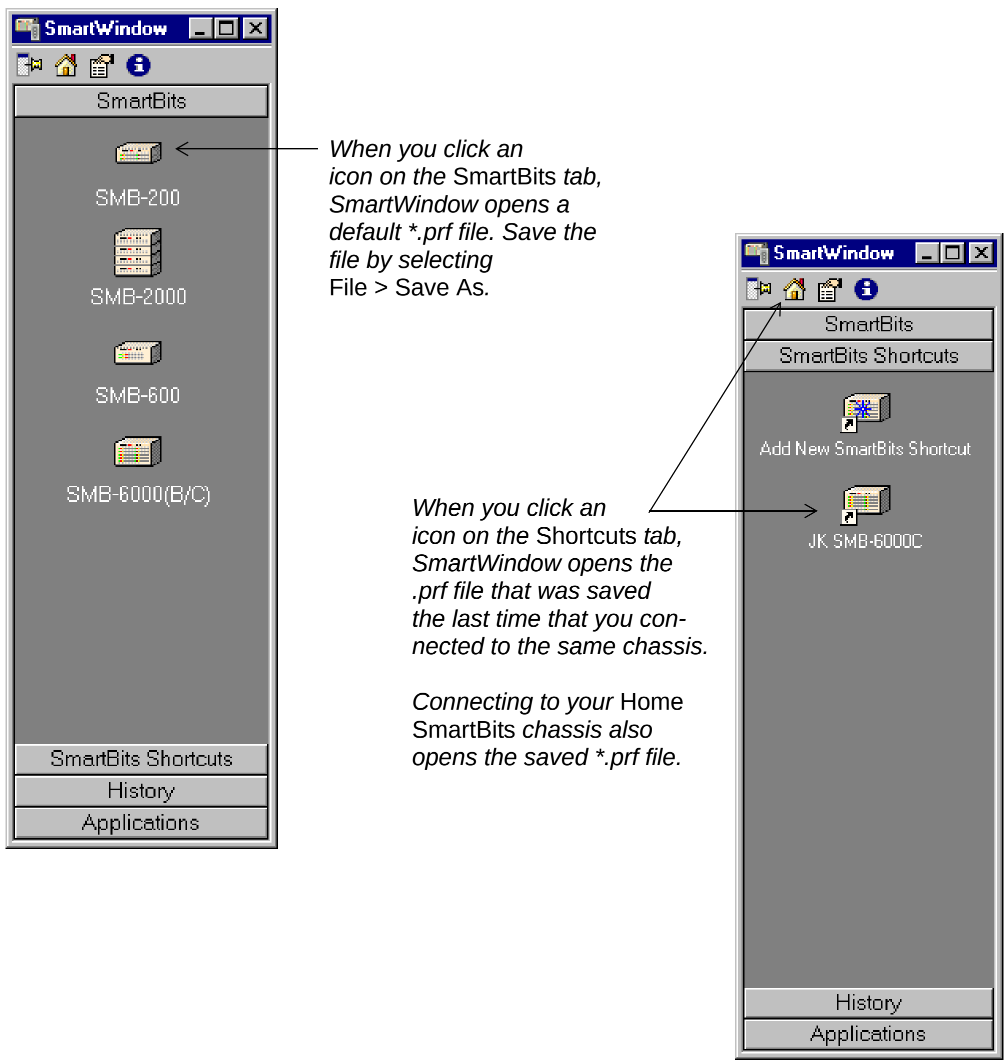


Figure 2-7. How the Launcher Handles *.prf Configuration Files

Setting up a Connection

The *SmartBits 200/2000 Installation Guide* and *SmartBits 600x/6000x Installation Guide* describe how to make a connection from your PC to a SmartBits chassis. Two connection methods are possible:

- **Serial**
  Used only with SmartBits 200 and SmartBits 2000. (This is the default.)
  Used for point-to-point connections. (See *"Initial SmartBits Configuration" on page 42*.)
- **Ethernet**
  Used with SmartBits 200/2000 and SmartBits 600x/6000x.
  Requires a Network Interface Card (NIC) in your PC. Enables you to connect SmartWindow to the SmartBits chassis over an Ethernet connection (including the Internet) from your PC. (See *"Configuring SmartWindow for an Ethernet Connection" on page 45*.)

Initial SmartBits Configuration

With an unconfigured *SmartBits 200/2000*, you can only use a serial connection to connect to the PC because SmartBits does not yet have an IP address.

Use SmartWindow to set the initial IP address. To do this, verify that you are using the appropriate serial cable. (Refer to *SmartBits 200/2000 Installation Guide* for cabling information.)

For the *SmartBits 600x/6000x*, initial IP address configuration is set through HyperTerminal.[1]

You must be offline to access the *Connection Setup* menu. Connection status is shown as **OnLine** or **OffLine** on the SmartWindow status bar.

To configure a SmartBits 200/2000:

1. Choose **Options** > **Connection Setup**.
2. Click the **Use Serial Port** button.

The following fields become enabled.

Port

Select the COM port that was used to connect the PC to the SmartBits. By default, the **Port** list shows only available COM ports. If the list does not include an installed COM port (e.g., COM1), this situation may be caused by the following:

1. The SmartBits 600x/6000x does not allow a serial connection through SmartWindow or other Spirent applications. (See *SmartBits 600x/6000x Installation Guide* for information on how to configure the IP address.)

- A serial mouse is connected to that port.
- The port is opened by another currently running program.

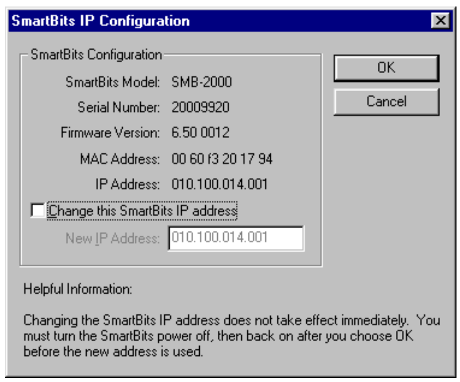
Baud Rate

Select the baud rate for the port. SmartBits supports connections at up to 38,400 bps; however, some PCs may have trouble keeping up with baud rates above 9,600 bps. SmartWindow attempts to connect to SmartBits at all possible baud rates, then sets the final baud rate to the rate selected.

3 Click **OK**.

4 Choose **Actions** > **Connect**, then **Options** > **SmartBits IP Configuration**.

The following dialog appears.



5 Set the designated IP address and click **OK**.

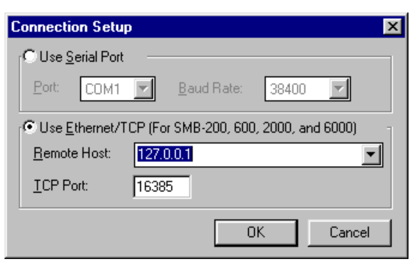
6 Choose **Actions** > **Disconnect**, then **File** > **Save As** and name the configuration file.

7 For the changes to take effect, power reset the unit.

8 If necessary, disconnect the serial cable and connect an Ethernet cable to the 10Base-T management port at the back of the unit.

Unplug the serial cable and plug in an Ethernet cable.

9 Choose **Options** > **Connection Setup** and click **Use Ethernet/TCP**.



10 Type in the IP address that was entered in Step 4, then click **OK**.

11 Choose **Actions** > **Connect**.

You should now be connected to the unit through the newly configured Ethernet IP address.

Serial Connection Problems

If SmartWindow cannot establish the communication link automatically, then the link must be established manually and some troubleshooting may be required. Most likely, another PC COM port should be selected. This can be done through SmartWindow by operating with the graphic display in the *OffLine* mode.

To further troubleshoot a communications link problem, check the cabling interconnecting the PC and the SmartBits chassis. Review the sections in the *SmartBits 200/2000 Installation Guide* to confirm that the RS-232 cables connecting the PC serial port to the SmartBits chassis (as well as any succeeding SmartBits chassis) are properly connected and terminated. The bottom DB-37 connector of the last SmartBits chassis must be terminated with the termination plug provided.

When trying to connect to SmartBits, the following conditions may cause communication errors:

- The wrong type of cable was used. Ensure that cable is *not* a null modem cable.
- The port is configured incorrectly.
- Inconsistent setup information
  Ensure that the information in the *Connection Setup* dialog box is consistent with the baud rate on the ET-1000 (when using a SmartBits 10 with external ET-1000), SmartBits 1000, or SmartBits 200/2000 via its front panel. SmartWindow operates successfully at 2400, 4800, 9600, 19,200 and 38,400 bps. Generally, baud rates of 9600 and above are preferred for better system performance.
- Invalid communication
  Check that the SmartBits chassis is communicating with SmartWindow and not trying to use the RS-232 port to print test results.
- Incorrect settings
  With an external ET-1000, it is advisable to first set up factory settings through mode [A,1] before specific changes are installed. (See *Appendix C, “Managing the ET-1000 Controller.”*)
- An invalid COM port was selected from the drop-down *Port Setup* menu. The COM port may already be in use by another Windows application, or there may not be hardware available to support it. In this case, try another COM port.

Configuring SmartWindow for an Ethernet Connection

A configured SmartBits chassis already has an IP address, which was set either through SmartWindow or HyperTerminal for the SmartBits 200/2000, or through HyperTerminal for the SmartBits 600x/6000x. This enables you to connect to SmartBits either through the management port or by using a network Ethernet connection.

Use the *Connection Setup* dialog box to specify an Ethernet connection between your PC and any SmartBits chassis on the network.

To access this window:

1 Select **Options** > **Connection Setup** from the main window.

Note: You must be offline to access **Connection Setup**.

2 *SmartBits 200/2000:* Click the **Use Ethernet/TCP (For SmartBits 200 and SmartBits 2000)** button. It enables these fields:

Remote Host	The IP address of the SmartBits chassis.
TCP Port	The host (SmartBits) TCP port on which SmartBits listens for connection requests. (Accept the default value of **16385**.)

SmartBits 600x/6000x: Only the IP address is required.

3 Type in the SmartBits IP address that you want to connect to.

4 Once the Ethernet connection is properly set, click **OK**. Connection is now possible.

To connect to the SmartBits chassis:

Once the connection type is set up, perform this procedure to make a connection.

1 Choose **Actions** > **Connect** or press **F8**.[1]

2 If connection is successful, the **OnLine** indicator appears in the lower right corner of the window.

Note: If the **OffLine** indicator appears, the unit is not connected. Review all connections for conformance with instructions in the *SmartBits 200/2000 Installation Guide*. If SmartWindow is not able to complete the communications link successfully, an error message appears.

3 Click **OK** in the error message box to work in **OffLine** mode. The SmartBits chassis graphic is displayed with the word **OffLine** appearing in the lower bar of the graphic.

1. In the *SmartWindow Preferences* dialog box, *Connect to SmartBits at Startup* is the default setting. When you connect for the first time, SmartWindow attempts to connect to the SmartBits chassis as designated in *"Configuring SmartWindow for an Ethernet Connection"* unless this selection is turned off.

Note: In the offline mode, right-click to display ejection options as shown in *Figure 2-8*. Several options are listed regarding the connection process. (Refer to the discussion regarding *"Connecting to the SmartBits" on page 32* for more information on how these options can be used.)

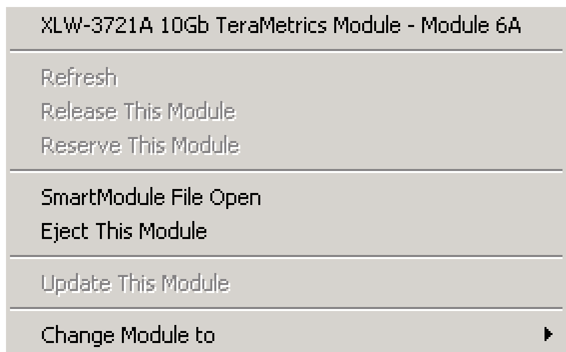


Figure 2-8. Ejection Options

Reconfiguring SmartBits IP Address

To reconfigure the IP address of a SmartBits chassis, it is not necessary to establish a serial connection through HyperTerminal. The IP address can be configured from within SmartWindow.

To connect to a SmartBits chassis through Ethernet:

1. Start SmartWindow, then choose **Actions** > **Connect**.
2. Choose **Options** > **SmartBits Setup** to configure the IP address.
   The *SmartBits IP Configuration Setup* dialog box appears.
3. Type in the new IP address, and click **OK**.

   Note: Although this is rarely necessary, if the TCP port needs to be set to a value other than the default, HyperTerminal must still be used. (See *SmartBits 200/2000 Installation Guide* or *SmartBits 600x/6000x Installation Guide* for this procedure.)
4. Power reset the unit for the change to take effect.

Disk Space Requirements for Large Tests

A large amount of network traffic can be simulated by using multiple streams per card and linked SmartBits chassis. A large-scale test consists of many ports (80 for the SmartBits 2000 and 96 for the SmartBits 600x/6000x) and many streams (1,000 or more per port). For any tests of this scale, have at least 0.50 Gigabyte (500 Mbytes) of hard disk space available for use.

The greater the number of streams per card and number of cards, the more hard disk space is needed to store the configuration on the PC. Specifically, about 4.5 Mb of disk space per stream is required. Running histograms also increases disk space requirements.

Note: If you plan to download histogram (chart) data, connect your PC to the Ethernet port on the SmartBits chassis. This connection provides higher data transfer rates.

Important: Do not run other applications that might affect performance during a test.

Chapter 3

SmartWindow Menus

The salient feature of SmartWindow is its dynamic menu system. No matter what SmartBits chassis is connected, SmartWindow displays a virtual front panel for the chassis and its installed cards.

In this chapter...

SmartWindow User Interface

The SmartWindow main window is a virtual front panel. It presents a graphical image of the current SmartBits chassis, including all its installed cards.

Connected to SmartBits 2000

When SmartWindow is connected to the SmartBits 200/2000, it displays a chassis image like that shown below.

The window is resizeable. If the monitor resolution does not allow you to see all chassis at once, you can adjust the size of the SmartWindow interface.

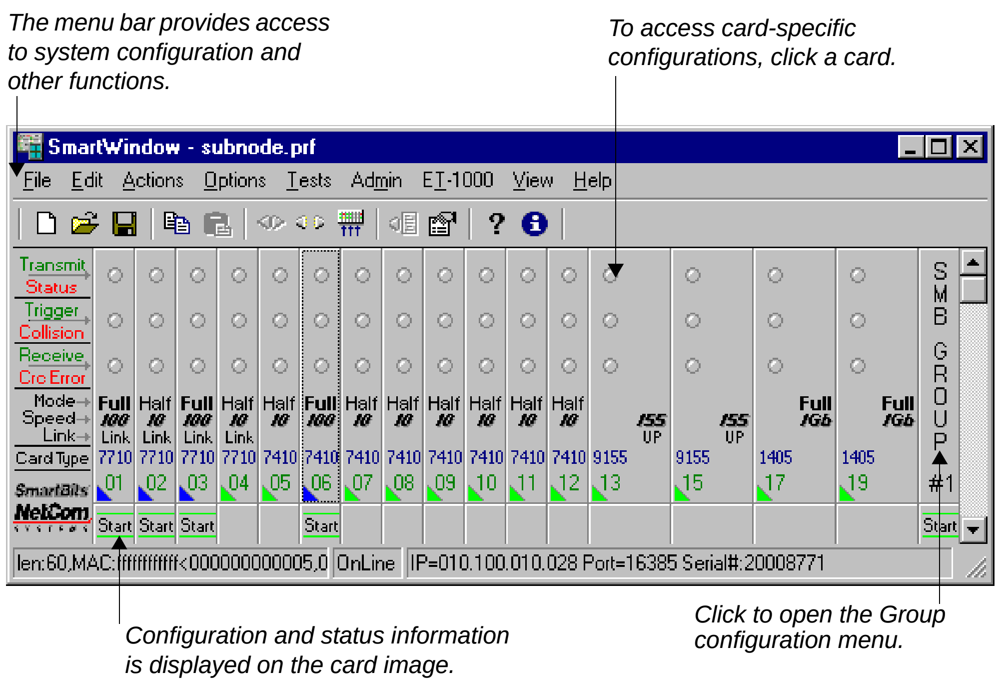


Figure 3-1. SmartBits 2000 Main Menu[1]

LEDs. Look to the left side of the main window for definitions of the LED status lights on each SmartCard. The lower part of each card image shows the current settings for configuration parameters such as mode, speed, and link. (If SmartWindow is connected to the SmartBits 200, these definitions are not visible.)

For information on multi-user main menu LEDs, see *"SmartBits 2000 Multi-user Operation" on page 95*.

1. For information on multi-user menus and configuration plus the differences between single-user and multi-user mode, see *"Multi-user Operation" on page 92*.

Connected to SmartBits 200

When SmartWindow is connected to a SmartBits 200, the interface adjusts to display that platform image.

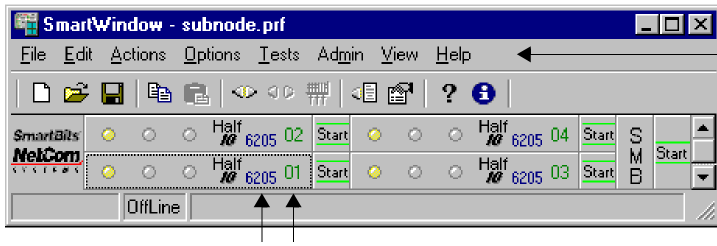


Figure 3-2. SmartBits 200 Main Menu

Card Type. The card type is identified next to the slot number. (See *Appendix A, "Supported Cards and Modules,"* for a list of card types.)

You can configure and control cards independently or as a group.

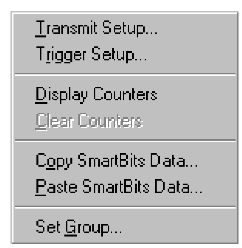
Configure Individual Cards. To configure an individual card, click the card image. Then use the displayed menu (as shown below left) to set up transmit and trigger configurations, view port counters, and control port actions.

Configure Groups of Cards. To configure a set of cards as a group, click the panel on the far right, labeled *SMB Group*. (See *Figure 3-1 on page 50*; in *Figure 3-2* above, only SMB is visible because of the smaller chassis size.) A menu for group configuration appears (below right).

Individual card configuration menu (example: ML-7710)

Choose this menu item to change the card image while disconnected.

Group configuration menu



Changing the SmartCard Image

When SmartWindow is not connected to the SmartBits chassis, use the **Change Module to** command (in a SmartBits 600x/6000x) or **Change SmartCard to** command (in a SmartBits 200/2000) to change the cards in the virtual display. This enables you to set up and save preferences and card parameters before actually installing the SmartBits system.

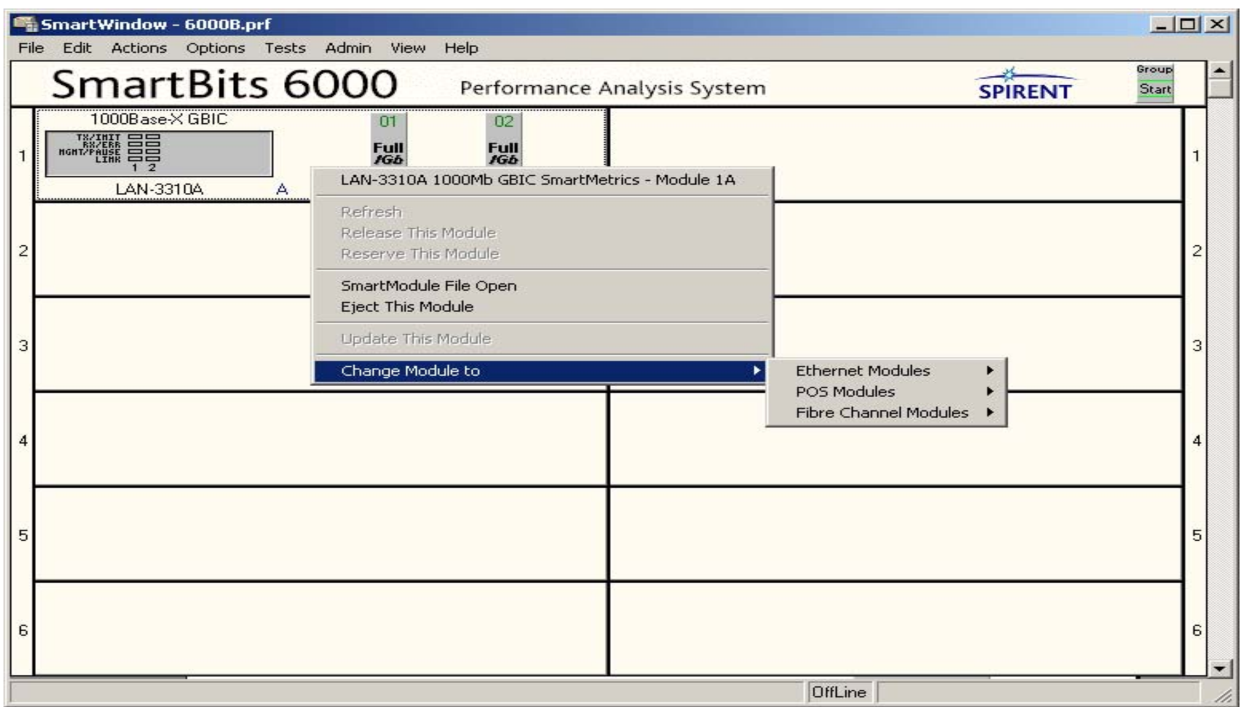
To change the SmartCard image:

1 **SmartBits 200/2000**: Click the card image, then choose **Change SmartCards to** from the menu.

2 **SmartBits 600x/6000x**: Right-click the card anywhere but over a port button, then choose **Change Module to** from the menu.

3 Select a card or module type from the drop-down menu.

The card image changes to the selected type. You can now set up the card configuration and save your settings to a *.prf file by using the *File* > *Save as* option.



When SmartWindow is disconnected from the SmartBits chassis, you can change any card image to that of any installable card. Right-click the card image (not on the port button) and choose the ***Change Module to*** *option from the pop-up menu. Some functions that require firmware validation are not presented offline.*

Figure 3-3. Changing the Card or Module Image When Disconnected

Connected to SmartBits 600x/6000x

When SmartWindow is connected to a SmartBits 600x or SmartBits 6000x chassis, its interface displays the horizontal orientation of the modules and the virtual port numbering. This is called the virtual front panel and has the same functionality as the virtual front panel of the SmartBits 200 and SmartBits 2000. The status lights and definitions for each card are graphically represented in the LED panel.

When connected to the SmartBits 600x chassis, the SmartWindow interface adjusts to display the more compact hardware platform, and each slot represents one module.

Figure 3-4 illustrates the SmartWindow interface when connected to a SmartBits 6000x. Each slot represents one module.

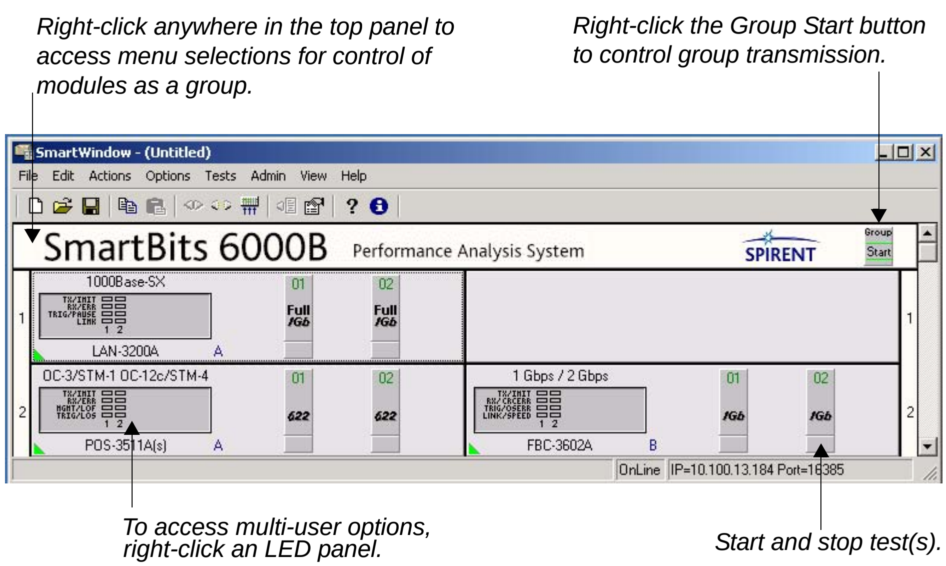
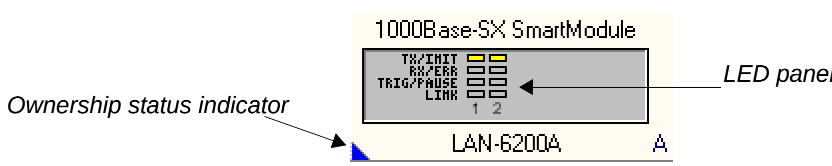


Figure 3-4. SmartBits 6000x Chassis Image

The ownership status indicator in the bottom left corner shows the ownership of the card in a multi-user environment.



Color	Description
Green	Card available
Blue	Reserved for you.

Color	Description
Red	Reserved for another user.

Menu Bar. The menu bar at the top of the window provides access to system configuration and other functions.

Resizing the Chassis Image. The window is resizeable. If the monitor resolution does not allow you to see all chassis at once, adjust the size of the SmartWindow interface.

Module Type. The module type is identified below the LED panel.

Configuring Ports. To configure an individual port, click the port, then use the menu to set up transmit and trigger configurations, view port counters, or control port actions.

Copy/Paste Port Configurations. Use the *Copy Port Data* and *Paste Port Data* menu options to transfer the configuration of one port to other ports.

Port Numbering. With the SmartBits 600x/6000x, SmartWindow uses a virtual port numbering system. (See *Figure 3-5*.) Slot numbering runs from top to bottom, with numbers 1 and 2 for the SmartBits 600 and numbers 1 through 6 for the SmartBits 6000x. These numbers are located on both sides of the interface image.

Each numbered slot contains two modules designated A (left side) and B (right side). Ports also are numbered from left to right.

Using this system, each port is identified by the slot number, side, and port. In the example below, the circled port is 2A-02.

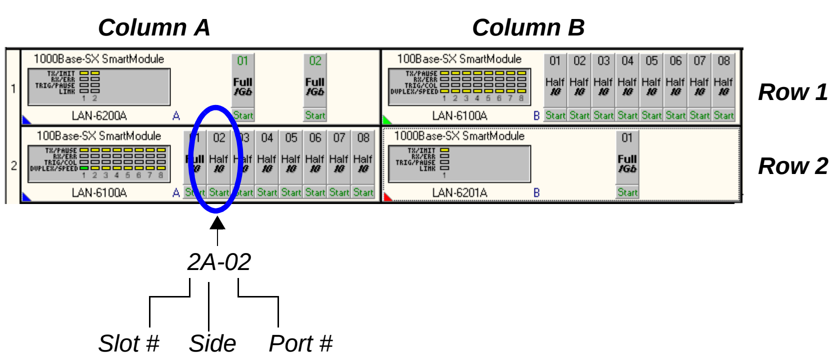


Figure 3-5. SmartBits 600x/6000x Port Numbering

Displayed in the middle of the circled port is an operating mode. This example shows *Half* to indicate Half Duplex. Other values include Local Fault (LF) and Remote (RF). (Refer to *Chapter 8, "Testing Gigabit Routers,"* for more information on these modes of operation for the XFP-373xA modules.)

File Menu

SmartWindow settings are saved to configuration files with an extension of *.prf. You can save a different *.prf file for each unique configuration that is created in SmartWindow. Configuration files can also be created without being physically connected to the chassis by selecting any chassis type from the menu when a new file is created.

Note: When connected to a chassis, the current hardware configuration replaces the settings of any previously saved *.prf file. If you save that configuration file, it is permanently overwritten with the current configuration. Also other files (with different file extensions such as MSI and WAN) are created to accommodate layers of the configuration. (See *“Configuration Files” on page 97*.)

From the **File** option in the main window, you can select:

File > New
Creates a blank configuration file for the selected chassis.

Note: Default configurations are automatically sent to the chassis unless the *Initialize ports after File/Open or File/New* checkbox in the SmartWindow Preferences window is cleared. (This is not applicable to the SmartBits 600x/6000x.)

File > Open
Opens a previously saved *.prf file.

Note: Selected configurations are automatically sent to the chassis unless the *Initialize ports after File/Open or File/New* checkbox in the SmartWindow Preferences window is cleared. (This is not applicable to the SmartBits 600x/6000x.)

File > Save
Saves the current SmartCard configurations to the current *.prf (configuration) file.

Important: Files saved in the current SmartWindow version cannot be opened by earlier versions. Backup all configuration files (*.prf. *.msi, *.vs[n], *.dx[n]). (See *“Backing up Configuration Files from a Previous Version” on page 99*.)

File > Save As
Saves the current SmartCard configurations to a new *.prf file.

File > Export
Appears only in SmartBits 200/2000 chassis. Provides a method to convert a SmartBits 200 or SmartBits 2000 configuration (as saved in a *.prf file) to a SmartBits 600x or SmartBits 6000x configuration file. (See *“Converting SmartWindow Configurations” on page 102*.)

File 1 <drive>:\<filename.prf>
These history listings allow you to use a recent *.prf file.

File > Exit
Closes SmartWindow.

Edit Menu

Use the *Edit* menu to quickly copy and paste configurations between cards and chassis. This menu allows you to apply existing setup configurations in three ways.

Action	Refer To
Port to Port. Copy SmartCard setup data from one SmartCard to another within the same SmartBits chassis.	*"Copy/Paste Port to Port"*
Chassis to Chassis. Copy an entire SmartBits chassis of SmartCard setups to another connected SmartBits chassis of SmartCards.	*"Copy/Paste Chassis to Chassis" on page 57*
Port to Chassis. Copy one port configuration to all SmartCards in another chassis.	*"Copy/Paste Port to Chassis" on page 58*

If more than one SmartBits chassis is actually connected to the system, selections for *Copy SmartBits Data* and *Paste SmartBits Data* options are available.

Copy/Paste Port to Port

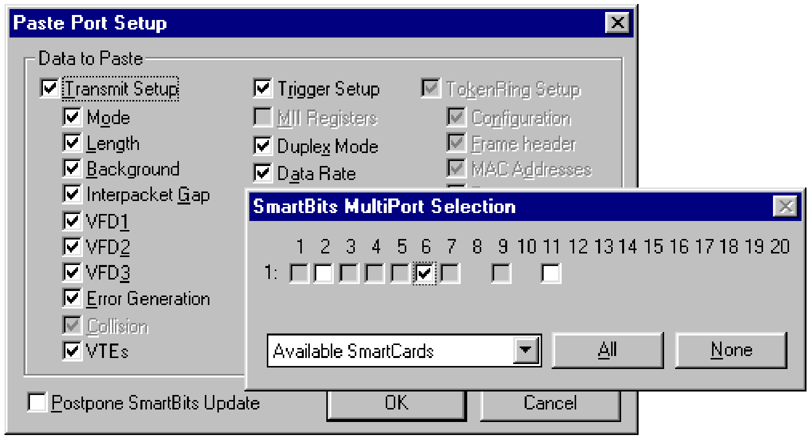
To copy the configuration of a SmartCard:

1. Click the card to copy.
2. Choose the **Copy Port Data** option from either the main menu or the context sensitive port menu.

Once copied, the configuration can be pasted to selected SmartCards within the chassis.

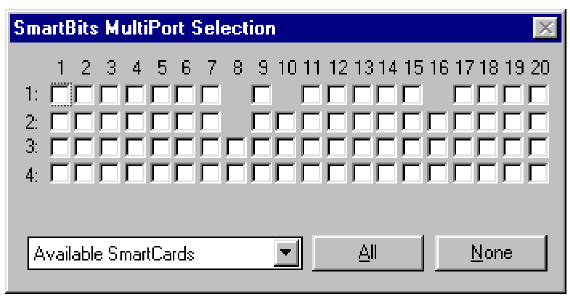
To paste the copied configuration:

1. Choose the **Paste Port Data** option from the main menu or the context sensitive port menu.
2. Review the two windows that are displayed.



The *Paste Port Setup* dialog box is used to filter which configuration items should be included in the paste function. Deselected items are not modified when the copied data is pasted to the selected port.

If multiple SmartBits chassis are available, the following window appears:



Multiple ports can be selected within one chassis. The drop-down menu provides a filter that dynamically displays the sets of installed SmartCards by topology.

Use the *All* and *None* buttons to select all cards or no cards. Choose cards to be pasted to by selecting the corresponding checkbox under the port number.

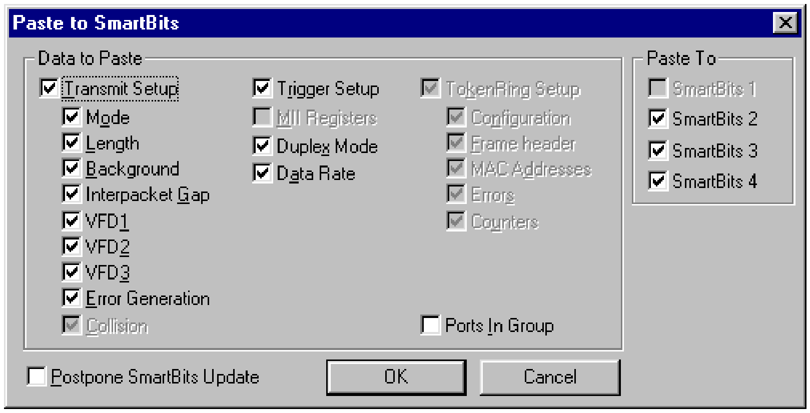
With the copy function, the port number selected defaults to the selected port when the port context sensitive menu is used.

Copy/Paste Chassis to Chassis

When multiple chassis are stacked, an entire chassis configuration can be copied and pasted by using the *Copy SmartBits Data* and *Paste SmartBits Data* options.

Use the *Paste to SmartBits* dialog box to filter which configuration items should be included in the paste function. (Unselected items are not modified.)

Note: Be careful when copying the *Mode* setting. When the mode changes between 10 Mbps and 100 Mbps (or vice versa), the interpacket gap automatically rescales.



Copy/Paste Port to Chassis

Copy a port configuration to ports in another SmartBits chassis by using the *Copy Port Data* option as described above. Then use the *Paste SmartBits Data* option to identify the destination SmartBits chassis and paste the port configuration to all its ports.

Actions Menu

Use the *Actions* menu to control modules in the selected SmartBits chassis. These actions are global and affect all supported and reserved modules. (See *Figure 3-6* for the LAN-3325A *Actions* menu.)

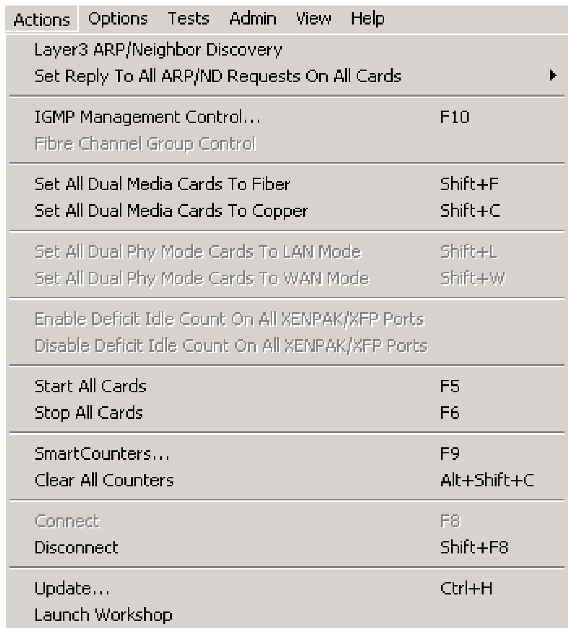


Figure 3-6. Actions Menu

The fields within the *Actions* menu vary, dependent on the type of card/module installed. Unavailable fields are either grayed or not displayed. [Refer to *Table 3-1 on page 60* that lists the cards/modules for fields (functions) that are grayed. Refer to the online Help text for detailed specifications of each module.]

Note: The *Set Reply to All ARP/ND Requests on All Cards* option is always boldfaced because it accesses a pull-down menu with options that implement global ARP and ND functions. These options are grayed (unavailable), depending on the installed card or module.

Table 3-1. Actions Menu Display

Display	Available in...
Set Reply To All ARP/ND Requests on All Cards	XLW-372xA, XFP-373xA, LAN-332xA, LAN-3306A[1]
Fibre Channel Group Control	FBC-3601A and FBC-3602A
Set All Dual Media Cards to Fiber/Copper	LAN-332xA
Set All Dual Phy Mode Cards to LAN/WAN	XLW-372xA and XFP-373xA
Enable/Disable Idle Count On All XENPAK/XFP Ports	XLW-372xA and XFP-373xA[1]

1 Requires lastest firmware version.

- **Layer3 ARP/Neighbor Discovery** initiates ARP exchanges between all SmartMetrics cards and the attached DUT.
- **Set Reply To All ARP/ND Request On All Cards** configures replies for ARP requests (IPv4) and solicitations (IPv6). This function has a pull-down menu with many options. These options are available on specific modules. For detailed information on how to use these options, refer to *"Neighbor Discovery Protocol" on page 179* for IPv6 and *"Virtual Flow Cyclic ARPs and ARP Requests" on page 186* for IPv4.
- **IGMP Management Control...** options are different in the SmartBits 200/2000 chassis and SmartBits 600x/6000x chassis, as follows:

  SmartBits 200/2000: **IGMP** selects the protocol version used for IP multicast groups, and issues joins and leaves for all SmartCards or resets the cards. These options are disabled unless you first define one or more IGMP streams on any given port.

  SmartBits 600x/6000x: **IGMP Management Control** opens the *IGMP Management* window, which provides comprehensive control of IGMP configuration and activity.

  For detailed setup information on both chassis families, refer to *"Setting up IP Multicast Groups" on page 112*.

- **Fibre Channel Group Control** is enabled when SmartWindow is used to test with the FBC-3601A or FBC-3602A Fibre Channel modules. SmartWindow must be connected to the SmartBits chassis for these options to be active. These options enable you send commands to multiple fibre channel ports at the same time. (See *“Send Commands to Make “Ready to Test”” on page 656* for more information.)
- **Set All Dual Phy Mode Cards To LAN Mode** (SmartBits 600B, SmartBits 6000B and SmartBits 6000C chassis)

  Set All Dual Phy Mode Cards To WAN Mode

  SmartWindow must be connected to the SmartBits chassis for these options to be active, and one or more XLW-372xA or XFP-373xA modules must be installed. These options enable you to the set the ports on the XLW-372xA and XFP-373xA modules to the LAN or WAN mode.
- **Set All Dual Media Cards to Fiber** (SmartBits 600B and 6000C chassis*)*

  Set All Dual Media Cards to Copper

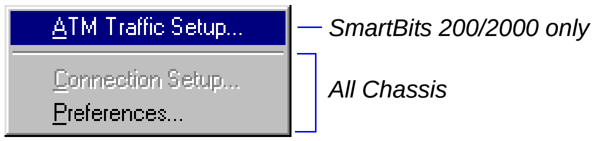
  SmartWindow must be connected to the SmartBits chassis for these options to be active, and one or more LAN-332*x*A-series Dual Media modules must be installed. The options enable you to set the interface mode for all ports on all Dual Media modules to either the fiber mode or copper mode. The interface mode for ports can be set individually by using the port menu.
- **Enable Deficit Idle Count On All XENPAK/XFP Ports** (SmartBits 6000B and SmartBits 6000C chassis)

  Disable Deficit Idle Count On All XENPAK/XFP Ports

  SmartWindow must be connected to the SmartBits chassis for these options to be active, and one or more XLW-372xA or XFP-373xA modules must be installed. The options control the use of the deficit idle count function located on the *Port Setup.*. window. (See *“General Tab” on page 328*.)
- **Start All Cards (F5)** starts all cards transmitting in all chassis.
- **Stop All Cards (F6)** stops all cards in all chassis.
- **SmartCounters (F9)** opens the *Results Framework* window. This display ccurs with the SmartBits 600x/6000x chassis. A different Smart Counter display appears with the SmartBits 200 and SmartBits 2000 chassis.
- **Clear All Counters** clears all counters on all cards in all chassis.
- **Connect** connects SmartWindow to a SmartBits chassis.
- **Disconnect** disconnects SmartWindow from the SmartBits chassis.
- **Update…** updates all card(s) with changes made in SmartWindow.
- **Launch Workshop** opens the *SmartCounters Workshop* window (SmartBits 600x/ 6000x).

Options Menu

Use the *Options* menu to configure SmartWindow, a SmartBits chassis, or various SmartCards when SmartWindow is not connected to a SmartBits chassis. This menu includes different options, depending on chassis type.



ATM Traffic Setup

Use the *ATM Traffic Setup* window to create a global list of customer traffic attributes that can be applied to ATM data streams. Specify traffic descriptor parameters such as the peak cell rate and Quality of Service. ATM UNI signaling messages use the information that is entered in this window directly in the ATM traffic descriptor, broadband bearer capability, and quality of service parameter C.

You can define multiple traffic setups to use with multiple streams that signal with the same traffic descriptors.

For more information, refer to *ATM Traffic Setup* in the SmartWindow **Help** file and *"Choose Options > ATM Traffic Setup from the main menu." on page 541*.

Connection Setup

Use this option to configure between a serial or Ethernet connection and to set the IP address for the SmartBits chassis.

Changes made to the IP address do not take effect until the chassis has been power cycled. (See *"Initial SmartBits Configuration" on page 42* for complete procedural information.)

Preferences

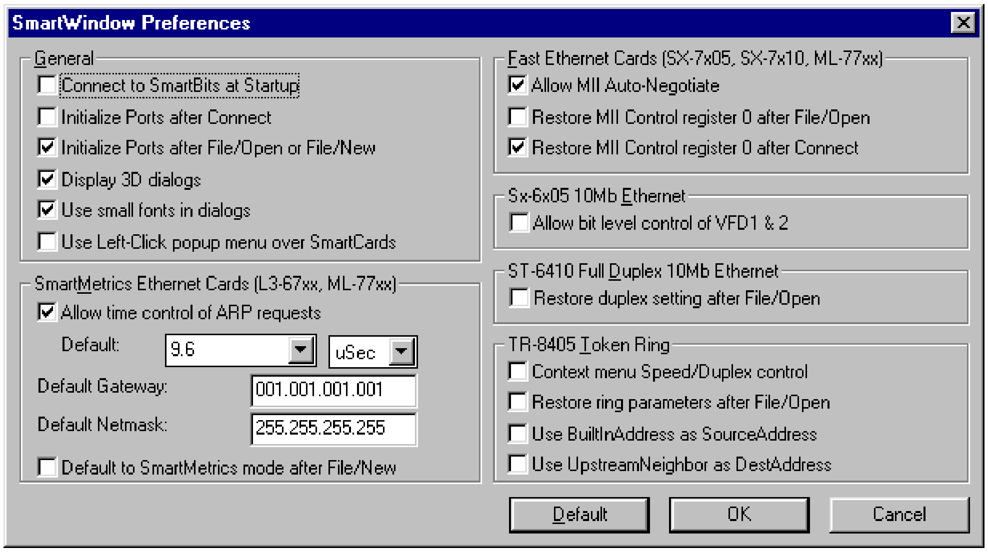
Use the *Preferences* menu to customize options in the system configuration.

This window presents different options depending on chassis family (SmartBits 200/2000 or SmartBits 600x/6000x).

Note: Some preferences are available for special cases only. As a general rule, it is recommended that you keep the default settings and only change settings with caution.

SmartBits 200/2000

For these chassis, the *Preferences* window presents the following options.



<u>**General**</u>

- **Connect to SmartBits at Startup**
  When selected, SmartWindow attempts to establish a connection to the SmartBits system when the SmartWindow session begins. When not selected, the connection is not attempted until **Actions** > **Connect** is selected from the drop-down menus.
  (Default is **Selected**.)
- **Initialize Ports after Connect**
  When selected, this option configures SmartWindow to update SmartCards automatically with new configurations upon connection. This single-user feature and applies only to the SmartBits 1000 and SmartBits 200.
  (Default is **Deselected**.)
- **Initialize Ports after File/Open or File/New**
  When selected, SmartWindow automatically updates SmartCards with new configurations when files are opened or created. *Automatic updates can occur only when the connection to the chassis is Online*. When not selected, files can be opened and modified without downloading the configuration when the file opens. If this option is disabled, the GUI does not match the current configurations loaded on the target port and modules.
  (Default is **Selected**.)
- **Show Splash Screen at Startup**
  When selected, the SmartWindow splash screen (*Figure 1-1 on page 18*), containing essential version information, appears when the application launches.
  (Default is **Selected**.)

- **Use Left-Click popup menu over SmartCards**
  This option from a previous SmartWindow version remains available for users who prefer it.
  (Current default is to right-click a SmartCard to access its menu.)

SmartMetrics Ethernet Cards (ML-77xx)

- **Allow time control of ARP requests**
  Some systems cannot handle ARP requests sent at full wire speed rate. If ARPs are missed by the DUT(s), then Layer 3 tests fail. To overcome this problem, select **Allow time control of ARP requests**, then set the gap between ARP requests to a suitable testing rate.
- **Default Gateway**
  Use this field to define a default gateway for Layer 3 tests when required.
- **Default Netmask**.
  Use this field to define a default netmask when required.
- **Default to SmartMetrics mode After File/New**
  SmartMetrics mode is normally disabled. This option sets modules into the SmartMetrics mode when a new configuration file is opened.
  (Default is **Deselected**.)

Fast Ethernet/Gigabit Cards

These options apply to cards that have an MII interface and are capable of autonegotiating line speed and duplex mode.

- **Allow MII/GMII Auto-Negotiate**
  When selected, this option allows cards with an MII or GMII interface to autonegotiate line speeds and duplex mode. When not selected, set these parameters by using SmartWindow.
  (Default is **Selected**.)

  When this option is selected, autonegotiation is enabled globally for the card ports; the AN enabled bits are set in the port control registers. These settings *always* override the control register values saved in a *.prf configuration file. As a result, if the global MII/GMII register bit settings are modified, the configuration file is saved, and the chassis is disconnected, the global settings take precedence over your file settings the next time that you connect to the chassis and load the configuration file.

Note: It is highly recommended to force the line speed to the desired rate for testing purposes. When the transceivers autonegotiate, your MII configurations are downloaded.

- **Restore MII Control Register 0 after File/Open**
  When selected, MII register 0 (control) is updated when a new configuration file is opened. When not selected, the update occurs only when warranted by a configuration change.
  (Default is **Deselected**. See *“MII Registers” on page 163* for more information.)

SX-6x05 10Mb Ethernet

- **Allow bit level control of VFD1 & VFD2**
  For 10Mbps Ethernet 6x05 SmartCards only. When selected, you can define the

length (without FCS) of Variable Field Definition (VFD) 1 and 2 in bits. This feature is similar to recycling VFD for 100 Mb fast SmartCards. The behavior is not identical to recycling a VFD. Because consecutive bits are modified on the output stream in network order, if this feature is used to span a byte boundary, the data does not increment or decrement in a smooth fashion, but skips as the high order bits of the next byte change. If random VFDs 1 and 2 are selected on a non-byte boundary, behavior is normal.
(Default is **Unselected**.*)*

ST-6410 Full Duplex 10Mb Ethernet

- **Restore duplex setting after File/Open**
  When selected, the ST-6410 SmartCard's duplex mode is updated when a new configuration file is opened.

Note: View SmartBits version information for each card by opening **Help** > **About SmartWindow** from the main menu and clicking the **Show Card Versions** button. *To use this feature, you must be connected to a chassis. In a multi-user environment, you must reserve the SmartCards.*

SmartBits 600x/6000x

For these chassis, the *User Preferences* window has two tabs (*General* and *Packet Decoders*) that contain the following information.

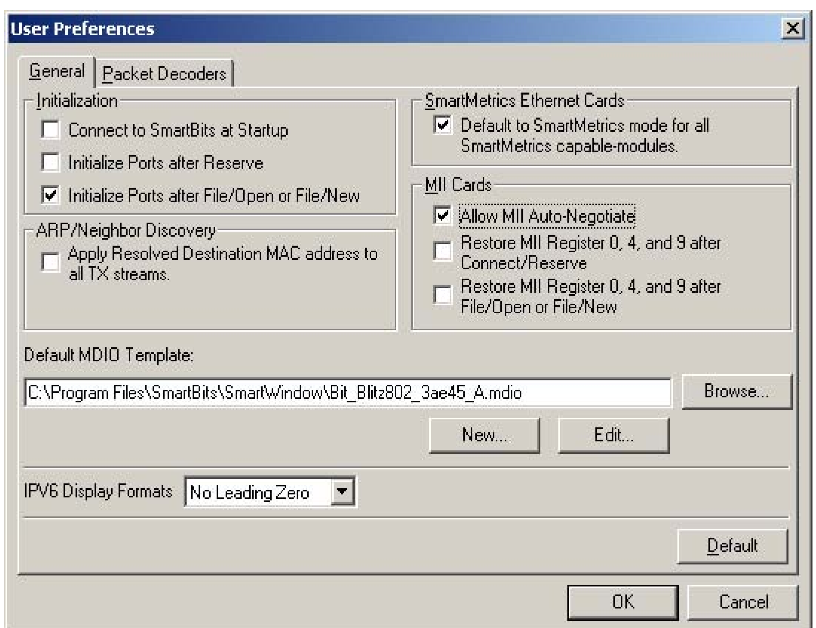


Figure 3-7. User Preferences Window

Note: This screen contains other checkboxes and parameters, dependent on the version of SmartWindow and type of module being used. The following paragraphs describe the elements for the *User Preferences* window.

General Tab

Initialization

- **Connect to SmartBits at Startup**
  When selected, SmartWindow attempts to establish a connection to the SmartBits system when the SmartWindow session begins. When not selected, the connection is not attempted until **Actions > Connect** is selected from the drop-down menus. (Default is **Selected**.)
- **Initialize Ports after Reserve**
  When selected, this option configures SmartWindow to update modules automatically with new configurations upon connection and when a module is reserved for use. (Default is **Deselected**.)
- **Initialize Ports after File/Open or File/New**
  When selected, SmartWindow automatically updates SmartCards with new configurations when files are opened or created. *Automatic updates can occur only when the connection to the chassis is online*. When not selected, files can be opened and modified without downloading the configuration when the file opens. This eliminates the delay of downloading a configuration that will be modified. (Default is **Selected**.)
- **ARP/Neighbor Discovery - Apply Resolved Destination MAC Address to all TX streams.**
  When selected, the MAC address (gained from the ARP/neighbor process) is used in the test TX stream(s). *Table 3-2* describes how this MAC address is processed by selecting/clearing the checkbox in the *Global Preferences* menu or the checkbox in the *Port Setup* > *General* tab. In both cases, these specifications are used to determine the preferences of the two settings.

Table 3-2. ARP/Neighbor Discovery

Global Preferences	Port Setup	Results
Selected	Selected	Destination MAC address used.
Selected	Cleared	Destination MAC address used.
Cleared	Selected	Destination MAC address used.
Cleared	Cleared	Destination MAC address not used.

The *Result* column of the table indicates whether the *Apply Resolved Destination MAC Address* has been implemented. After the checkbox is selected and a test is initiated, a *Progress* dialog box appears on the screen. At this stage of resolution, click the

Abort button to stop the process. However, any actions (resolutions of MAC addresses/sending ARPs) implemented up to this point cannot be recalled.

- **Default to SmartMetrics mode After File/New**
  SmartMetrics mode is normally disabled. This option sets modules into the SmartMetrics mode when a new configuration file is opened.
  (Default is **Deselected**.)

MII Cards

These options apply to modules that have an MII interface and are capable of autonegotiating line speed and duplex mode.

- **Allow MII Auto-Negotiation**
  When selected, this option allows Ethernet modules with MII interfaces to autonegotiate line speed and duplex mode. When not selected, set these parameters by using SmartWindow.
  (Default is **Selected**.)

  When this option is selected, autonegotiation is enabled globally for the card ports; the AN enabled bits are set in the port control registers. These settings *always* override the control register values saved in a *.prf configuration file. As a result, if the global MII register bit settings are modified, the configuration file is saved, and the chassis is disconnected, the global settings take precedence over your file settings the next time that you connect to the chassis and load the configuration file. (See *"MII Registers" on page 163* for more information.)

Note: It is highly recommended to force the line speed to the desired rate for testing purposes. When the transceivers autonegotiate, it can produce unexpected test results because the line speed is not what was expected.

- **Restore MII Register 0, 4, and 9 after File/Open or File/New**
  When selected, MII registers 0, 4, and 9 are updated when a new configuration file is opened. When not selected, the update occurs only when warranted by a configuration change.
  (Default is *not* selected.)

- **Restore MII Register 0, 4, and 9 after Connect/Reserve**
  When selected, registers 0, 4, and 9 are updated when SmartWindow connects to the chassis and when a module is reserved for use.

Default MDIO Template

This pane identifies the default template MDIO file for the port, when it is equipped with a XAUI extender card with MDIO interface.

SmartWindow provides six predefined files. You can quickly select any of these from the default directory by clicking the **Browse** button. The files are:

- ieee802_3ae45.mido – Based on IEEE Std.802.3ae, with the first five devices defined. It includes no vendor specifics and no extensions.

- BitBlitz802_3ae45.mdio – BitBlitz IEEE Std.802.3ae. It includes the vendor’s specifics and extensions.
- jdsu802_3ae45.mdio – JDSU IEEE Std.802.3ae. It includes the vendor’s specifics and extensions.
- agilent802_3ae45.mdio – Agilent IEEE Std.802.3ae. It includes the vendor’s specifics and extensions.
- intel802_3ae45.mdio – Intel’s IEEE Std.802.3ae. It includes the vendor’s specifics and extensions.

Click the **Browse** button to locate a custom MDIO template file in a different directory on your PC. Click the **New** or **Edit** button to create a new template file or modify the specified default file, respectively. (The *MDIO Template Editor* opens. Use it to set new values for devices and registers.)

IPv6 Display Formats

Use these options to select how IPv6 addresses are shown in dialog boxes and windows for modules that support IPv6 streams. RFC 2373 provides a detailed explanation of these formats. It is paraphrased here:

Hexadecimal

The preferred form is x:x:x:x:x:x:x:x, where the 'x's are the hexadecimal values of the eight 16-bit pieces of the address.

Examples

`FEDC:BA98:7654:3210:FEDC:BA98:7654:3210`

`1080:0:0:0:8:800:200C:417A`

No leading zero

This format is like the *Preferred* format above, but the leading zeros in individual fields are omitted. (There must be at least one numeral in every field.)

Compact

Some methods of allocating IPv6 addresses result in addresses that contain long strings of zero bits. To simplify writing such addresses, a special syntax is available to compress the zeros. The use of “::” indicates multiple groups of 16-bits of zeros. The “::” can only appear once in an address. The “::” can also be used to compress the leading and/or trailing zeros in an address.

Examples

Unicast address:

`1080:0:0:0:8:800:200C:417A>1080::8:800:200C:417A`

Multicast address:

`FF01:0:0:0:0:0:0:101>      FF01::101`

Loopback address:

`0:0:0:0:0:0:0:1>           ::1`

Unspecified address:

`0:0:0:0:0:0:0:0>           ::`

Mixed

This form can be more convenient when dealing with a mixed environment of IPv4 and IPv6 nodes. It is x:x:x:x:x:x:d.d.d.d, where the 'x's are the hexadecimal values of the six high-order 16-bit pieces of the address, and the 'd's are the decimal values of the four low-order 8-bit pieces of the address (standard IPv4 representation).

Examples

```
0:0:0:0:0:0:13.1.68.3
in compressed form:
::13.1.68.3
```

```
0:0:0:0:0:FFFF:129.144.52.38
in compressed form:
::FFFF:129.144.52.38
```

Packet Decoders Tab

The fields within this tab are used to import and display the path of a data decoder. (Refer to *Chapter 5, "Advanced Operational Theory,"* for a description of how to capture files and use a data decoder to analyze SmartWindows data.)

Tests Menu

Use the *Tests* menu to configure specific test characteristics, including the backoff truncation exponent value and SmartMetrics parameters.

Backoff Truncation Exponent

By default, all SmartCards that support Ethernet are configured for a backoff truncation exponent value of 10, in accordance with 802.3 standards. You can modify this default value on a per-port basis. Lowering the value results in a more aggressive collision, re-transmission algorithm.

1 Select **Backoff Truncation Exponent** from the **Tests** menu.
Two windows appear: One window is used to select the ports to modify, and the other window is used to select the new backoff truncation exponent value.
Use the following window to select the ports to modify:

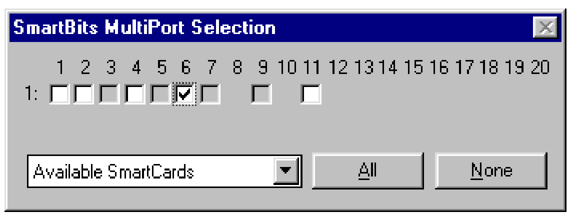
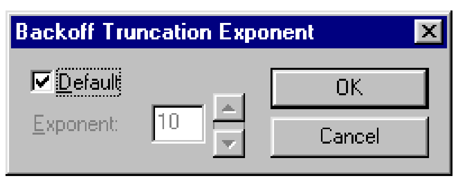


Figure 3-8. SmartBits 200/2000 Port Selection Dialog

2 Select the checkbox under each port number to be modified. Then use the window below to set the new value:



If the **Default** checkbox is not selected, the field for the exponent value is active and can be modified.

3 Set an integer value from **1** to **10**. Smaller values result in the test port being more aggressive in a collision situation, since the truncation for backoff times starts at a lower number of successive collisions.

Note: SmartWindow enables you to set the truncation value, but not to read it back on a per-port basis. In addition, if you enter a value different from the default of **10**, then exit the menu and return later, the menu returns to the default state (i.e., enabled).

SmartMetrics Tests

See *Chapter 7, "SmartMetrics Testing."*

Admin Menu

The *Admin* menu provides administrative functions. Use these functions to learn about the current IP configuration for the SmartBits chassis, as well as to view history information about chassis users and to manage current user connections.

Note: The Admin functions are available on any SmartBits 600x/6000x chassis, as well as on any SmartBits 200/2000 chassis with chassis firmware Version 6.62 or later and proper configuration of the `smartbit.ini` file.

To activate the admin functions on a SmartBits 200/2000 chassis, add the following line to the preferences section of the `smartbit.ini` file:

```
[Preferences]
Allow Admin = 1
```

SmartBits IP Configuration

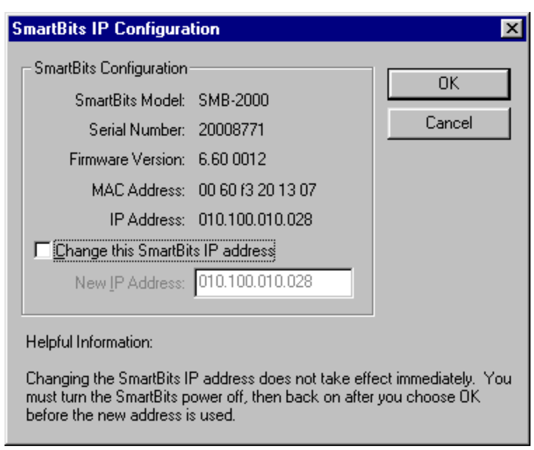
When SmartWindow is connected to the chassis, the *SmartBits IP Configuration* dialog box is active and shows chassis and address information.

To change the IP address of the chassis:

1. Select the **Change this SmartBits IP address** checkbox.
2. Enter the new address in the **New IP Address** field.

Note: Be sure to make a note of the new address before recycling the power.

3. Recycle power to put the new address into effect.



SmartBits Users

This option shows a history of user connections to the SmartBits 600x/6000x. It also provides administrative control, including the ability to kill a user's connection to SmartBits and to ping a user's workstation if you are the administrative super user.

When you select **SmartBits Users**, SmartWindow asks for your user password. This validates you as the assigned super user with administrative privileges.

After you enter your password successfully, the SmartBits Users window opens. At first, the message *Retrieving...* indicates that SmartWindow is gathering both current and past user information. It shows a history list like the one shown in *Figure 3-9*.

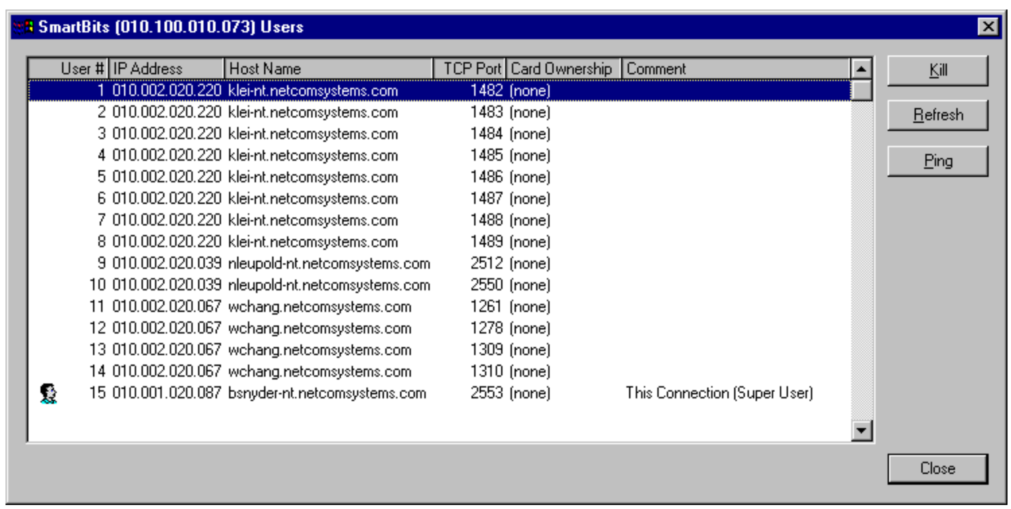


Figure 3-9. SmartBits Users History List

User #. The user number is for identification only. It follows the chronological sequence of connections to the chassis.

IP Address. This address is the user's IP address for the connection to SmartBits.

Host Name. This name is the assigned host name of the user's workstation.

TCP Port. This number is the user TCP port number.

Card Ownership. This column lists all cards in the chassis that the user currently has reserved for use.

Comment. This column identifies the super user (administrator) connection. (See *Figure 3-9 on page 72*.)

Close Connection. If a user's connection is dead, use this option to terminate the connection.

Refresh. Use this button to update the display.

Ping. Use this button to verify that a user's IP connection is alive. Select the connection from the history list, then click the **Ping** button. SmartWindow sends a ping packet to the user's workstation, then displays the results information (*Figure 3-10*).

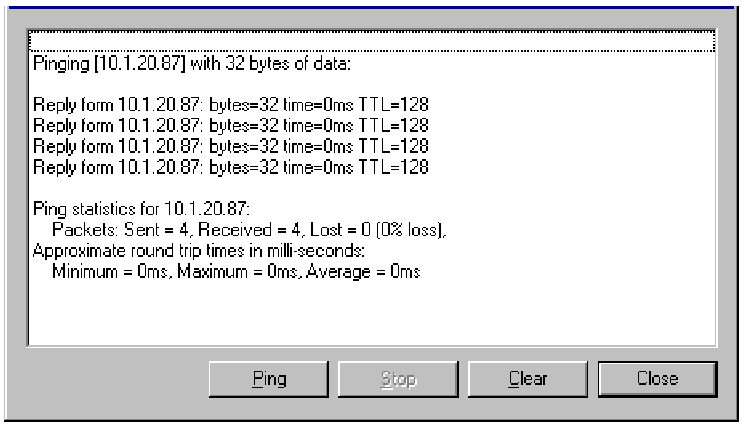
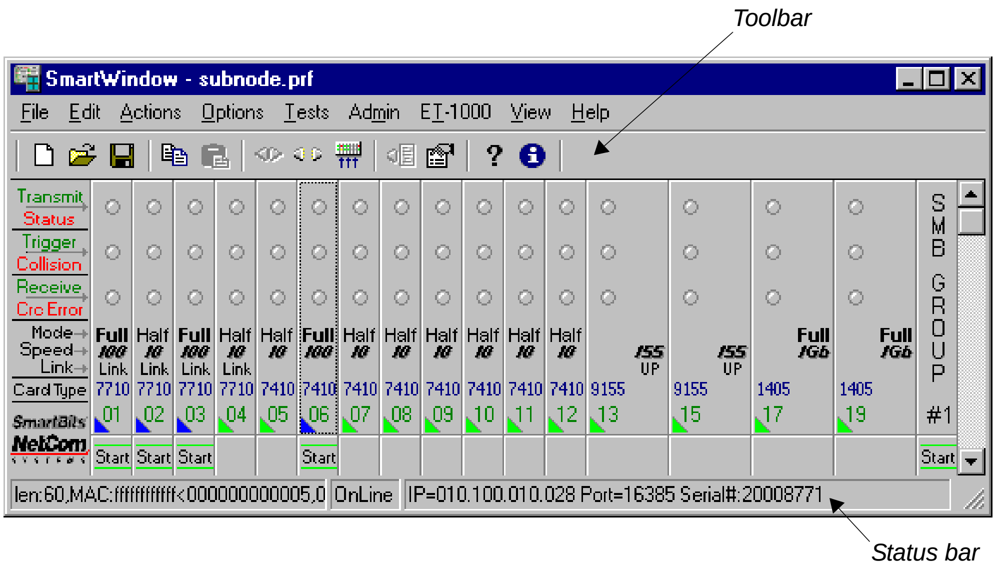


Figure 3-10. Pinging to Validate a User Connection

View Menu

Use the *View* menu to show or hide the toolbar and status bar in the main window.



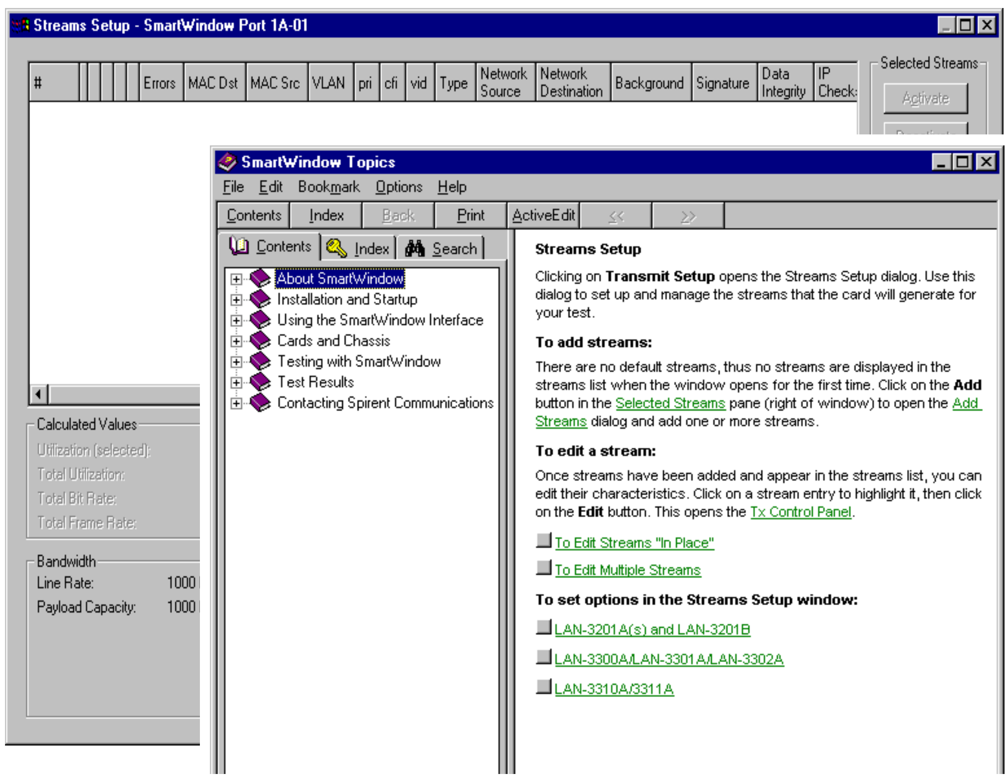
Help Menu

Use the *Help* menu to open the SmartWindow Help, to view the Spirent Communications website, and to retrieve version information.

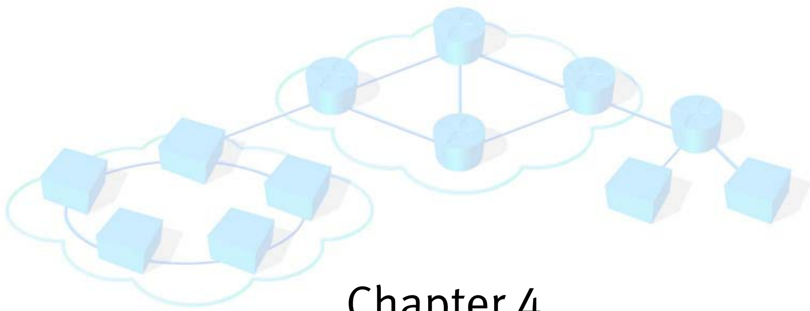
Contents F1

Select **Contents** or press **F1** to open the SmartWindow online Help.

Pressing **F1** over any active window or dialog box in SmartWindow opens the related Help topic. For example, pressing **F1** when a *Streams Setup* window is active (as shown below for a LAN-3311A module) displays a Help topic on setting up Gigabit streams.



SPIRENT
Communications



Chapter 4

Basic Operational Theory

SmartWindow performs testing and analysis on a diverse set of protocols. Understanding its basic operation can help speed and optimize test setup.

In this chapter...

SmartWindow Basics

SmartWindow allows you to open up to five simultaneous instances of the program.

- A single instance of SmartWindow can connect to only one SmartBits chassis.
- Multiple instances can connect to separate chassis or to the same chassis (if the chassis is multi-user ready).[1]

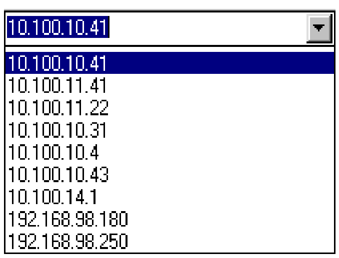
Multiple instances do not share timing information, so be careful to design tests with this in mind. For example, you can set up two SmartBits chassis—one on either end of a DUT or SUT—then transmit from SmartBits 1 to SmartBits 2. Throughput and packet loss tests can be performed with this type of configuration, but latency tests would not have much value since those tests depend on precise timing information.

Single Instances of SmartWindow

Opening a single instance of SmartWindow is straightforward. Refer to *"Starting SmartWindow" on page 31*.

Each time you connect to a new chassis, SmartWindow remembers the IP address and includes it on the list. The next time you choose **Options > Connection Setup**, the IP addresses of all recent connections appear in the drop-down menu for *Remote SmartBits* (SmartBits 600x/6000x) or *Remote Host* (SmartBits 200/2000).

As long as these chassis are active on the network and path authorization is granted, you can select a new connection from the drop-down menu.



1. *See "Multi-user Operation" on page 92*.

Off-line Configuration

SmartWindow can be configured off-line (when it is not connected to a SmartBits chassis) as well as on-line (when it is connected).

To configure off-line:

Use the SmartWindow Launcher to open a new *.prf file for off-line configuration. (See *"SmartWindow Launcher" on page 31*.)

1. With the *SmartBits* tab open, click the icon for the desired chassis type.

   SmartWindow presents the chassis image and creates a *.prf file. (See *"Creating New Configuration Files" on page 98*.)
2. Select the desired combination of card images. (See *"Changing the SmartCard Image" on page 52*.)
3. Select individual cards and configure them.
4. When finished, choose **File** > **Save** to save the *.prf file.

You can use off-line configuration to become familiar with card or chassis setup and configuration, and to create *.prf files as a starting point for further configuration. However, not all cards are available off-line and not all options are available for all cards.

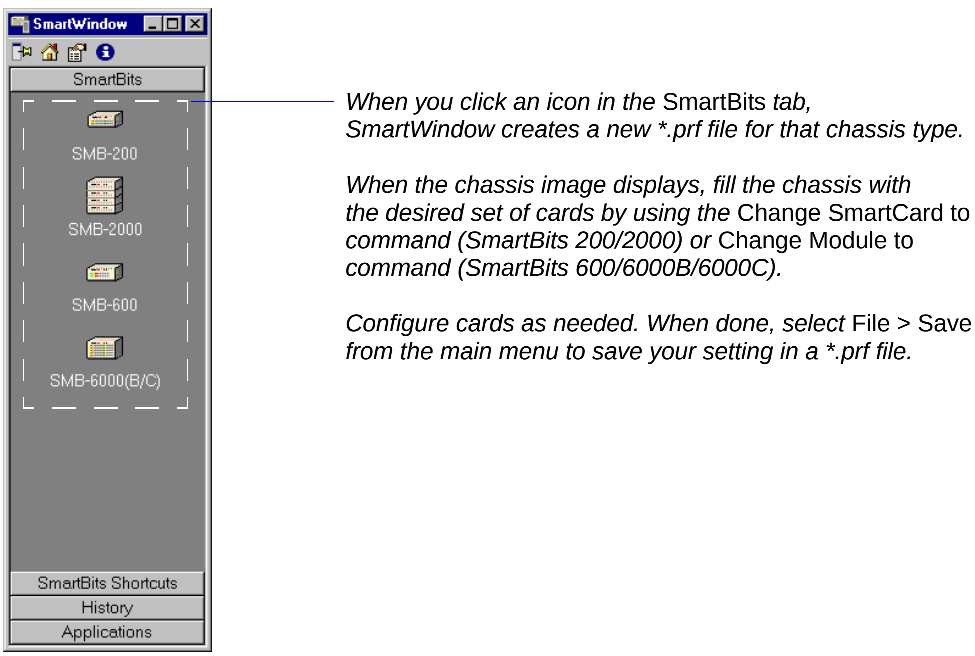


Figure 4-1. Using the Launcher for Off-line Configuration

On-line Configuration

When connected to a chassis, the default chassis image changes to reflect the makeup of cards or modules that are actually installed (*Figure 4-2*).

Only the cards actually installed are now visible, but all menu options and dialog boxes are accessible. Even if the chassis was pre-configured in the off-line state, the final adjustments can be made while on-line.

After you connect to a SmartBits, the SmartWindow image changes to show the actual mix of cards or modules that are installed.

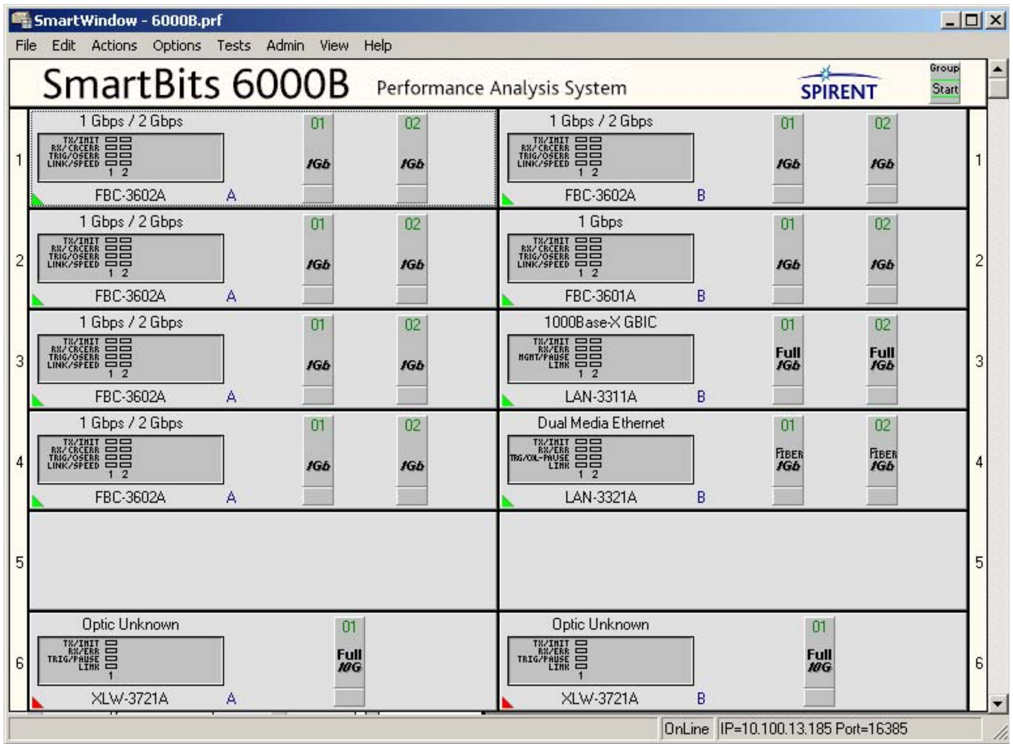


Figure 4-2. Smart Window Image Shows the Mix of Installed Cards Or Modules

Note: After the chassis has been configured and disconnected, the default chassis image takes the appearance of the preferences file that corresponds to the latest connection. You now have an accurate image of the chassis configuration. Some menu options, however, may not be available until connection is once again established.

Multiple Instances of SmartWindow

In some circumstances, you may choose to control multiple SmartBits chassis by using multiple instances of SmartWindow. SmartWindow allows up to five simultaneous instances to run concurrently.

If more than one copy of SmartWindow cannot be opened at the same time, add a line to the `smartbit.ini` file located in the Windows directory. (See *"Smartbit.ini Files" on page 142* for more information.) Under the Preferences section, add one of the following lines:

`Allow Multiinstance=1`	(allow multiple instances)
`Allow Multiinstance=0`	(do not allow multiple instances)

Multiple instances of SmartWindow can connect to different chassis or to the same chassis (if the chassis is multi-user ready). Multi-instance group behavior is explained in *"Grouping SmartCards" on page 84*.

Multiple Instance Behavior

Each time an instance of SmartWindow is opened, it uses the first preference file from the previous session, regardless of number of instances. When SmartWindow is started the next day, the first SmartWindow instance uses `1.prf`, even though you are connecting to a SmartBits 6000B or SmartBits 6000C that was configured the previous day with `2.prf`. (See *Figure 4-3*.)

Two things can be done to prevent mistakes:

1 To avoid overriding an existing configuration, use off-line configuration.

2 Select the target *.prf file, then connect to the target chassis.

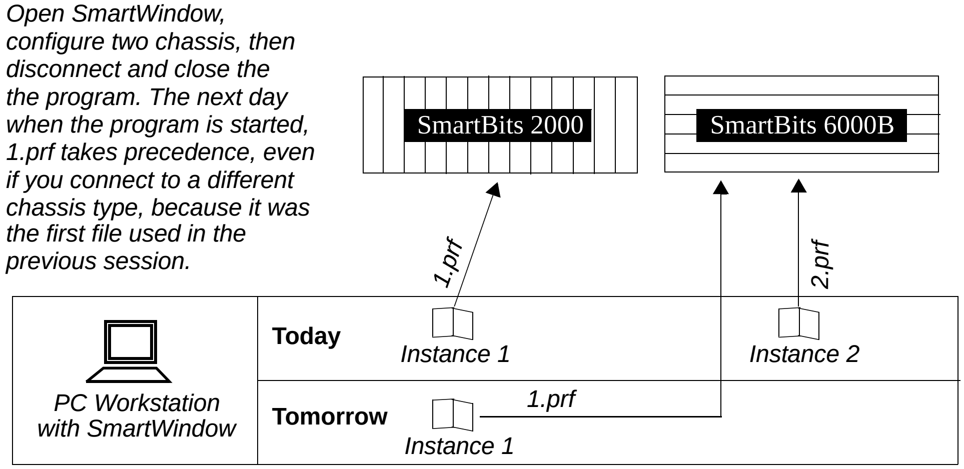


Figure 4-3. Configuration File Precedence

Naming Connections

To avoid confusion, change a title to different SmartWindow chassis connections. To do this, edit the `Smartbit.ini` file located in the Windows folder. Under the `[Serial Number]` section of the file, add an entry that lists the controller serial number and the chassis title that you choose. For example, add a line like the following:

```
63665001=Engineering
```

The title bar in SmartWindow will read:

```
Engineering
```

when it is connected to controller `63665001`.

Refer to *Table 4-1* for a list of chassis identification prefixes. To form the full eight-character serial number, the prefix is concatenated with the four-digit serial number found on the back of each SmartBits chassis.

Full serial # = Chassis identification prefix + individual chassis serial #

Add as many title references in the `smartbit.ini` file as needed. Each title reference should use this syntax:

Syntax: `<Serial#>=<title>`
Example: `63665002=joesSMB-2000`

Table 4-1. Chassis Identification Prefixes for SmartBits Chassis

Chassis Model	Serial Number Prefix
SmartBits 200	6366
SmartBits 2000	6366
SmartBits 600x	6266
SmartBits 6000x	6000
ET-1000	6366
SmartBits 1000	6366

Host Name-to-Address Mapping

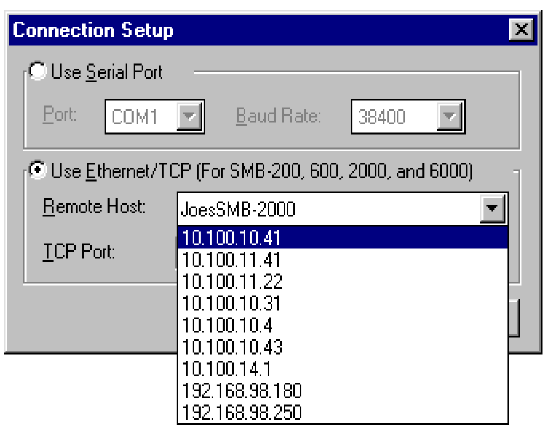
Assign a familiar name to a chassis by using the Windows hosts file. This is useful when there are many IP addresses in the *Connection Setup* dialog box since names help to identify each chassis.

To assign names and edit the Hosts sample file `Hosts.sam` **in the Windows directory:**

1. Open `Hosts.sam` in Notepad or another text editor.
   The sample file provides information on how to add and edit entries and comments.
2. Enter the IP address and name in the following format. (Do not leave any spaces in the familiar name.)
   Syntax:`<IP address>=<name>`
   Example:`192.168.14.10 JoesSMB-2000`
3. Save the file as <`Hosts.`>.

Note: When saving the file, there must be no extension after the < **.** > in the file name so edit the filename in Windows Explorer. Be sure to type the filename exactly as shown between the brackets: <`Hosts.`>. The <.> disappears. The filename appears as <`Hosts.`>.

4. Choose **Options** > **Connection Setup**.
5. Type the name that was entered in the `Hosts` file (JoesSMB-2000), then click **OK**.



6. Choose **Actions** > **Connect**.
   You are now connected to chassis using IP address: `192.168.14.10`. In addition, if the chassis was renamed in the `Smartbits.ini` file (*"Naming Connections" on page 82*), when you connect to the chassis, the *Title Bar* reads as follows:

7. Now select a name from the **Connection Setup** dialog box to see the same name in the *Title Bar.*

Grouping SmartCards

The concept of *group* allows several SmartCards to be configured for transmit and trigger setup at the same time. It also allows a group of cards to be managed for simultaneous transmission control.

Group Rules

Ownership. For a card to be part of a group, it must be owned either implicitly or explicitly:

- **Implicit Ownership.** Occurs with single-user chassis. Since only one user can connect to a single user chassis, all cards are considered to be owned when the connection is made.
- **Explicit Ownership.** Occurs with multi-user chassis. (See *"Multi-user Operation" on page 92*.) More than one user can connect to the same chassis. When a connection is made, the user must reserve the desired cards. No other user can own these cards.

Once you own cards, a group can be defined.

Group Make-up. The *Set Group* command selects all the reserved cards and proposes them as a default group. (To set up a group, accept the proposed group or change the mix of selected ports by using the *SmartBits MultiPort Selection* dialog box. Then click **OK**.) Notice that all unowned cards are grayed out until reserved.

Multiple SmartWindow Instances. A single instance of SmartWindow cannot connect to more than one chassis. However, multiple SmartWindow instances can connect to different chassis or to the same chassis (if the chassis is multi-user capable).

When multiple SmartWindow instances are connected to the same multi-user chassis, each instance is independent of the others. As a result, a group in one instance is independent of groups in other instances.

Group Transmit and Trigger Setup (SmartBits 2000 only)

Although each connection has only one group, the group *Transmit Setup* and *Trigger Setup* dialog boxes allow actions on sub-groups. (See *"Transmit Setup for a Group of SmartCards" on page 89*.)

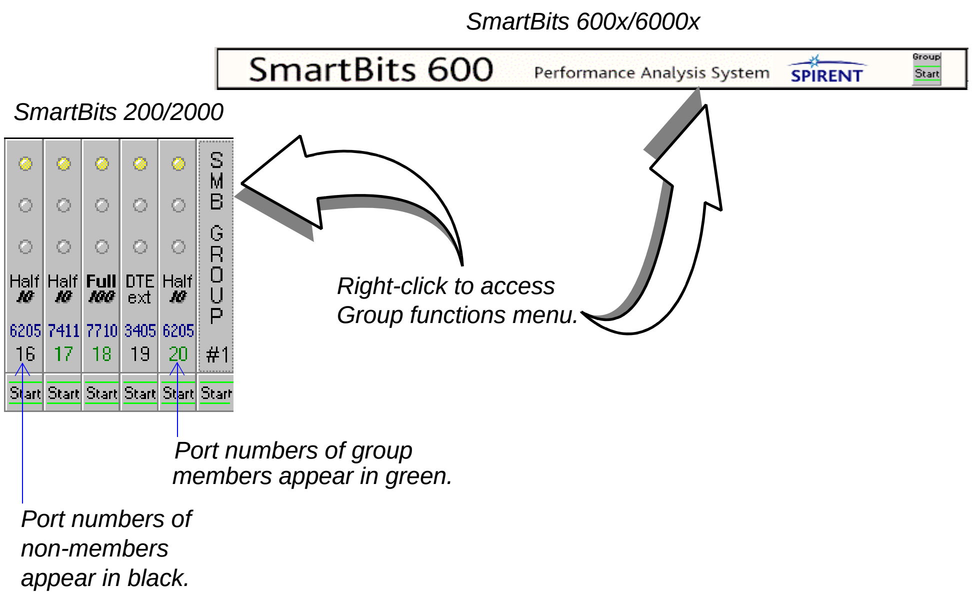
- *Set Group* dialog box allows you to configure a master group across a chassis or stack of chassis.
- *Group Trigger Setup* or *Transmit Setup* dialog box permits you to subdivide cards in the master group. For example, in a group composed of ports 1, 2, 3, 5, 6, 8, 9, 11, and 12, you can open the *Transmit Setup* dialog box from the *Group* menu to configure streams only on ports 1, 2 5, 6, 8, and 9; then set triggers on ports 3, 11, and 12. Choosing **Group > Start** starts all cards in the group, but only ports 3, 11, and 12 are transmitting and receiving triggers.

Defining a Group of SmartCards

To define a group of SmartCards:

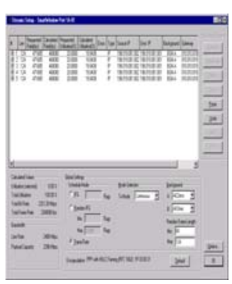
1 Access the group functions menu.

- **SmartBits 600x/6000x**
  Right-click anywhere on the top panel.
- **SmartBits 200/2000**
  Right-click anywhere on the **SMB Group** pane.

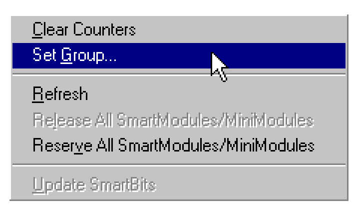


Depending on the SmartBits chassis type, the following menus appear:

SmartBits 200/2000



SmartBits 600x/6000x



2 To define a group of SmartCards, choose **Set Group**.

3 In the *SmartBits MultiPort Selection* dialog box, select ports as group members by selecting the checkboxes beneath the port numbers.

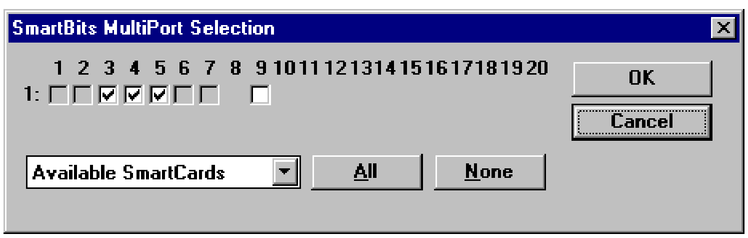
The following actions are available:

Action	Definition
All	Puts all available SmartCards in the group.
None	Clears all available SmartCards from the group.
Types of SmartCards	Puts all SmartCards of the specified type in the group.

Multi-user and Group

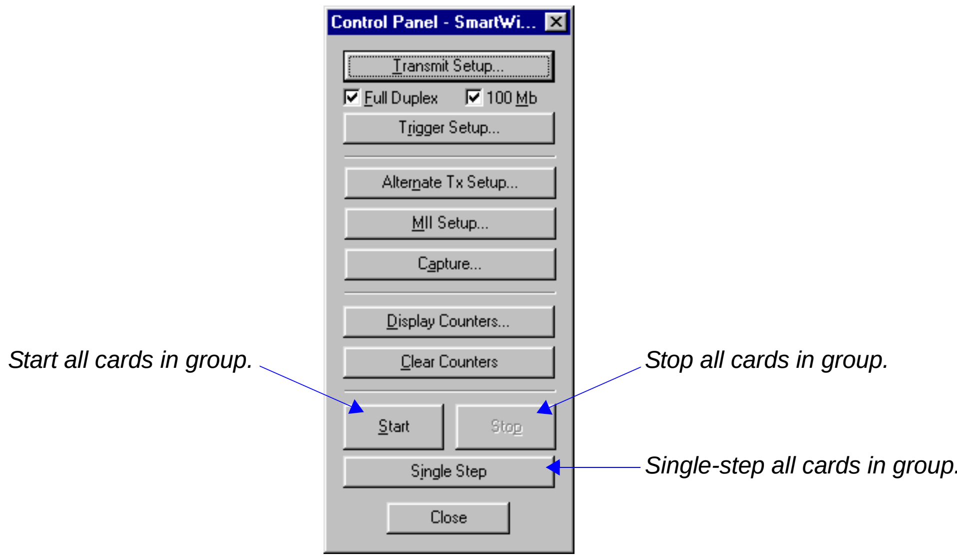
With certain exceptions, define a group of SmartCards for a multi-user chassis by using the procedures just described for a single-user chassis. (See *"Defining a Group of SmartCards" on page 85.*) These exceptions are illustrated in the figure below:

- Selected ports 3, 4, and 5 make up the group.
- Ports 1, 2, 6, and 7 are reserved for another user or another instance of SmartWindow, so these ports are not shown as available for group membership.
- Port 9 is reserved by this user, but not selected as a member of the group.



Controlling a Group of SmartCards

Once a group has been defined, the buttons in the lower section of the *Group Setup* window become active. These buttons function as shown below:[1]



SmartWindow toggle button

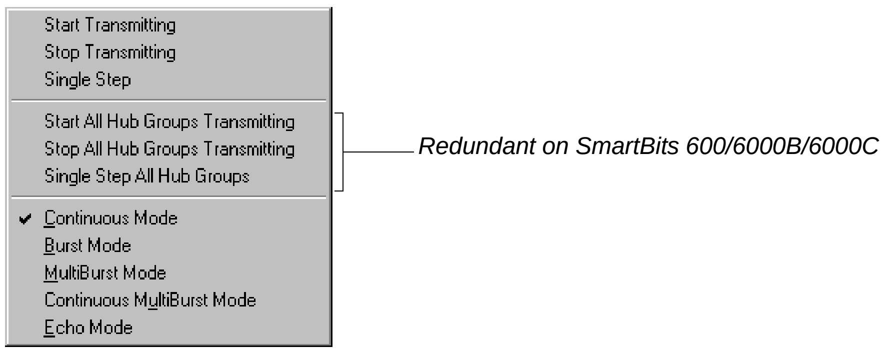
1. This legacy SmartWindow menu is controlled by clearing *Use Left-Click popup menu over SmartCards*.

A group can also be controlled via the main SmartWindow display. Once a group is defined, the Start/Stop toggle button becomes active.

To control a group via the display:

1 Open the group transmission menu.

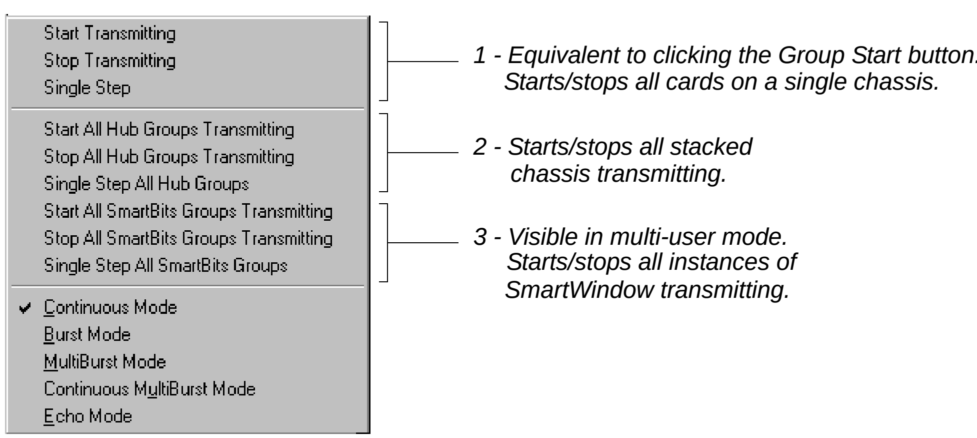
- **SmartBits 600x/6000x**
  Right-click the **Start** button on the right side of the top panel.
- **SmartBits 200/2000**
  Right-click the **Start** button at the bottom of the *SMB Group* pane.



2 Make a menu choice according to *Table 4-2, "Group Transmit Menu Commands," on page 91*.

Controlling Groups on the SmartBits 2000

Controlling SmartCard groups on the SmartBits 2000 is similar to the single-user procedures described above (*"Controlling a Group of SmartCards" on page 87*). But because multiple SmartBits 2000 chassis can be stacked, there are additional options as shown below.

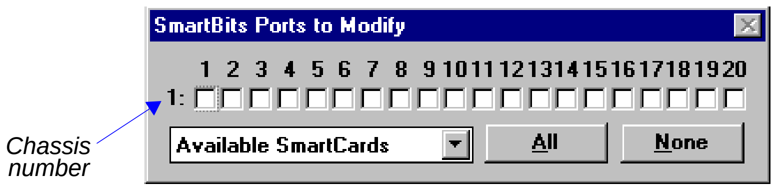


Transmit Setup for a Group of SmartCards

For a SmartBits 200/2000, transmit setup can be defined and applied to a group of SmartCards.

To define and apply transmit setup:

1. Choose **Transmit Setup** in the *SMB Group* menu.
   The *Transmit Setup* dialog box appears. (This dialog box resembles the individual transmit setup dialog box.) At the same time, the following window appears.



2. To select the SmartCards to configure as a group, select the appropriate checkboxes.
   In this window, the chassis number is displayed to the left of the checkboxes. For easier port selection, a drop-down menu allows you to select cards by type. You can also click the **All** cards button or **None** button (that clears previous selections). See *"Defining a Group of SmartCards" on page 85*.
3. Once ports have been selected, set up the transmit specifications as required.
4. Click **OK** in the *Transmit Setup* dialog box.

SmartWindow updates all selected cards with the given transmit specifications. (To use the copy/paste function for a group of SmartCards, see *"Edit Menu" on page 56.)*

Trigger Setup for a Group of SmartCards

Trigger setup can be configured for a group of SmartCards.

During this procedure, the *SmartBits MultiPort Selection* window and a *Receive Trigger Setup* dialog box are displayed simultaneously.

To configure trigger setup:

1. Select the ports, then define the trigger specifications. (Refer to the previous procedure for checkbox and button descriptions.)
2. Click **OK**.

The trigger specification is applied to the selected ports.

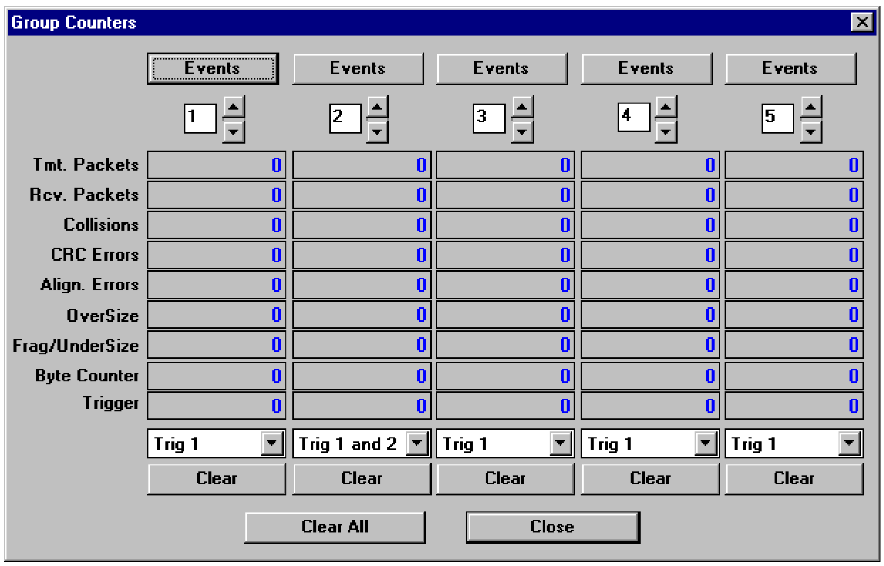
Displaying Counters for a Group of Ports

To condense multiple individual counter windows, SmartWindow provides a group counter function that displays the counters for five ports at one time.

To view the group counter window:

1 Choose **Display Counters** from the SMB Group menu.

The following window is displayed.



2 Use the top row of buttons to toggle between *Events* or *Rates*.

3 To change the port being displayed, use the spin box or enter the value manually in the field.

4 Click the **Clear** button below the port being displayed to reset the counters of each port.

5 Click the **Clear All** button to clear all port counters.

Table 4-2. Group Transmit Menu Commands

Category	Command	Definition
1	Start Transmitting	Begins transmission from all ports in the group.
	Stop Transmitting	Halts transmission from all ports in the group.
	Single Step	Transmits a single packet instead of a burst of packets for all ports in the group.
2	Start All Hub Groups Transmitting Stop All Hub Groups Transmitting Single Step All Hub Groups	When one chassis is connected to another in a stack connection, use these menu commands to control simultaneous transmission for the ports on all hubs (SmartBits 10/1000/2000 only).[1]
3	Start All SmartBits Groups Transmitting Stop All SmartBits Groups Transmitting Single Step All SmartBits Groups	For multiple SmartWindow instances, use these commands to control transmission for all instances of SmartWindow.[2]

1 Category 2 does not apply to the SmartBits 600x/6000x. Because of high-port density, it does not support stacked chassis. Choosing any option in this category is the same as choosing the corresponding option in Category 1.

2 See *"Multiple Instances of SmartWindow" on page 81* and *"Multi-user Operation" on page 92*.

Multi-user Operation

SmartWindow supports up to 10 simultaneous users on a SmartBits 2000 or SmartBits 6000x chassis. It is recommended that no more that six users/connections be attached during heavy performance testing.

Important: Multi-user mode is enabled by default.

In a multi-user environment, the ability to configure cards or use them in tests depends on *card ownership*. You cannot configure a card or use it in tests until you have reserved it.

Note: Once connected to a chassis, the link is maintained even though no cards are reserved.

To connect to a SmartBits 6000x over a network, see *"Configuring SmartWindow for an Ethernet Connection" on page 45*.

SmartBits 6000x Multi-user Operation

When on-line, SmartWindow displays all modules that you own with an off-white background. Modules that are unreserved or owned by another user are shown with a gray background.

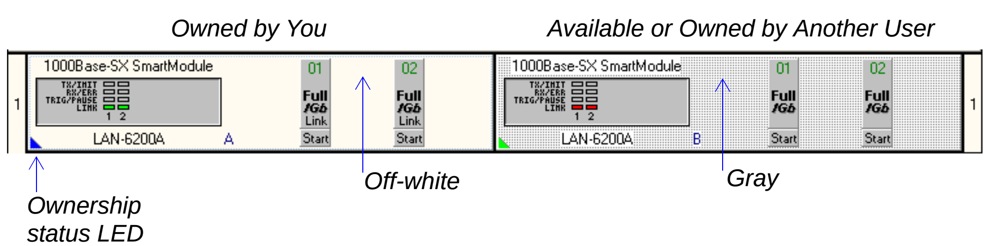


Figure 4-4. How SmartWindow Shows Card Ownership

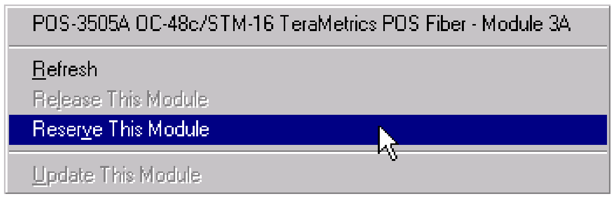
In a multi-user environment, the ownership status of a module is shown by a status LED in the bottom left corner, as follows:

Color	Description
Green	Card available.
Blue	Reserved to you.
Red	Reserved to another user.

Reserving Individual Modules

To reserve a module:

1 Right-click the LED panel to open the multi-user menu.



2 Choose **Reserve This Module**.

Problems Reserving a Module

The ownership status LED only reflects the status of the modules as of the most recent refresh. It is possible in a multi-user environment for a module to be reserved by another user in the time between the last refresh and your attempt to reserve the module.

If you receive a message informing you that the module is unavailable, click **OK** to dismiss the dialog box and automatically refresh the display.

Controlling Groups of Modules

Right-click the **Group/Start** button (*Figure 4-5*) to open a multi-user menu that controls all modules.

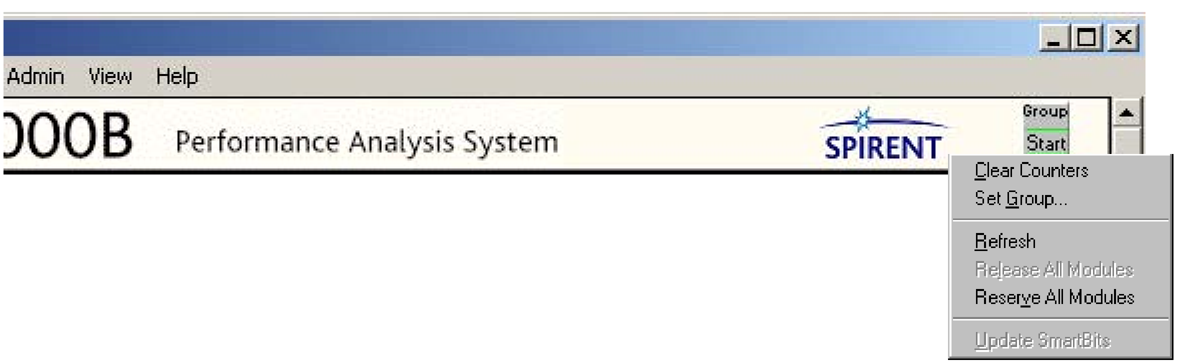
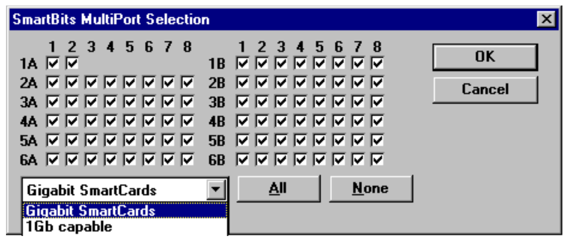


Figure 4-5. Multi-user Menu for Group and Modules Control

Table 4-3. Reserving Modules – Menu Commands

Command	Use
Set Group[1]	To open the *SmartBits MultiPort Selection* window and select the ports to be defined as a group.  Select each port by selecting its checkbox. To select ports according to commonly-used criteria, use the drop-down list of filters along with the **All** and **None** buttons.
Clear Counters	To reset all port counters to zero.
Refresh	To update the display of module ownership in order to determine availability and status of modules.
Reserve This Module	To reserve a module for your use.
Release This Module	To make a module available to other users when you are finished using it.

1 Cards must be reserved before any configuration can be done. See *"Reserving SmartCards" on page 96*.

Note: All reserved cards and modules are released when you disconnect from the SmartBits chassis.

SmartBits 2000 Multi-user Operation

A multi-user ready SmartBits 2000 has an identifying sticker on it. Unlike the SmartBits 6000x chassis, which is always multi-user ready, any SmartBits 2000 chassis without a sticker must be refitted at the factory to be multi-user compliant. In such a case, a SmartBits 2000 multi-user-compliant backplane is installed.

Note: The SmartBits 200 is a single-user only chassis

The multi-user capability of a chassis can be affected by selected cards when specific controller firmware is installed, as follows:

- **Controller firmware 6.50**
  When ST-64xx, SC-63xx, and SE-62xx SmartCards are installed, SmartWindow operates in single-user mode. (To operate in multi-user mode, simply withdraw the cards.)
- **Controller firmware 6.60**
  SmartWindow supports the multi-user mode for installed ST-64xx, SC-63xx, and SE-62xx SmartCards.

In a stack of SmartBits 2000 chassis, all chassis must be fitted with multi-user compliant backplanes and firmware to use the multi-user capability.

Important: If these modifications are present on a SmartBits 2000, SmartWindow displays the multi-user interface. Otherwise, it displays the single-user interface. See *"Connected to SmartBits 2000" on page 50* for SmartBits 2000 single-user information.

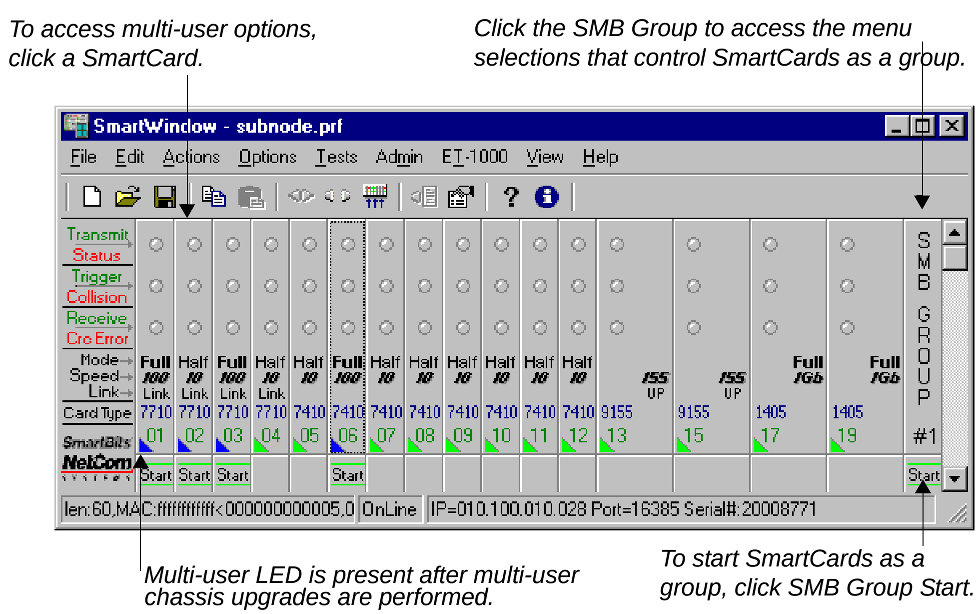


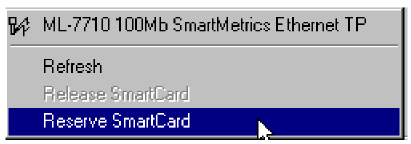
Figure 4-6. Multi-user Compliant SmartBits 2000 Main Menu[1]

Reserving SmartCards

To reserve cards in a SmartBits 2000 that is multi-user compliant:

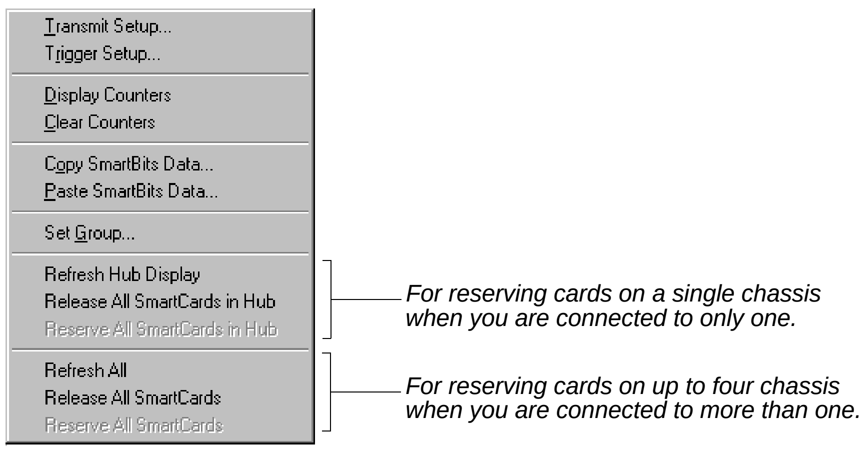
1 Start SmartWindow. As shown in *Figure 4-6*, the multi-user main menu has an additional LED.

2 Right-click a card to reserve it.
The following dialog box appears.



3 Choose **Reserve SmartCard**.
The LED changes from green to blue. Use this same process for reserving designated SmartCards individually.[1]

4 To reserve all cards, right-click the **SMB Group** panel.



5 Choose **Reserve All SmartCards.**

Note: Cards cannot be grouped or configured until you have reserved them. Clicking an unreserved card displays no configuration options; the card must first be reserved. Cards reserved by other users are released on disconnect.

1. See *"SmartBits 6000x Multi-user Operation" on page 92* for information on color-coding.
1. See *"Connected to SmartBits 600x/6000x" on page 53* for information on LED color-coding.

Configuration Files

SmartWindow settings are saved to configuration files with an extension of *.prf. Save *.prf files for each configuration that is created in SmartWindow. For instance, you can create a file called WAN.prf that contains only WAN card configurations for testing frame relay. Other cards or combination of cards can have configuration files. (See *"File Menu" on page 55* for more information.)

Configuration File Types

When saving or updating a chassis configuration file, the file suffix is *.prf.

Table 4-4. Configuration File Types

File Suffix	Purpose/Description
.prf	Configuration file modified or opened by the user. Contains the frame-based background fill patterns and variable field definition for SmartMetrics.
.scf	A file created when an individual SmartCard configuration is saved. Accessed by clicking a card and choosing **SmartCard Save**.
.msi	Related file containing stream information for SmartMetrics, ATM, and WAN SmartCards.

Important: Once a configuration is saved in SmartWindow 6.50 or a later version, you can no longer open it in a previous version of SmartWindow. It is recommended that you back up any existing configuration files before saving them in SmartWindow 6.50 or a later version.

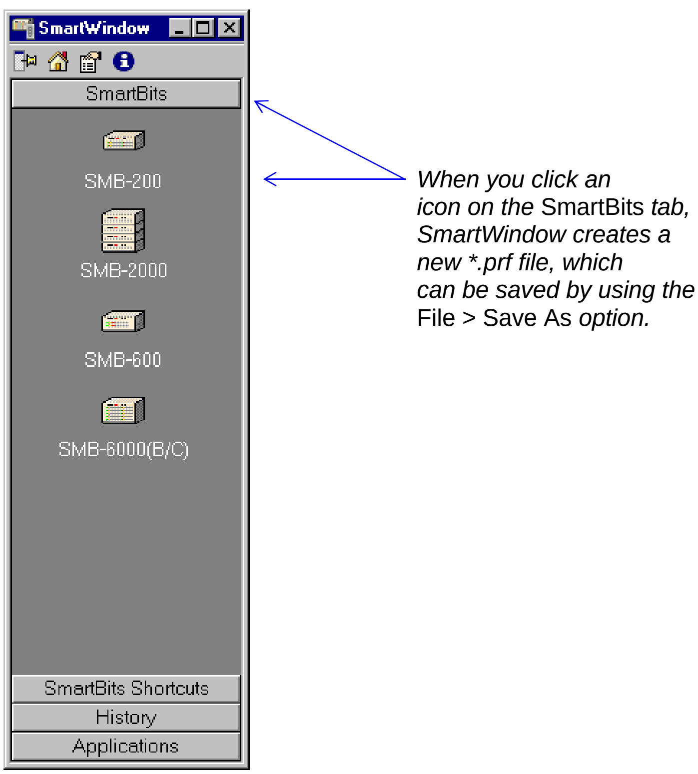
Creating New Configuration Files

SmartWindow can create a configuration file even when not connected to a chassis.

Use the SmartWindow Launcher (*"SmartWindow Launcher" on page 31*) to open a new *.prf file for off-line configuration.

To create a new configuration file:

1. With the *SmartBits* tab open, click the icon for the desired chassis type.
   SmartWindow presents the chassis image and creates a *.prf file. (See *"Creating New Configuration Files" on page 98*.)
2. Set up the desired combination of card images. (See *"Changing the SmartCard Image" on page 52*.)
3. Select individual cards and configure those cards.
4. When finished, choose **File** > **Save** to save the *.prf file.



Backing up Configuration Files from a Previous Version

When saving configuration files created in a previous version of SmartWindow, you are prompted to back up all files before saving. Depending on your configuration, there may be several files with the following extensions:*.prf, *.msi, *.vx[n], *.dx[n]

To back up configuration files:

1. Cancel the save operation by clicking the **Cancel** button —*or*—
   Suspend the save operation by clicking the Windows **Start** button.
2. Open Windows Explorer.
3. Locate the configuration files to be backed up and copy them to another folder.
4. Restart or resume the save operation of the current configuration file.

Updating a Configuration

The SmartBits configuration is stored both on the SmartCards and in configuration files on the manager workstation. Update the SmartBits system by updating the chassis using a selected *.prf configuration file. When the file is sent to the chassis, each SmartCard is reconfigured.

The configuration can also be maintained from another application, such as SmartApplications or SmartLibrary, or from another SmartWindow session. For example, you can run a customized test application, then open SmartWindow without losing the previous settings.

Update Process

Downloading a preference file to a SmartBits chassis and SmartCard system is referred to as *updating SmartBits* or *updating* for short. Updating is the process of configuring the SmartBits hardware after configuring parameters in SmartWindow.

The length of the update process depends upon the type of card, number of cards, and streams per card. Once the update is complete, the configuration may be modified or saved.

Update Steps

- **To Automatically Update** – *Not applicable to the SmartBits 600x/6000x*
  Choose **Initialize Ports after Connect** and/or **Initialize Ports after File/Open** option on the SmartWindow **Preferences** window. These options use the most current *.prf file to update the system.
- **To Keep the Previous Configuration**
  Clear the **Initialize Ports after Connect** and/or **Initialize Ports after File/Open** checkboxes in the SmartWindow **Preferences** window.
- **To Update Manually**
  Choose **File** > **Open** and select a *.prf file.
- **To Update after Configuring**
  If configuration changes have been made to a specified card, the currently active configuration file does not reflect the changes unless updated. To update a card, click the **Download** button on the SmartWindow toolbar.

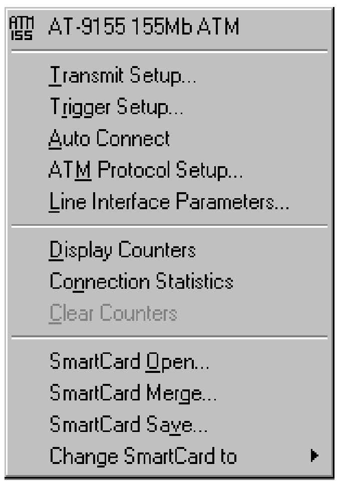
Saving Individual SmartCard Configurations

In addition to saving the configuration settings for groups of SmartCards, the settings for a single card can be saved.

To save individual SmartCard configurations:

1. Click the desired card in SmartWindow.
2. From the drop-down menu, choose **SmartCard Save**.
   Individual SmartCard configurations are saved in .scf files.
3. To access the configuration file again, click the card to be configured.
4. From the menu, choose **SmartCard Open**. Select the appropriate file.

Use the **SmartCard Merge** option to append VTE settings to currently configured VTEs. This function applies to multi-layer cards.



Converting SmartWindow Configurations

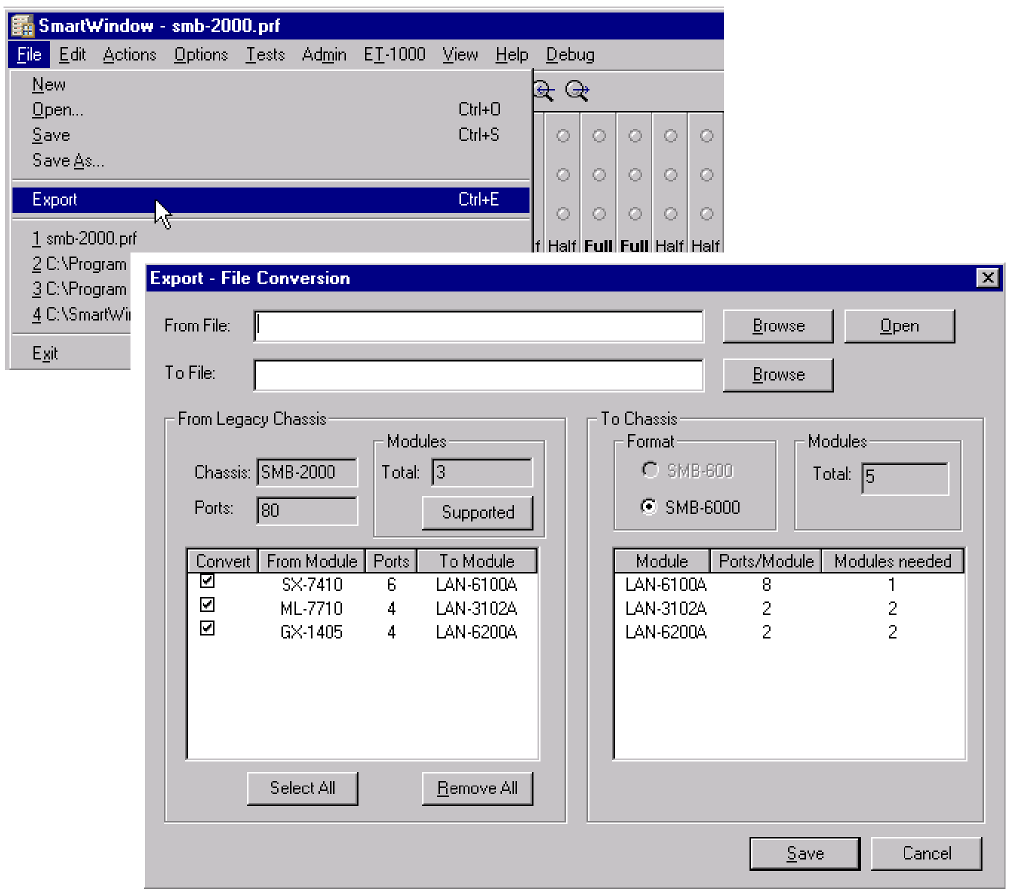
A *.prf configuration file developed for use with a SmartBits 200 or SmartBits 2000 can be converted for use with a SmartBits 600x/6000x. Not all SmartBits 200/2000 card setups are candidates for conversion, because some SmartBits 200/2000 cards have no equivalent SmartBits 600x/6000x module type. But the configuration for all candidate cards can be transferred.

To convert a SmartWindow configuration:

1 Open SmartWindow on the source SmartBits chassis (e.g., a SmartBits 200 or SmartBits 2000).

2 Select **File** > **Export** from the main menu.

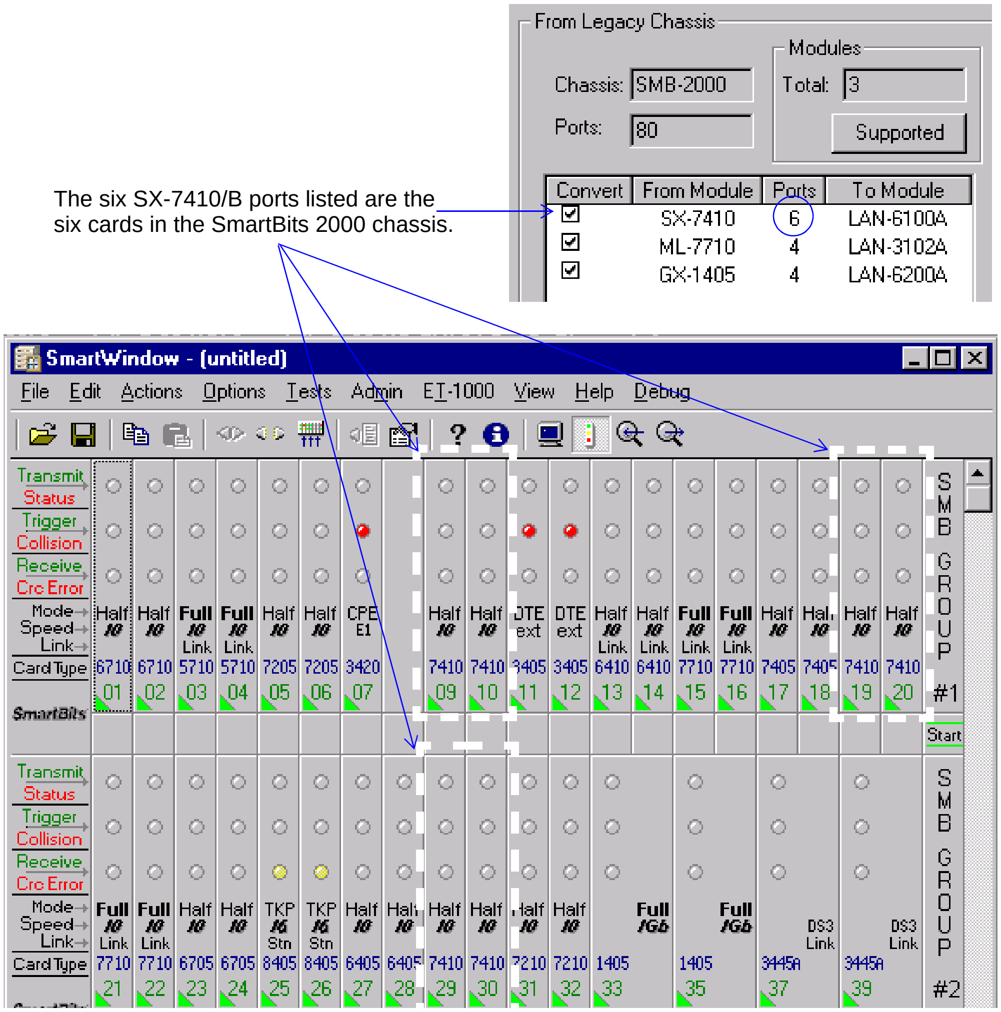
The *Export – File Conversion* window opens.



From legacy chassis

The *From Legacy Chassis* pane lists the cards in the SmartBits 200/2000 chassis whose configuration can be converted to one for a SmartBits 600x/6000x chassis.

For each card type, it shows the total number of ports installed in the chassis.



To card

The *To Card* column proposes an equivalent SmartBits 600x/6000x module for the file conversion.

As shown in *Figure 4-7*, the SX-7410/B port configurations will be converted to equivalent configurations for ports on LAN-6100A modules.

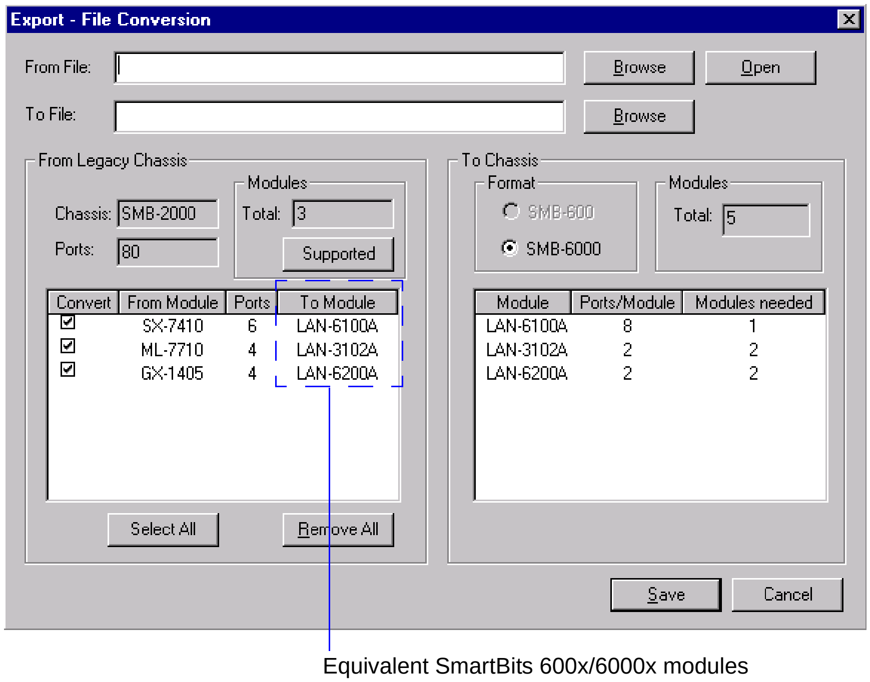
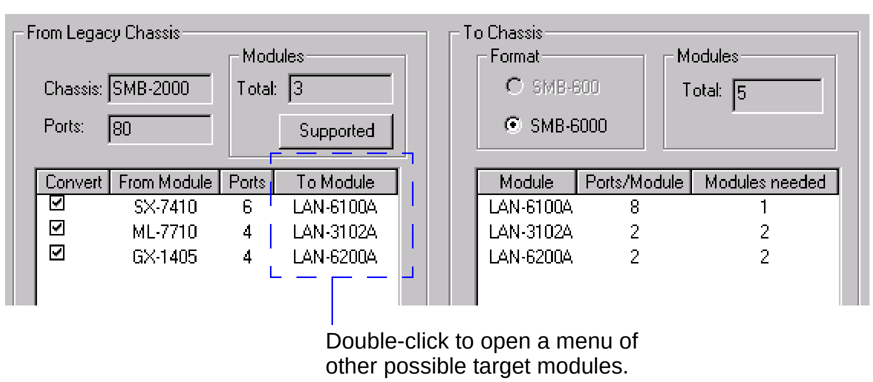


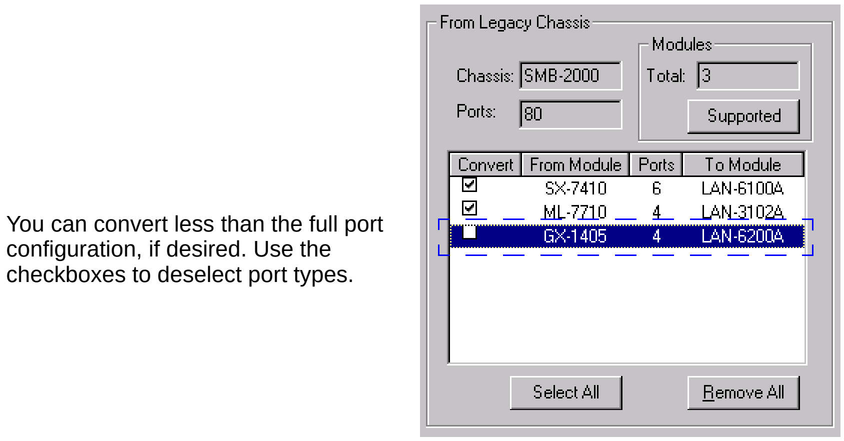
Figure 4-7. Proposed Conversion Modules

3 SmartWindow proposes suitable target modules, but others may be possible. Double-click a **To Card** entry to open a drop-down menu that lists the other modules that can handle the converted port configuration.

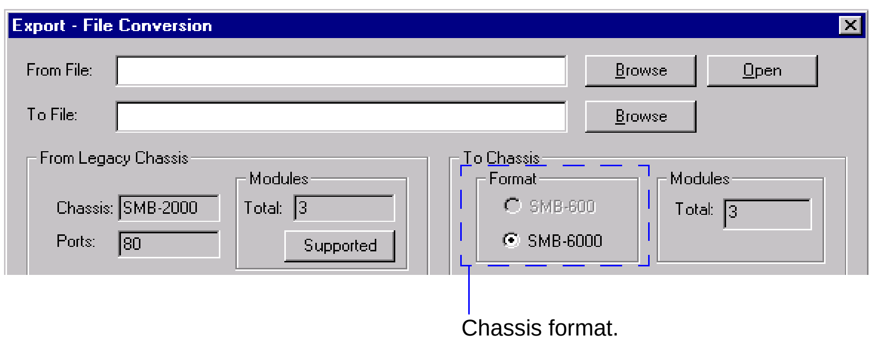
4 To select an alternative module, click its entry in the list.



5 Deselect one or more of the SmartBits 200/2000 card types, if needed. When a card type is not included, those portions of the SmartBits 200/2000 configuration are not converted.



6 In the *To Chassis* pane, ensure that the selected chassis format is correct. (Default value is **SMB-6000**.)



To chassis

The *To Chassis* pane summarizes the selected target module types, the number of ports available on each module, and the number of modules that are needed to accommodate the SmartBits 200/2000 port configuration to be converted.

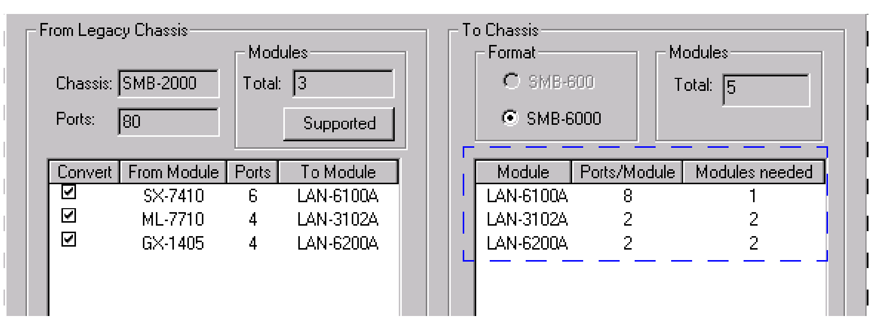
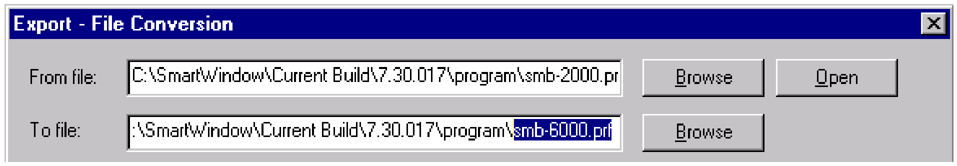


Figure 4-8. Proposed Conversion Modules

Source and target file names

7 In the **From file** field, specify the SmartBits 200/2000 *.prf file to be converted.

8 In the **To file** field, specify the name of the target SmartBits 600x/6000x *.prf file.



Note: When a value is entered in the **From file** field, SmartWindow automatically inserts the same file name in the **To file** field. Be sure to modify the pathname to identify a unique SmartBits 600x/6000x *.prf file.

9 When all settings are correct, click **Save** to begin the file conversion.

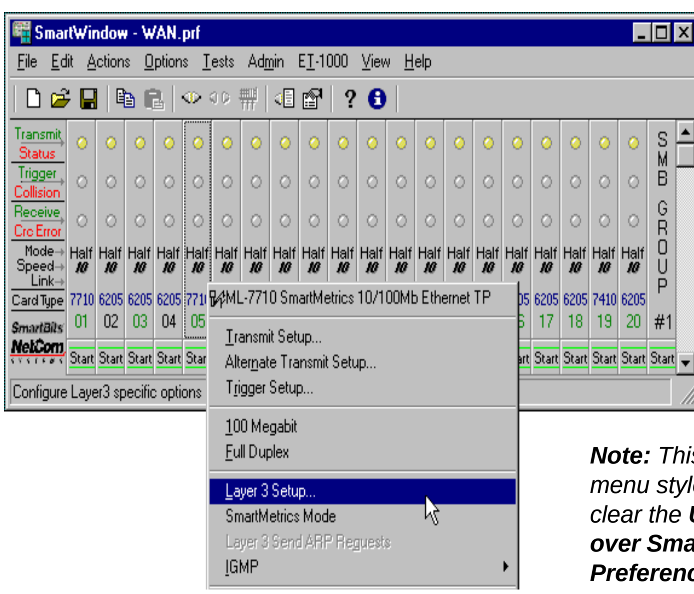
Configuring SmartBits Cards

To understand the configuration options in SmartWindow, it is helpful to remember that there are three basic types of configurations:

- **Frame Content**
  To configure the frame content of a card, click the desired card in SmartWindow. Then select **Transmit Setup** (or possibly **Alternate Transmit Setup**, depending on the card). These options include VFD settings and may include VTE settings for multiple streams. Frame content includes information such as network addresses, background patterns, and how the traffic is sent (such as continuous or burst).
- **Network Interaction**
  To configure network interactions for a card, click the desired card in SmartWindow. Then select options from the drop-down menu. Available options vary depending on the card. Network interactions include full duplex, ATM protocol, SmartMetrics, and MII registers setup.
- **Trigger Setup**
  This additional option—trigger setup for the receiving card—does not fit into either of the above categories. Triggers support specific test results in SmartBits. The transmitting card adds a trigger pattern to the frames it sends, and the receiving card is configured to recognize the trigger pattern and count the frame. To set up triggers, click the card in SmartWindow, then choose **Trigger Setup** from the menu.

Configuration Options

To configure an individual SmartCard, click the card image. These operations can also be performed on groups of SmartCards by clicking **SMB Group** in the main window.



SMB group

***Note:** This figure shows the current menu style. To use the legacy menus, clear the **Use Left-click popup menu over SmartCards** option in **Options > Preferences**.*

Configuring Frame Content

Use these options to configure the content of the frames to be transmitted from each SmartCard:

- **Traditional/ Frame-Based Mode**
  Click the card in SmartWindow, then choose **Options > Transmit Setup**.
- **SmartMetrics/ Stream-Based Mode**
  Click the card in SmartWindow, choose **Options > SmartMetrics Mode**, then choose **Transmit Setup**.
  - To edit *global* options, click **This Port.** Global options include the group of VFD 3s that cycle in each stream.
  - To edit individual streams (VTEs), select the stream(s) to be edited, and click **Selected VTEs**.
- **ATM SmartCards**
  Click the card in SmartWindow. Then choose **Options > Transmit Setup**.

Configuring Network Interactions

To configure network interactions for a card, click the desired card in SmartWindow. Then select the feature group to be viewed or edited. Network interactions include options such as full duplex, ATM protocol, SmartMetrics, and MII registers setup.

For more information, see the *SmartBits System Overview & Reference Guide*.

Types of Tests

SmartWindow includes these types of tests:

- **Manual Setup Tests**
  To run these tests, first configure the frame content (in transmit setup), the network interactions, and the triggers for each SmartCard. Once the configurations are complete, run the test by starting transmission:
  - **From all cards** in the chassis by selecting **Actions** > **Start All Cards** from the main menu.
  - **From an individual card** by clicking **Start** on the appropriate SmartCard in SmartWindow.
  - **From a group of cards** by defining the group, then clicking **Start** on the far-right group SmartCard.
- **SmartMetrics Tests**
  These stream-based tests use Layer 3 and some Layer 2 protocols. These tests are available from the main menu (**Tests** > **SmartMetrics Tests)**. SmartMetrics tests offer specific test methodology and results based on the type of test. For more information, refer to *Chapter 7, "SmartMetrics Testing."*

View test results during the transmission process or after the test is completed, depending on the type of results to be viewed.

Chapter 5

Advanced Operational Theory

SmartWindow supports more advanced operations, in addition to the configuration options presented in *Chapter 4, "Basic Operational Theory."* This chapter provides information on these important features.

In this chapter...

Setting up IP Multicast Groups

The Internet Group Management Protocol (IGMP) is a technology used to deliver IP multicast traffic: a stream of traffic sent from one sender to multiple receivers simultaneously. IP multicast is used in multimedia and data-sharing applications.

You can set up and test IGMP capabilities on the Ethernet and WAN cards listed in *Table 5-1*.

Note: This section covers IGMP setup for Ethernet cards. To set up IGMP testing with WAN cards, see *"Set up IGMP Streams on WAN Cards" on page 514*.

Table 5-1. SmartBits Cards and Modules Supporting IGMP

Ethernet	Description
ML-7710	10/100Base-TX Ethernet, 1-port, SmartMetrics
ML-7711/s	100Base-FX Ethernet, 1-port, multi-mode/single mode, 1300nm/1310nm, SmartMetrics
LAN-3101A/B	10/100Base-T Ethernet, 6-port, SmartMetrics
LAN-3102A	10/100Base-T Ethernet, 2-port, SmartMetrics
LAN-3111A/As	100Base-FX Ethernet, 6-port, multi-mode/single mode, 1300nm/1310nm, SmartMetrics
LAN-3201A	1000Base-SX SmartMetrics
LAN-3201B/C	1000Base-X Ethernet, GBIC, 1-port, SmartMetrics
LAN-3300A	10/100/1000Base-T Ethernet, Copper, 2-port, SmartMetrics
LAN-3301A	10/100/1000Base-T Ethernet, Copper, 2-port, TeraMetrics
LAN-3302A	10/100Base-TX Ethernet, Copper, 2-port, TeraMetrics
LAN-3310A	1000Base-X Ethernet, GBIC, 2-port, SmartMetrics
LAN-3311A	1000Base-X Ethernet, GBIC, 2-port, TeraMetrics
LAN-372xA	10/100/1000 Mbps and Gigabit Ethernet Fiber, 2/4-port, SmartMetrics and TeraMetrics
XLW-3720A	10GBase Ethernet, XENPAK MSA, 1-port, 2-slot, SmartMetrics
XLW-3721A	10GBase Ethernet, XENPAK MSA, 1-port, 2-slot, TeraMetrics
XFP-3730A	10GBase Ethernet, XFP MSA, 1-port, 1-slot, SmartMetrics

Table 5-1. SmartBits Cards and Modules Supporting IGMP (continued)

Ethernet	Description
XFP-3731A	10GBase Ethernet, XFP MSA, 1-port, 1-slot, TeraMetrics
POS	
POS-3504As/AR	POS OC-48c (STM-16c), 1-port, single mode, 1310nm/1550nm, SmartMetrics
POS-3505As/AR	POS OC-48c (STM-16c), 1-port, single mode, 1310nm/1550nm, TeraMetrics
POS-3510A	POS OC-3c/OC-12c (STM-1c/STM-4c), 2-port, multi-mode, 1300nm, SmartMetrics
POS-3510As	POS OC-3c/OC-12c (STM-1c/STM-4c), 2-port, single mode, 1310nm, SmartMetrics
POS-3511A	POS OC-3c/OC-12c (STM-1c/STM-4c), 2-port, multi-mode, 1300nm, TeraMetrics
POS-3511As	POS OC-3c/OC-12c (STM-1c/STM-4c), 2-port, single mode, 1310nm, TeraMetrics
POS-3518As/AR	POS OC-192 (STM-64c), 1-port, 2-slot, single mode, 1310nm/1550nm, SmartMetrics
POS-3519As/AR	POS OC-192 (STM-64c), 1-port, 2-slot, single mode, 1310nm/1550nm, TeraMetrics
WAN	
WN-3441A	WAN T1, Frame Relay/PPP, channelized 4-port, SmartMetrics
WN-3442A	WAN E1, Frame Relay/PPP, channelized 4-port, SmartMetrics
WN-3445A	WAN DS3, Frame Relay/PPP, 1-port, SmartMetrics

About IGMP

IGMP provides a way for a host to inform a network forwarding device of its desire to receive IP multicast traffic, i.e., traffic that is sent from one source to many destinations. In addition, it enables group information and multicast forwarding tables to be maintained dynamically.

To join a group, a host sends an IGMP membership request (*join request*). In IGMP Version 1, a joined host needed to respond to periodic router queries to maintain its membership status. If the host failed to respond to queries for a specified time interval, its membership timed out and was removed. (The port must be in SmartMetrics mode with at least one stream configured for the LAN-3101A/B cards to receive IGMP queries.)

IGMP Version 2, an updated version, allows hosts to leave groups explicitly by sending a *leave request*. This offers a more efficient mechanism because it minimizes the quantity of unwanted traffic forwarded to the host.

IGMP Version 3 allows a requesting host to specify a list of hosts from which it wishes to receive traffic. Traffic from other hosts is blocked inside the network. IPv6 does not currently support IGMP.

IGMP in SmartWindow

Using any of the cards listed in *Table 5-1*, individual multicast streams can be configured in one port, as well as all streams on a port or all ports on the card. Each multicast stream acts as a member in an IP multicast group.

SmartWindow options include using IGMP Version 1, Version 2, or Version 3 for streams, commands to join and leave an IP multicast group, and a command to reset the IGMP stack when switching versions.

See *"How IP and MAC Addresses Identify Multicast Traffic" on page 115* for overview information on IGMP addressing.

Setup Menus

The menus and options used to set up multicast streams differ depending on card type.

ML-7710 and other SmartBits 200/2000 SmartCards

For ML-7710 and the related SmartCard for SmartBits 200/2000, see *"Set up Multicast Streams on SmartBits 200/2000 SmartCards"* (*page 116* through *page 129*) for setup information. The IGMP menu options on these cards become enabled when one or more IP multicast streams are configured.

SmartBits 600x/ 6000x TeraMetrics and SmartMetrics modules

With SmartBits 600x and SmartBits 6000x/6000x modules, use the *IGMP Management* window to set up IGMP groups. This window provides access to all ports in the chassis, in one view. It also displays statistics and log information. See *"Set up IGMP for SmartBits 600x/6000x Modules"* (*page 120* and following pages) for setup information.

IGMP with VLAN

Multicast streams can be added that are also assigned to a Virtual LAN (VLAN). In addition, VLAN trunking can be set up, in which one port sends multicast streams with varying group membership and/or VLAN membership. This operation works in two ways:

- One port can send multicast streams that belong to the same multicast group but have different VLAN IDs.
- One port can send multicast streams that belong to different multicast groups but have the same VLAN membership.

See *"Multicast Groups and VLANs" on page 129*.

How IP and MAC Addresses Identify Multicast Traffic

An IP multicast frame is identified by its IP destination address, sometimes referred to as a group address. The Internet Engineering Task Force (IETF) has reserved Class D IP addresses for multicast traffic. These are addresses in which the four most significant bits contain the bit pattern `1110`. The result is a range of group addresses from `224.0.0.0` through `239.255.255.255` (as shown in *Table 5-2*).

The Internet Assigned Numbers Authority (IANA) maintains the list of registered IP Multicast Groups. *Table 5-2* lists the IP addresses reserved for multicast.

Table 5-2. Registered IP Multicast Groups

Address Range	Use
`224.0.0.0 to 224.0.0.255`	Routing protocols
`239.0.0.0 to 239.255.255.255`	Local intranets

Reserved addresses

Two addresses in the IP multicast range have special functions and should not be used with SmartBits test streams. These are the "All Hosts Group" address 224.0.0.1 and "All Routers Group" address 224.0.0.2.

Address mapping with MAC address

The IP multicast address is mapped onto the Ethernet MAC destination address by concatenating the Ethernet prefix `01:00:5E` with three host bytes of the IP multicast group address (i.e., the three bytes after the four most significant bits `1110`). For example, the Ethernet prefix concatenated with the IP group address `224.1.2.3` would result in the MAC destination address `01:00:5E:01:02:03`.

`Byte`	1	2	3	4	5	6
`Value`	**01**	**00**	**5e**	*From Destination IP Address Bytes 2, 3, 4*		

Set up Multicast Streams on SmartBits 200/2000 SmartCards

Use the following procedure to set up multicast addressing for SmartBits 200/2000 Ethernet cards. This procedure uses the ML-7710 SmartMetrics module as an example, but it applies generally to any Ethernet card that uses this type of SmartWindow setup.

Note: The setup method for newer SmartBits 600/6000B/6000C modules is different. Refer to *"Set up IGMP for SmartBits 600x/6000x Modules" on page 120*.

To set up multicast streams on the WN-3441A, WN-3442A, or WN-3445A, see *"Set up IGMP Streams on WAN Cards" on page 514*.

To set up SmartBits 200/2000 multicast streams:

Use the following groups of steps to set up multicast streams on SmartBits 200/2000 SmartCards like the ML-7710:

- *"Specify the Layer 3 Addresses" on page 116*
- *"Configure the Individual Streams" on page 117*
- *"Select IGMP Version and Actions" on page 117*

Specify the Layer 3 Addresses

1 Assign the Layer 3 addresses, as needed.

a Open the card menu and select **Layer 3 Setup**.

b Specify the **MAC Address** and **IP Address** to be used in streams, as well as the default **Gateway** and subnet mask (**Netmask**), if necessary.

ML-7710

Select **Layer 3 Setup** *from the card menu.*

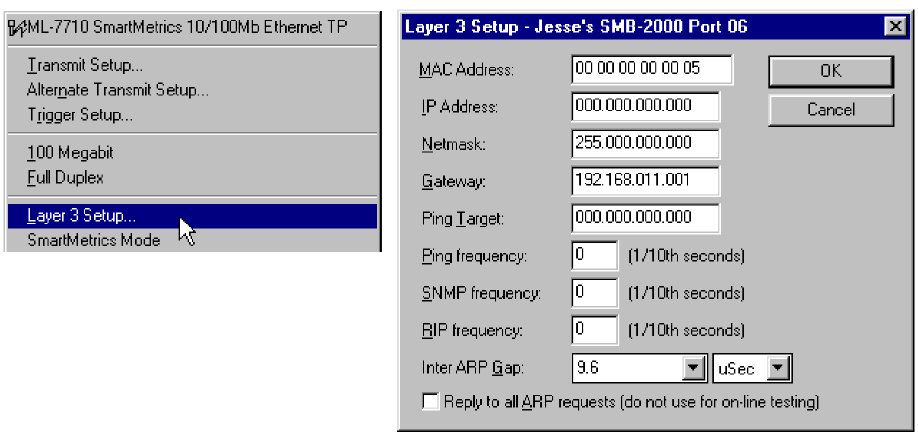


Figure 5-1. Setting Layer 3 Addresses (Example for ML-7710)

Configure the Individual Streams

This group of steps can apply to existing streams or to new streams that are added. In the following steps, click the card to open the card menu.

1. From the card menu, select **SmartMetric Mode**.
2. Select **Transmit Setup** to open the *Streams Setup* window.
3. Add a stream. (The displayed stream is a default template.)
   a. Click the **Add** button.
   b. When the *Add Streams* dialog box appears, accept the default values. Click **OK**.
4. In the new stream, double-click the **Network Destination** field.
5. Enter an IP destination address in the range `224.x.x.x` to `239.255.255.255`. Avoid using the All Hosts Group address 224.0.0.1 and All Routers Group address 224.0.0.2.
6. Press **Tab** to set the information into the field.
7. The *IGMP Update* dialog box states that the destination MAC address (and other addresses) will be updated to conform to the multicast format, as shown below. The `01 00 5e` is the hexadecimal equivalent for the multicast MAC initiator. (See *“How IP and MAC Addresses Identify Multicast Traffic” on page 115* for a description of the how the multicast MAC destination address is formed.) Click **OK**.

   The value for the **MAC Source** field should be the same as the Layer 3 MAC address of the card. This address is established on the *Address* tab of the *Layer 3 Setup* window.

   The value for the **Network Source** field should be the same as the source IP address of the card. This address is also set on the *Address* tab of the *Layer 3 Setup* window.
8. Click **OK** to close the *Streams Setup* window, or press **Enter** and the window closes automatically.

Select IGMP Version and Actions

Once the IGMP streams have been set up, SmartWindow enables the *IGMP* menus and options. Use these menus and options to select the IGMP version, reset the IGMP stack when changing versions, and perform join and leave actions for multicast streams that have been set up.

IGMP version

IGMP Version 2 is the default. Select the version that is supported by the DUT. The IGMP version must be set before a join takes effect.

If the IGMP version is changed, you must reset the IGMP stack. To do this, use the *Reset* option.

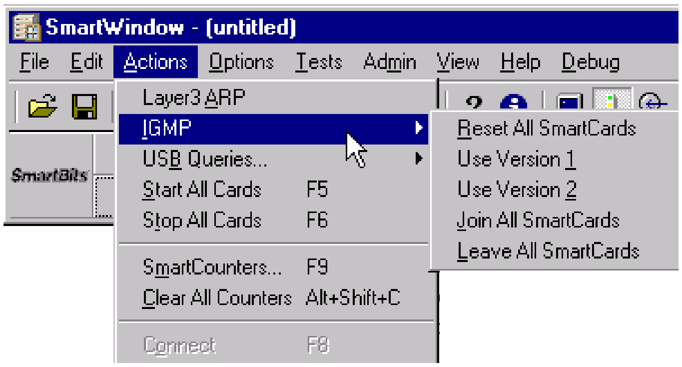
If Version 2 is used, no leaves are sent automatically when you reset. For this reason, it is recommended that leave commands are issued for all joined groups before selecting the

Reset command so the internal IGMP stack is reset. The port may continue to receive frames from previously joined multicast groups for some time.

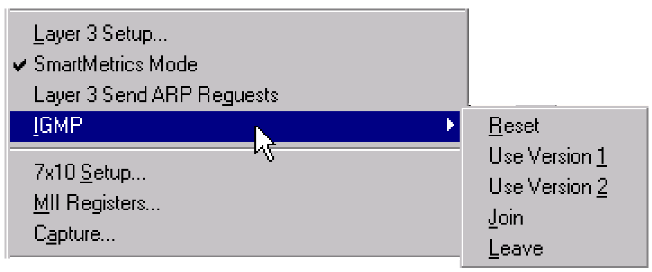
How to select IGMP options

You can select the IGMP options in several ways:

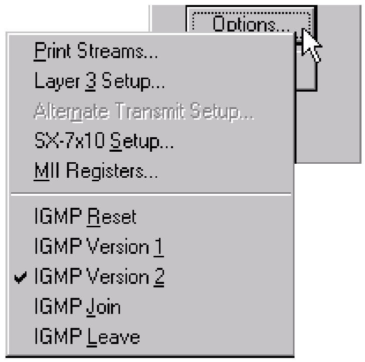
- Use SmartWindow global options. Select **Actions** > **IGMP** from the main menu, then select from the IGMP menu.



- Select **IGMP** from the card menu. These options apply to all multicast streams that are set up for the port.

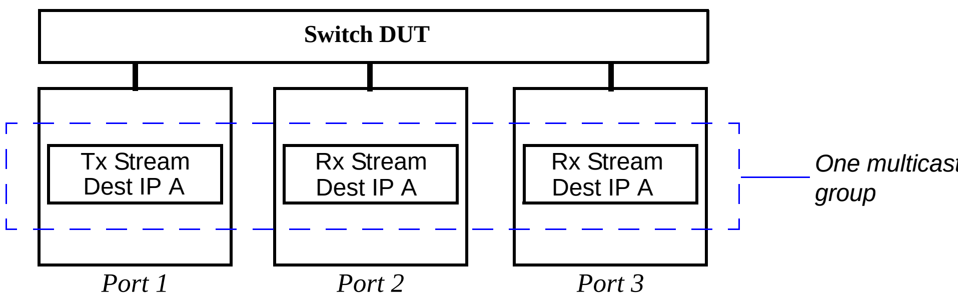


- Click the **Options** button in the *Streams Setup* window, then select from the menu. These options apply to all highlighted multicast streams in the streams list. If a mix of multicast and non-multicast streams are highlighted, a join or leave applies only to the multicast streams.



Set up a Multicast Group

You can set up one port as a transmitter for multicast streams, and one or more ports as receivers of multicast traffic.



1 Use the same steps already described to set up the addresses for the transmitting stream and the receiving streams. (See *"Set up Multicast Streams on SmartBits 200/2000 SmartCards" on page 116*.)

2 Set up the individual streams. (See *"Configure the Individual Streams" on page 117*.)

- **a** Configure one port as a transmitter.
- **b** Configure the receiving ports. For each port, use the same multicast destination IP address that was used for the transmitting port.

3 On the transmitting port, click the **Start** control to start the port transmitting.

4 Use the IGMP options to select the version and to perform joins for all ports. (See *"Select IGMP Version and Actions" on page 117*.)

Set up IGMP for SmartBits 600x/6000x Modules

To set up multicast streams on newer modules for the SmartBits 600x or 6000x, use the *IGMP Management* window. This window enables you to view all IGMP information and control all reserved ports while working in one window. It provides detailed statistics and event log information.

Note: The setup method for SmartBits 200/2000 modules is different. See *"Set up Multicast Streams on SmartBits 200/2000 SmartCards" on page 116*.

To set up multicast streams on the WN-3441A, WN-3442A, or WN-3445A, see *"Set up IGMP Streams on WAN Cards" on page 514*.

The *IGMP Management* window is used for IGMP setup on the following modules.

Table 5-3. SmartBits Module Support: IGMP Management Window for Ethernet

Ethernet	Description	Groups per Port	Comments
LAN-3101A/B	10/100Base-T Ethernet, 6-port, SmartMetrics	1024	LAN-31xxA family
LAN-3102A	10/100Base-T Ethernet, 2-port, SmartMetrics		
LAN-3111A/As	100Base-FX Ethernet, 6-port, multi-mode/ single mode, 1300/1310nm, SmartMetrics		
LAN-3201B/C	1000Base-X Ethernet, GBIC, 1-port, SmartMetrics		LAN-3201 family
LAN-3300A	10/100/1000Base-T Ethernet, Copper, 2-port, SmartMetrics	20,000 [512]	TeraMetrics-based modules: **IGMPv3:** Must have firmware 3.50 or later; 20,000 groups per port maximum. **IGMPv1/v2:** With firmware 3.50 or later, 20,000 groups per port maximum. With earlier firmware, 512 groups per port maximum.
LAN-3301A	10/100/1000Base-T Ethernet, Copper, 2-port, TeraMetrics		
LAN-3302A	10/100Base-TX Ethernet, Copper, 2-port, TeraMetrics		
LAN-3310A	1000Base-X Ethernet, GBIC, 2-port, SmartMetrics		

Table 5-3. SmartBits Module Support: IGMP Management Window for Ethernet (continued)

Ethernet	Description	Groups per Port	Comments
LAN-3311A	1000Base-X Ethernet, GBIC, 2-port, TeraMetrics		
LAN-332*x*A	Dual Media SmartMetrics and TeraMetrics		
XLW-372xA	10GBase Ethernet XENPAK MSA, 1-port, 2-slot, SmartMetrics and TeraMetrics		
XFP-373xA	10GBase Ethernet XFP MSA, 1-port, 1-slot, SmartMetrics and TeraMetrics		

Table 5-4. SmartBits Module Support: IGMP Management Window for POS

POS	Description	Groups per Port	Comments
POS-3504As/AR	POS OC-48c (STM-16c), 1-port, 1310/1550nm, SmartMetrics	20,000 [512]	TeraMetrics-based modules: **IGMPv3:** Must have firmware 4.00 or later; 20,000 groups per port maximum. **IGMPv1/v2:** With firmware 4.00 or later, 20,000 groups per port maximum. With earlier firmware, 512 groups per port maximum.
POS-3505As/AR	POS OC-48c (STM-16c), 1-port, 1300/1550nm, TeraMetrics		
POS-3510A/As	POS OC-3c/Oc-12c (STM-1c/STM-4c), 2-port, multi-mode/single mode, 1300nm/1310nm, SmartMetrics		
POS-3511A/As	POS OC-3c/Oc-12c (STM-1c/STM-4c), 2-port, multi-mode/single mode, 1300nm/1310, TeraMetrics		
POS-3518As/AR	POS OC-192c (STM-64c), 1-port, 2-slot, single mode, 1310nm/1550nm, SmartMetrics		
POS-3519As/AR	POS OC-192c (STM-64c), 1-port, 2-slot, single mode, 1310nm/1550nm, TeraMetrics		

To set up IGMP tests on SmartBits 600x/6000x modules:

Use the following groups of steps to set up IGMP on the SmartBits 600x/6000x modules listed in *Table 5-3*:

- *"Specifying the Layer 3 Addresses" on page 122*
- *"Set up Multicast Groups" on page 126*

Specifying the Layer 3 Addresses

Assign the Layer 3 IP addresses.

1. Open the port menu and select **Port Setup**.
2. Open the **Address** tab *(Figure 5-2)*.
3. Specify the **MAC Address** and **IP Address** to be used in streams, as well as the default **Gateway** and subnet mask (**Netmask**), if necessary.

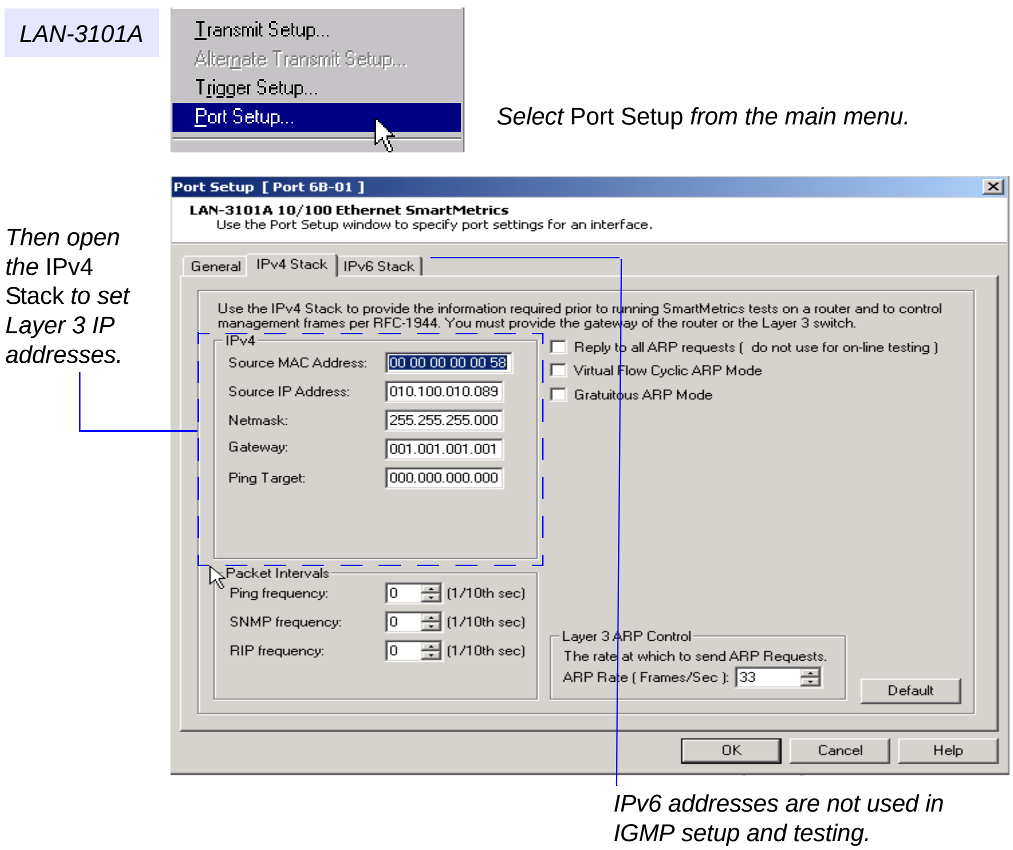


Figure 5-2. Setting Layer 3 Addresses (Example for LAN-3101A)

Optional: Configure One or More Streams

IGMP counters for joins, leaves, and transmitted frames appear in the *SmartCounters* window even when no streams are set up on either port.

You can view counters for Rx frames as well, when a stream is added on each port. Perform the following steps for each port:

1. Select **SmartMetric Mode** from the port menu.
2. Set up one stream.
   a. Select **Transmit Setup** to open the *Streams Setup* window.
   b. Click the **Add** button.
   c. Click **OK** to accept the default values presented by the *Add Streams* dialog box. (A multicast address or any particular stream characteristics do not need to be set.)
3. Click **OK** to close the *Streams Setup* window, or press **Enter** and the window closes automatically.

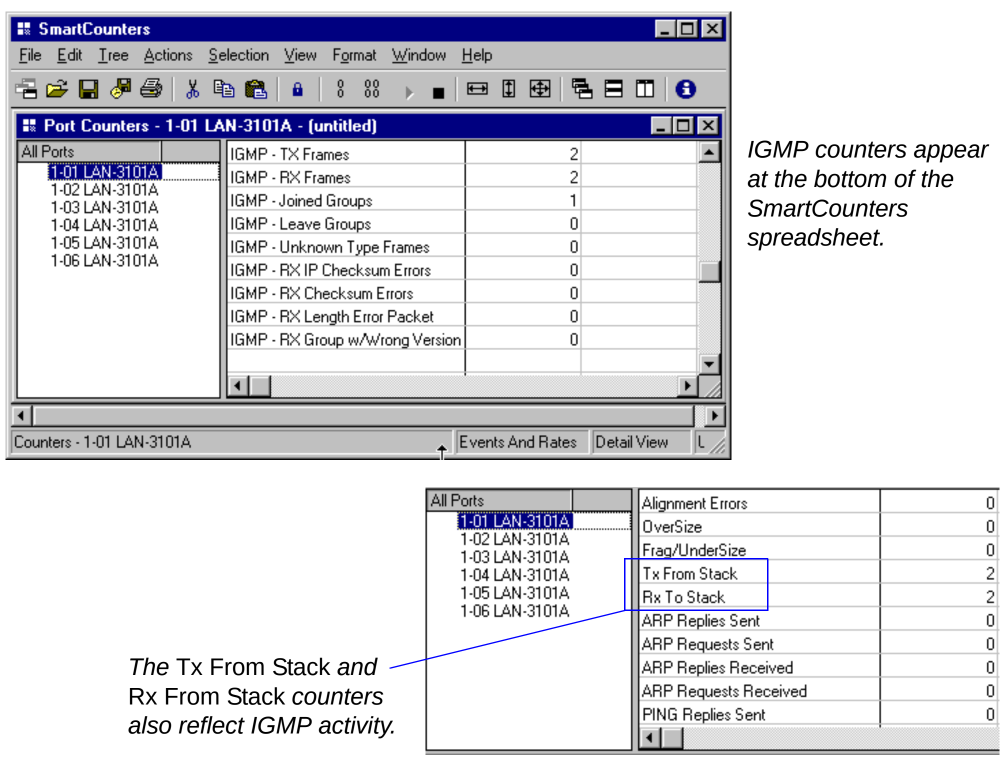


Figure 5-3. IGMP Counters in SmartCounters

Configure Groups and Port Settings

1 Click the port button of any reserved module and select **IGMP Setup**.
The *IGMP Management* window opens.

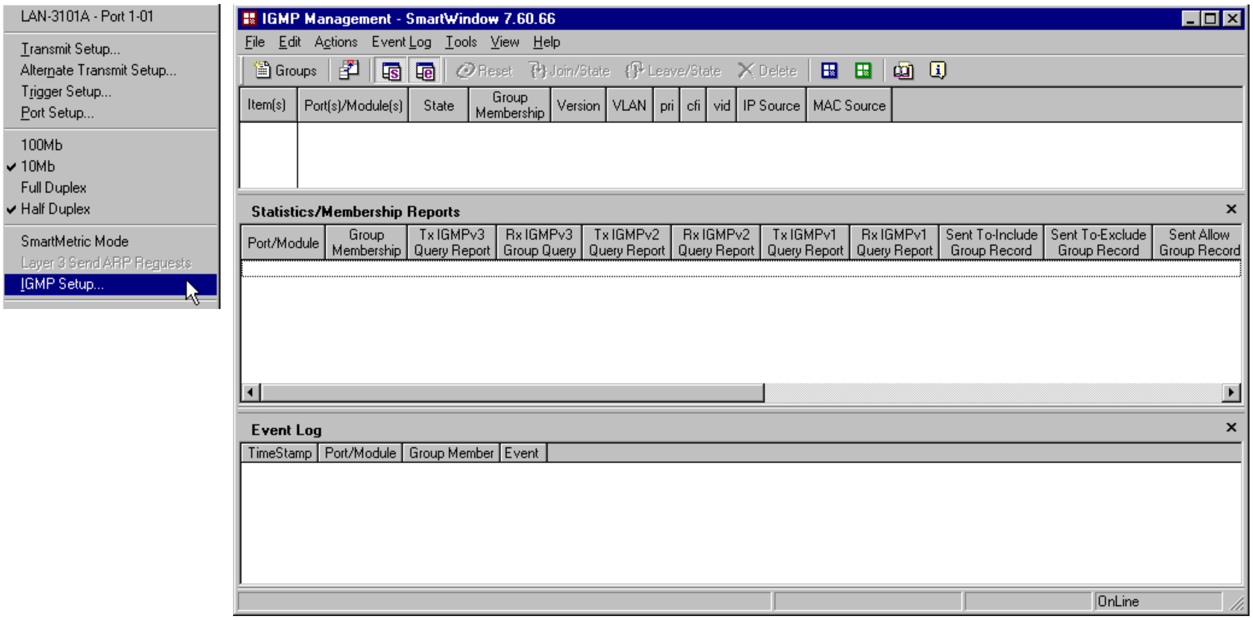


Figure 5-4. IGMP Management Window – SmartBits 600x/60000x Modules

2 Click the **Groups** button to open the *Group Membership Setup* dialog box (*Figure 5-5 on page 125*).

The *Available Ports* list includes all ports on all modules that have been reserved.

3 To set up IGMP group membership on any port:

a Select the port.

b Use the entry fields to set the desired values for *IGMP Version* and *Group Count*.

c Click **Apply** to add the new values for the selected port.

4 Select each available port (in turn) to specify the IGMP settings for that port.

The default values specify *IGMP Version* **3**. On fast Ethernet modules, up to 1,023 groups per port can be added. (See *Table 5-1, "SmartBits Cards and Modules Supporting IGMP," on page 112*.) On TeraMetrics modules, up to 20,000 groups can be added.

When IGMP Version 3 is selected (the default), additional options are available. These include *Robustness Variable, Report Interval,* and *Record Suppression.*

Important: Be sure to click **Apply** for each port to add the new values. Clicking **OK** closes the window but does not save your settings.

5 When finished, click **OK** to close the *Group Membership Setup* dialog box.

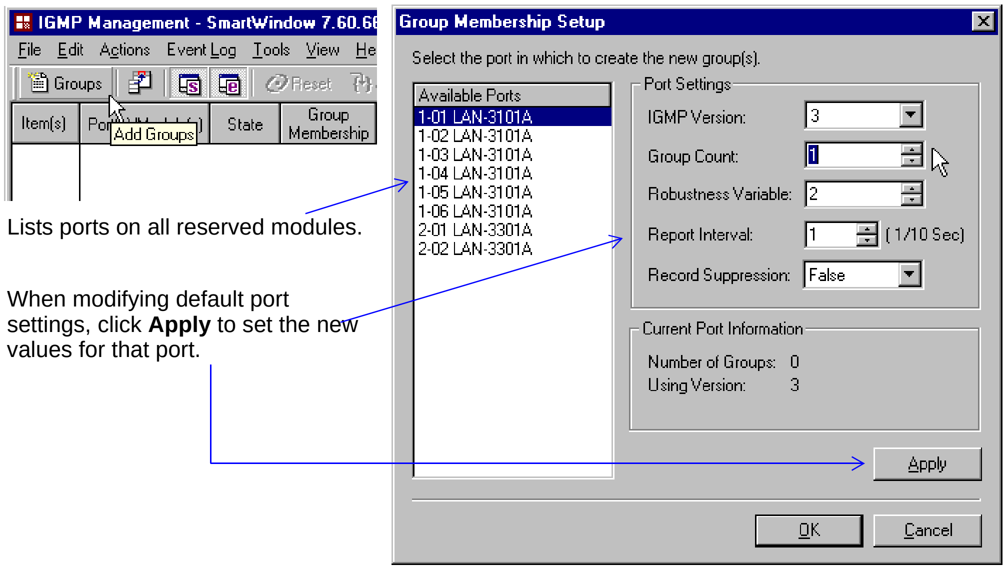


Figure 5-5. IGMP Management: Group Membership Setup

Current port information

These fields show the port IGMP setup in the current (saved) configuration. Field values do not update dynamically when values in the *Port Settings* pane are modified. Rather, these fields show your "starting point" when making new or additional changes.

When the *Group Membership Setup* window is opened, the *IGMP Management* window lists the groups that have been defined for all ports. Use this window to manage multicast groups.

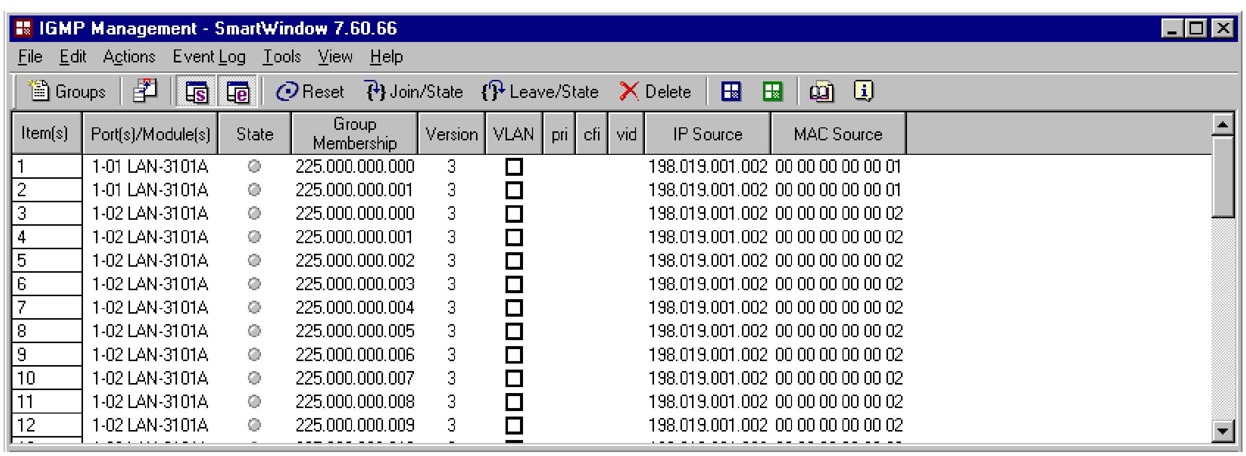
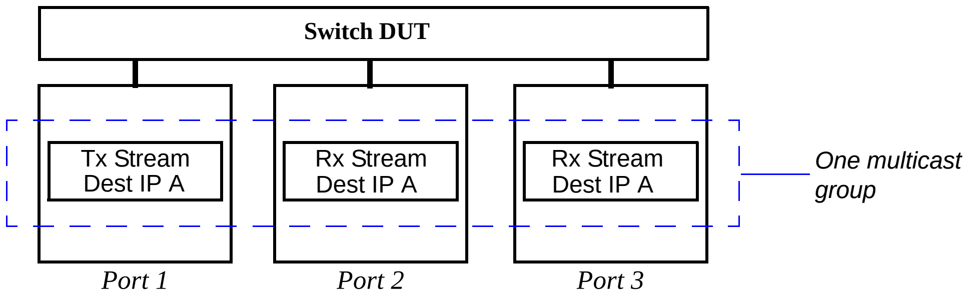


Figure 5-6. IGMP Management: Group Membership List

Set up Multicast Groups

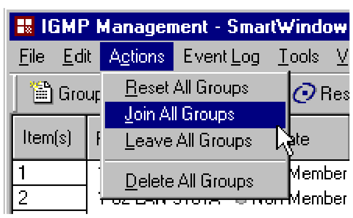
Set up one port as a transmitter for multicast streams, and one or more ports as receivers of multicast traffic. The *Group Membership* field represents the destination IP address. A typical test scenario involves one transmitting port (host) and one or more receiving ports (receivers). For all ports in a group, the *Group Membership* address should be identical.



Perform Joins and Leaves

Perform joins and leaves, as well as reset the IGMP stack, in two ways:

- Select from the *Actions* options on the menu.
- Use the toolbar buttons.



Actions menu options

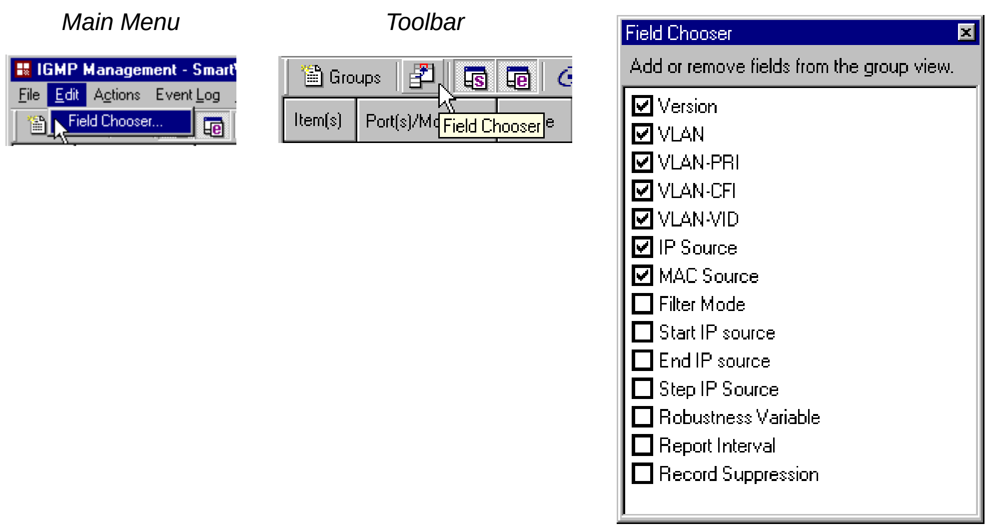
Toolbar options

Additional Window Options

The *IGMP Management* window includes a number of menu options and toolbar shortcuts, as well as quick access to the SmartCounters and SmartMetrics Tests windows.

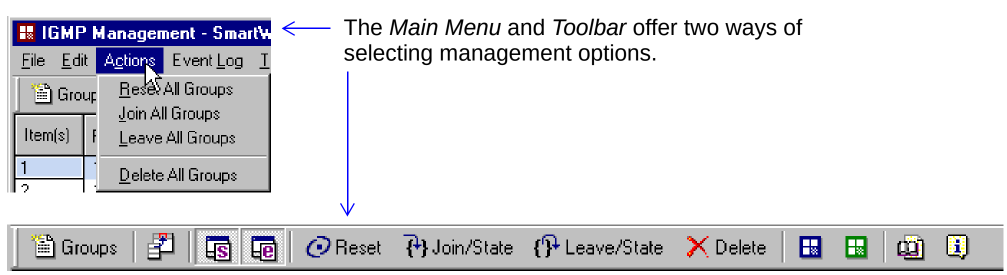
Field Chooser

Use the *Field Chooser* to select which fields will appear in the list.



Menu and toolbar options

The menu and toolbar in the *IGMP Management* window provide alternate ways of selecting and using all available options. Toolbar selections are labeled or self-identify when the cursor is placed over a button.



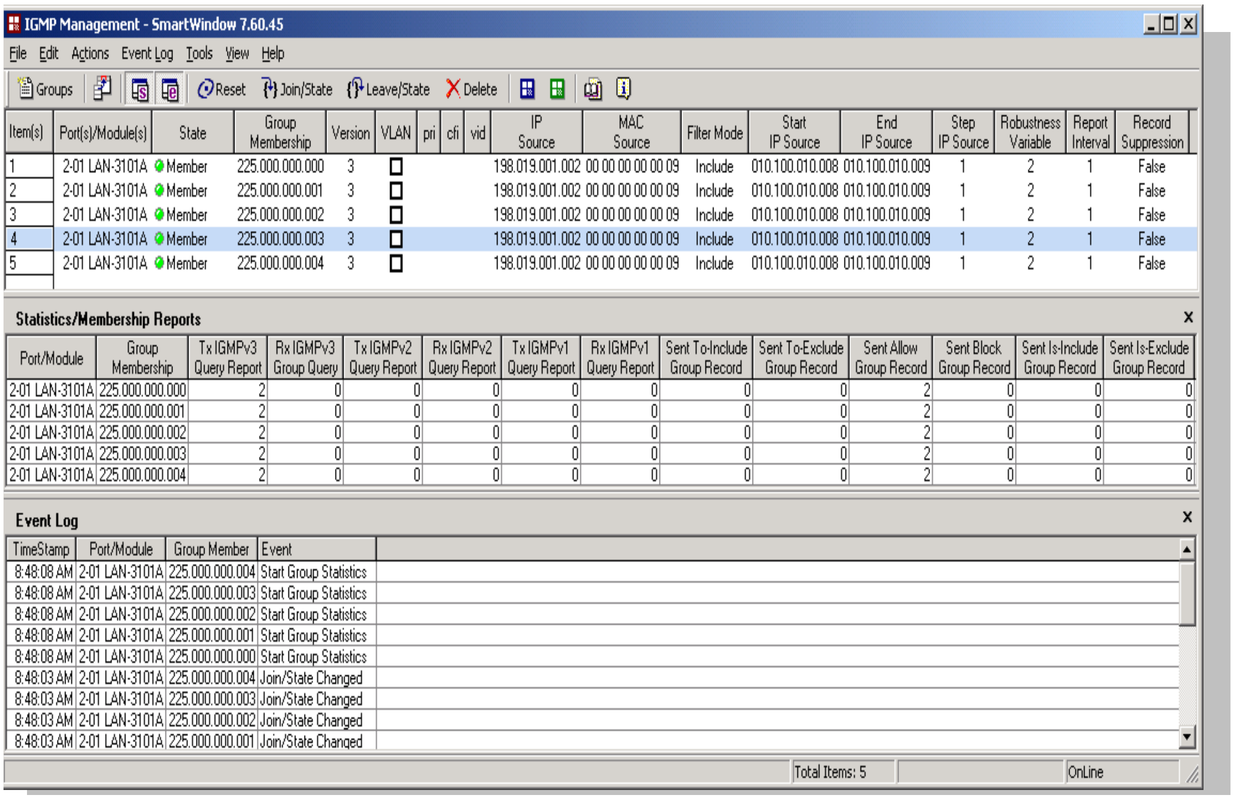
These options enable you to:

- Show or hide the *Statistics/Membership Reports* and *Event Log* panels.
- Clear, copy, or print *Event Log* information.
- Perform IGMP actions (e.g., joins and leaves; reset the internal IGMP stack).
- Delete groups.
- Open the *SmartCounters* or *SmartMetrics Test* window.

Statistics/Membership Reports and Event Log

These two panels in the *IGMP Management* window provide detailed statistics and membership reports for all ports and an event log of all actions.

Hide or display both panels by using menu or toolbar options. (See *"Menu and toolbar options" on page 127*.)



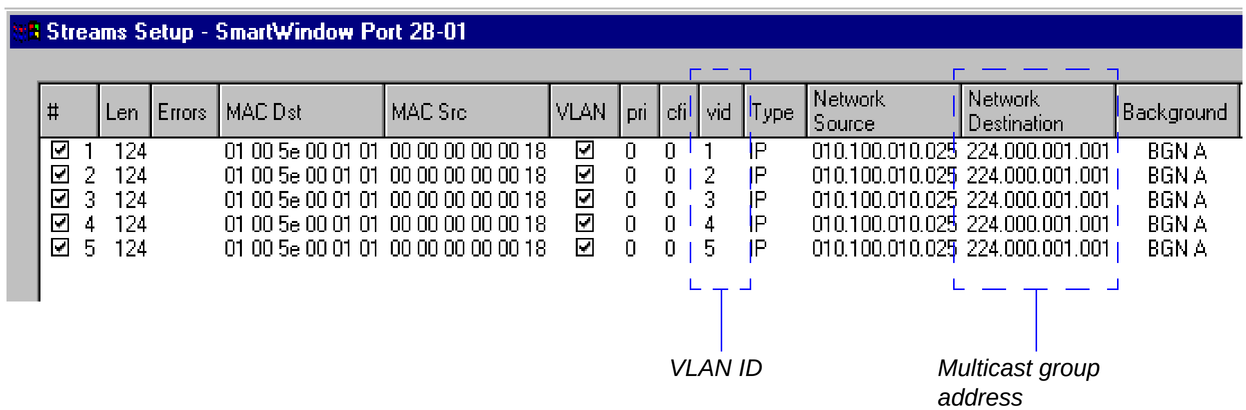
Multicast Groups and VLANs

With most SmartBits cards, you can set up multicast streams that also belong to a VLAN. In addition, use the same SmartBits port to generate streams that have varying multicast group membership and/or VLAN membership. Here are two examples.

Same multicast group, different VLAN IDs

A SmartBits port can send multicast streams that belong to the same multicast group but have different VLAN IDs.

For example, in *Figure 5-7*, port 2B-01 sends five streams. All have the same multicast group address (i.e., destination IP address: 224.0.1.1), but each has a different VLAN ID.

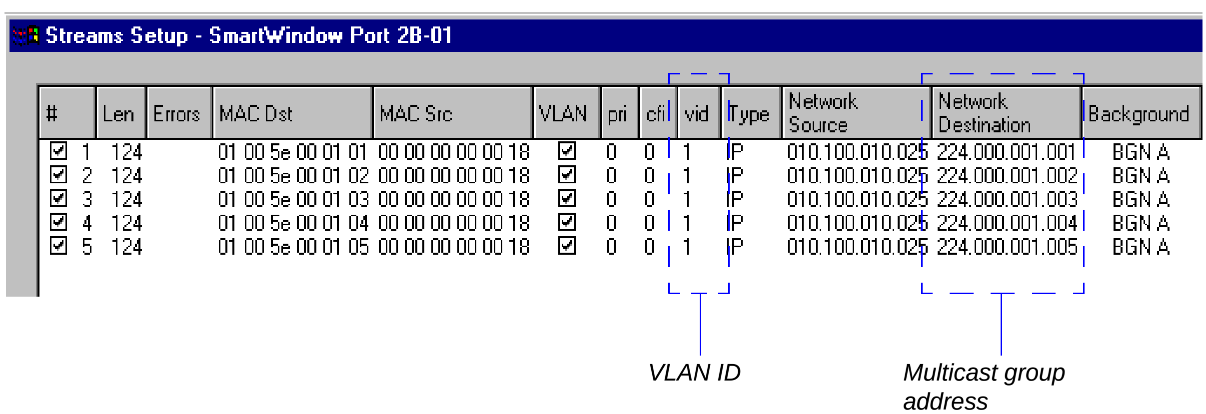


#	Len	Errors	MAC Dst	MAC Src	VLAN	pri	cfi	vid	Type	Network Source	Network Destination	Background
☑ 1	124		01 00 5e 00 01 01	00 00 00 00 00 18	☑	0	0	1	IP	010.100.010.025	224.000.001.001	BGN A
☑ 2	124		01 00 5e 00 01 01	00 00 00 00 00 18	☑	0	0	2	IP	010.100.010.025	224.000.001.001	BGN A
☑ 3	124		01 00 5e 00 01 01	00 00 00 00 00 18	☑	0	0	3	IP	010.100.010.025	224.000.001.001	BGN A
☑ 4	124		01 00 5e 00 01 01	00 00 00 00 00 18	☑	0	0	4	IP	010.100.010.025	224.000.001.001	BGN A
☑ 5	124		01 00 5e 00 01 01	00 00 00 00 00 18	☑	0	0	5	IP	010.100.010.025	224.000.001.001	BGN A

Figure 5-7. Example 1: Different VLANs, Same Multicast Group

Same VLAN ID, different multicast groups

A SmartBits port can send multicast streams that belong to different multicast groups but have the same VLAN ID. *Figure 5-8* shows an example.



#	Len	Errors	MAC Dst	MAC Src	VLAN	pri	cfi	vid	Type	Network Source	Network Destination	Background
☑ 1	124		01 00 5e 00 01 01	00 00 00 00 00 18	☑	0	0	1	IP	010.100.010.025	224.000.001.001	BGN A
☑ 2	124		01 00 5e 00 01 02	00 00 00 00 00 18	☑	0	0	1	IP	010.100.010.025	224.000.001.002	BGN A
☑ 3	124		01 00 5e 00 01 03	00 00 00 00 00 18	☑	0	0	1	IP	010.100.010.025	224.000.001.003	BGN A
☑ 4	124		01 00 5e 00 01 04	00 00 00 00 00 18	☑	0	0	1	IP	010.100.010.025	224.000.001.004	BGN A
☑ 5	124		01 00 5e 00 01 05	00 00 00 00 00 18	☑	0	0	1	IP	010.100.010.025	224.000.001.005	BGN A

Figure 5-8. Example 2: Same VLAN, Different Multicast Groups

VLAN Priority

The VLAN priority field (**pri**) is used to set one of eight VLAN priorities for each VLAN. These priorities are labelled 0 through 8 and are counted and displayed by priority in the SmartCounters window. This function provides the capability to analyze counts for each VLAN by VLAN priority. The default priority value is zero.

The following modules have this capability.

- LAN-3306A
- LAN-332xA
- XLW-372xA
- XFP-373xA

Review *"VLAN Priority Counters"* in *Chapter 8, "Testing Gigabit Routers,"* for a description of how these counters are displayed in the SmartCounters window. Review the Help text for more information on configuring and using VLANs as well as VLAN stacking (QnQ) TX side support features.

SmartCounters

SmartWindow has two types of SmartCounters with spreadsheet capabilities. Each of these counters is available on one set of modules/cards with a specific hardware chassis. Refer to *Table 5-5* for a listing of these combinations and the associated counter title.

Table 5-5. Counter Title

Card/Module	Chassis	Counter Title
AT-9xxx, GX-1xxx, ML-xxxx, ST-6410, SX-7xxx, and WN-34xx	SmartBits 200/2000	SmartCounters
FBC-360xA, LAN-3xxxA, POS-3xxxA, XLW-372xA, and XFP-373xA	SmartBits 600x/6000x	SmartCounters

This section describes the SmartCounters for cards used on the SmartBits 200/2000 chassis. SmartCounters for modules that use the SmartBits 600x/6000x chassis are primarily described in *Chapter 8, "Testing Gigabit Routers."* Other explanations of SmartCounters are given throughout the SmartWindow User Guide and online Help. In such cases, each description is footnoted with the correct reference to the module and chassis.

The SmartCounters feature used for the SmartBits 200/2000 chassis counts the cumulative number of transmit frames and calculates the transmit frame rate. SmartBits 600x/6000x uses a different method in calculating the number of frames.

The SmartBits 600x/6000x counters record the number of frames transmitted in the previous second. The counter is updated once (and only once) per second. It is not cumulative and reports the number of frames transmitted in the previous second. If the counter is polled 50 times a second, the same figure appears 50 times, until the hardware updates the counter with the number of frames transmitted in the previous second (which is reported another 50 times until it is updated again).

SmartCounters for SmartBits 200/2000 Cards

The SmartCounters window offers features available in many traditional spreadsheets. The SmartCounters window displays two statistics for each port:

- **Events** – The number of occurrences of an action, such as transmitting or receiving a frame, since the last time that counter was reset or cleared.
- **Rates** – The number of events per second at which the events happen.

SmartCounters Features

SmartCounters enables you to view events and rates for each installed card from one window. For some cards, it also presents sub-groups of counters, which reflect different protocols or functions. For these, the standard expansion (+) button lets you open and close branches in the navigation tree.

See *Figure 5-9* for an example of the *SmartCounters* window.

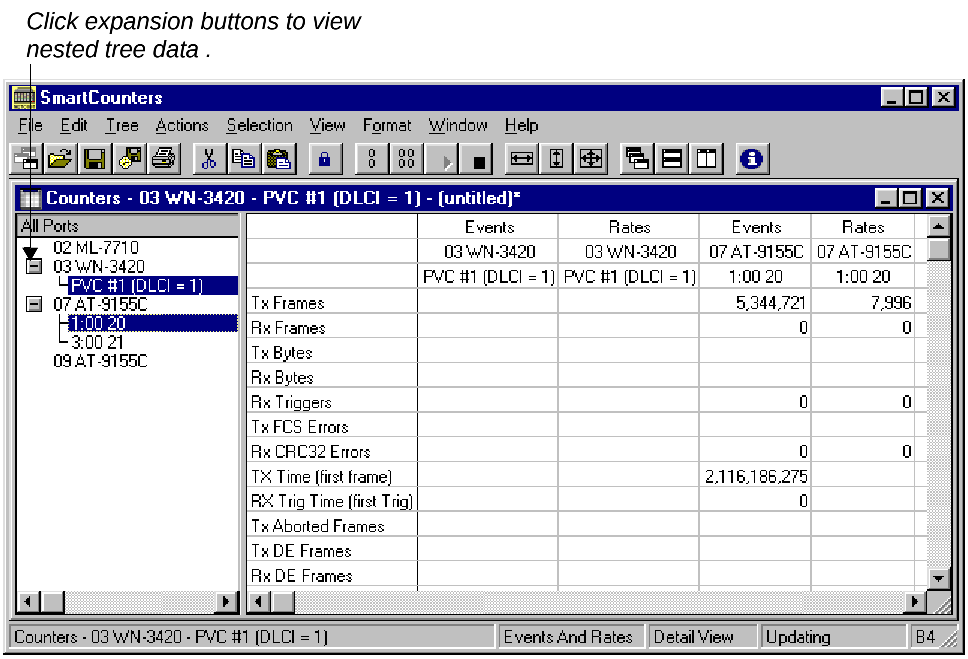


Figure 5-9. SmartCounter Window

Notes:

- If data is saved for more than 68 ports, the SmartCounters window displays an error when opened. However, SmartCounters will save the file, and it can be opened in Excel.
- The WN-3445A can require additional time to clear counters and display new counts. (Allow from 10 to 15 seconds.)

Display selected counters

Only the counters for a selected card can be displayed. Highlight the card in the navigation tree. The display window shows only the counters for that card. (See *Figure 5-10 on page 133* for an an example of this operation.)

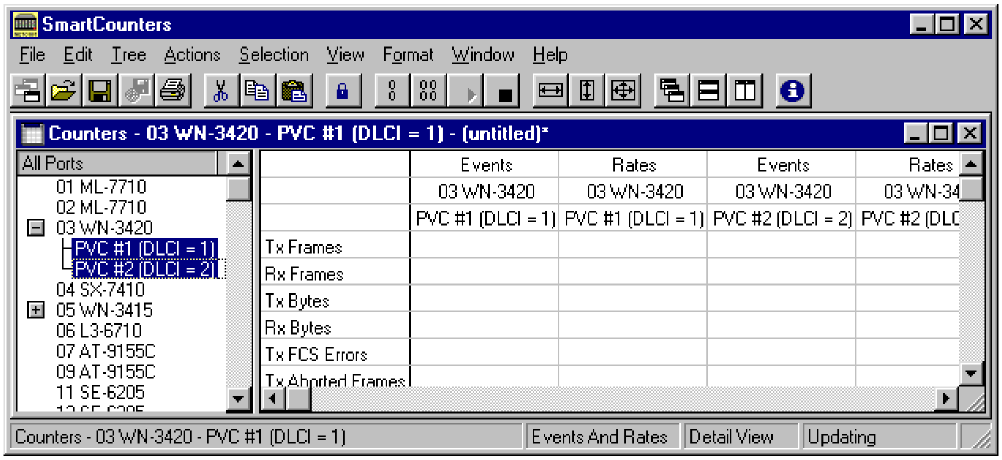


Figure 5-10. SmartCounters Window with Navigation Tree

Spreadsheet capabilities

The SmartCounters window provides many common spreadsheet functions:

- Embed a calculation on a count.
  Simply type the calculation in the cell.

Important: See *"Saving a SmartCounters Calculation" on page 133* for important guidelines on using and saving calculations in a SmartCounters window.

- Modify the spreadsheet format, such as the font or column width with the *Format* menu options.

Saving, restoring, and printing counter data

- Use menu and toolbar options to save and print the counter information.
- Use timed save feature to save data to a file at selected intervals. (See *"Using Timed Save with Counters" on page 136* for information on how to use this option.)
- Restore selected counters from a saved file for comparison.

Saving a SmartCounters Calculation

To save a calculation in the SmartCounters window, be sure to save the counters to a file before closing the window, exiting SmartWindow, or disconnecting from the SmartBits chassis. When the saved file is reopened, the formula is retained.

Be careful to place your calculation to the side of the displayed counters, not below them. The area below the displayed counters generally is reserved by SmartWindow for use with other counters, e.g., when other card types are added to the window.

In most cases, if the number of displayed columns increases, SmartWindow moves your calculation automatically, provided it is placed to the right of the current counters. To be safe, if you expect to change the number of displayed cards or the types of counters displayed, place the calculation far enough to the right to avoid possible conflict. (See *Figure 5-11* for an example.)

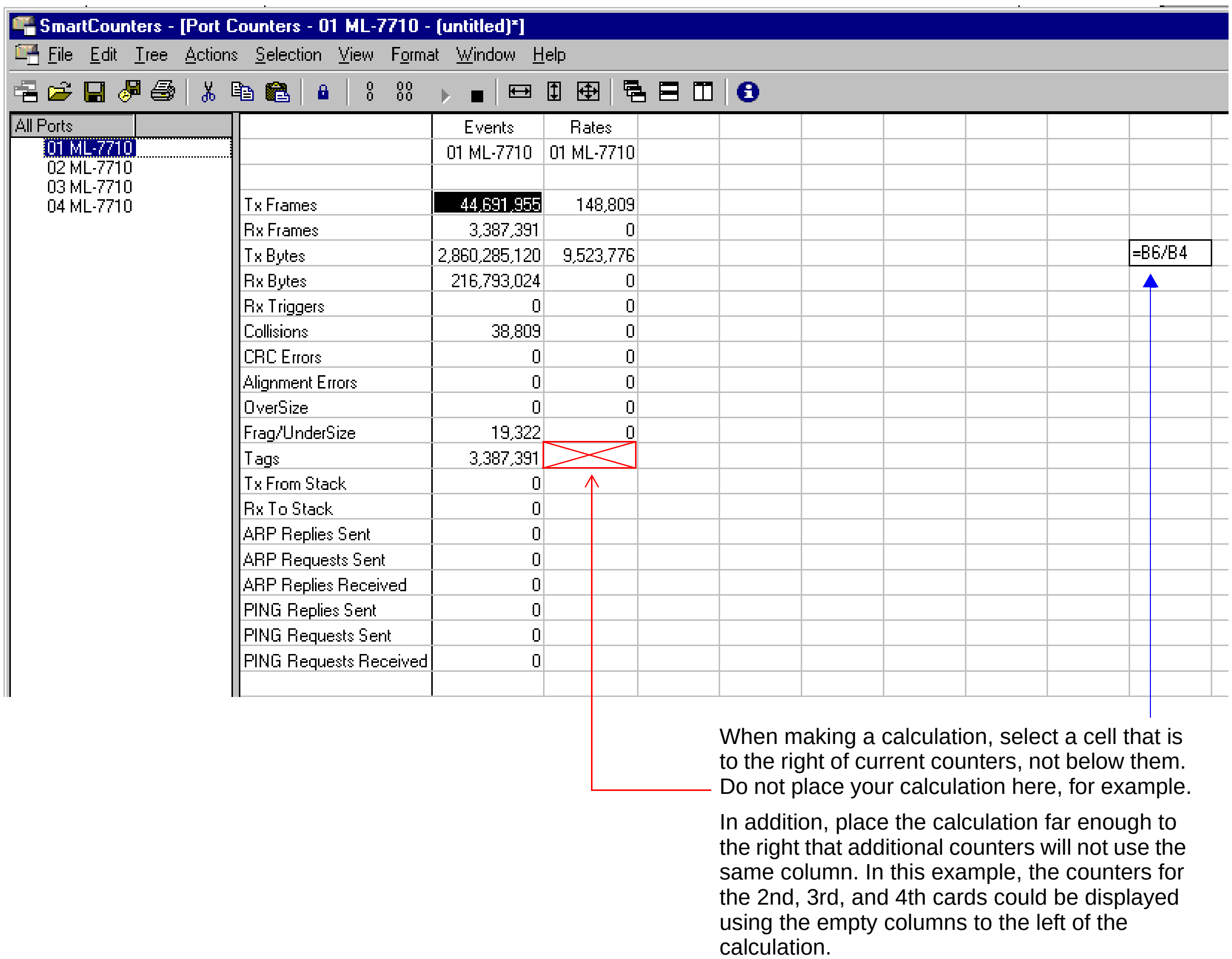


Figure 5-11. Choosing Where to Place a Calculation in the SmartCounters Window

Setting up the SmartCounters Window

To set up the SmartCounters window:

1 Ensure that you are connected to the SmartBits chassis and that all of the cards are started.

2 To access the SmartCounters window, choose **Actions** > **SmartCounters** from the SmartWindow main menu.

3 From the SmartCounters window, choose **File** > **New Counter Window** to display a new window listing all ports.

To display an existing file, choose **File** > **Open**.

4 Use the toolbar or menu bar options to specify formatting or window elements. (See *"SmartCounters Toolbar" on page 136*.)

5 Highlight the port(s) for which you want to see counters. To highlight more than one port, hold down the **Ctrl** key and click the port(s). To highlight all ports, click the first port. While holding down the **Shift** key, click the last port.

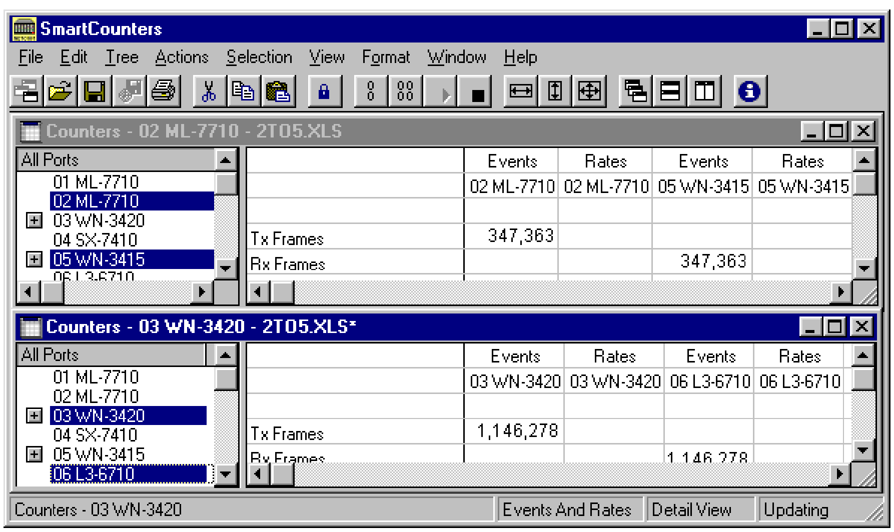
Tiling SmartCounters

If the counters for ports 2 and 5 are saved from one test and counters for ports 3 and 6 are saved from another test, you can view both counters simultaneously in the SmartCounters window.

To tile SmartCounters:

1 To reopen both files side by side for comparison, select **File** > **Open** from the menu bar to open both files.

2 Then select **Window** > **Tile Vertical** to place the files on top of each other in the window.



Note: If a calculation is placed in a cell and then the displayed port counters are changed, **#REF!** appears in the cell. This message occurs because the column that the calculation is referencing is no longer being displayed.

SmartCounters Features

The SmartCounters menus provide full standardized Windows menu functionality. See *Table 5-6 on page 136* for detailed information on the menu items.

Table 5-6. Features of SmartCounters

Menu Item	Description
File	Open a new SmartCounters window or open an existing counters file, save the current window, or print the current counters file.
Edit	Manipulate highlighted information, e.g., copy and paste to another window. Clear highlighted areas of window (such as a counter or entire line) or remove formatting that has been set.
Tree	Expand or contract any nodes of a SmartCard, such as a WAN card with multiple streams.
Actions	Clear a counter (which stops updating all counters).
Selection	Select the SmartCards for which to count.
View	Specify what elements of the spreadsheet will appear, such as column headings, toolbar, and events only. Specify the mouse/keyboard actions allowed to edit.
Window	Specify how the multiple files will be displayed in the window.
Help	Identify the SmartCounter module.

Using Timed Save with Counters

Set up SmartCounters to automatically save counter statistics at specified time intervals. To enable this option, click the **Timed Save** button on the SmartCounters toolbar.

Use the *Frequency* field to specify how often counter results should be written to a file. The *File Prefix* field (four letters) defines a common prefix for all the results files. SmartWindow adds another four digits to number the files sequentially. For example, if the *File Prefix* is set to **ETHE**, the output files will be named **ETHE0001**, **ETHE0002**, etc. Files are saved to the SmartWindow folder.

SmartCounters Toolbar

The SmartCounters window displays a toolbar if the **Toolbar** checkbox is selected in the **View** menu. (See *Figure 5-12 on page 137*.)

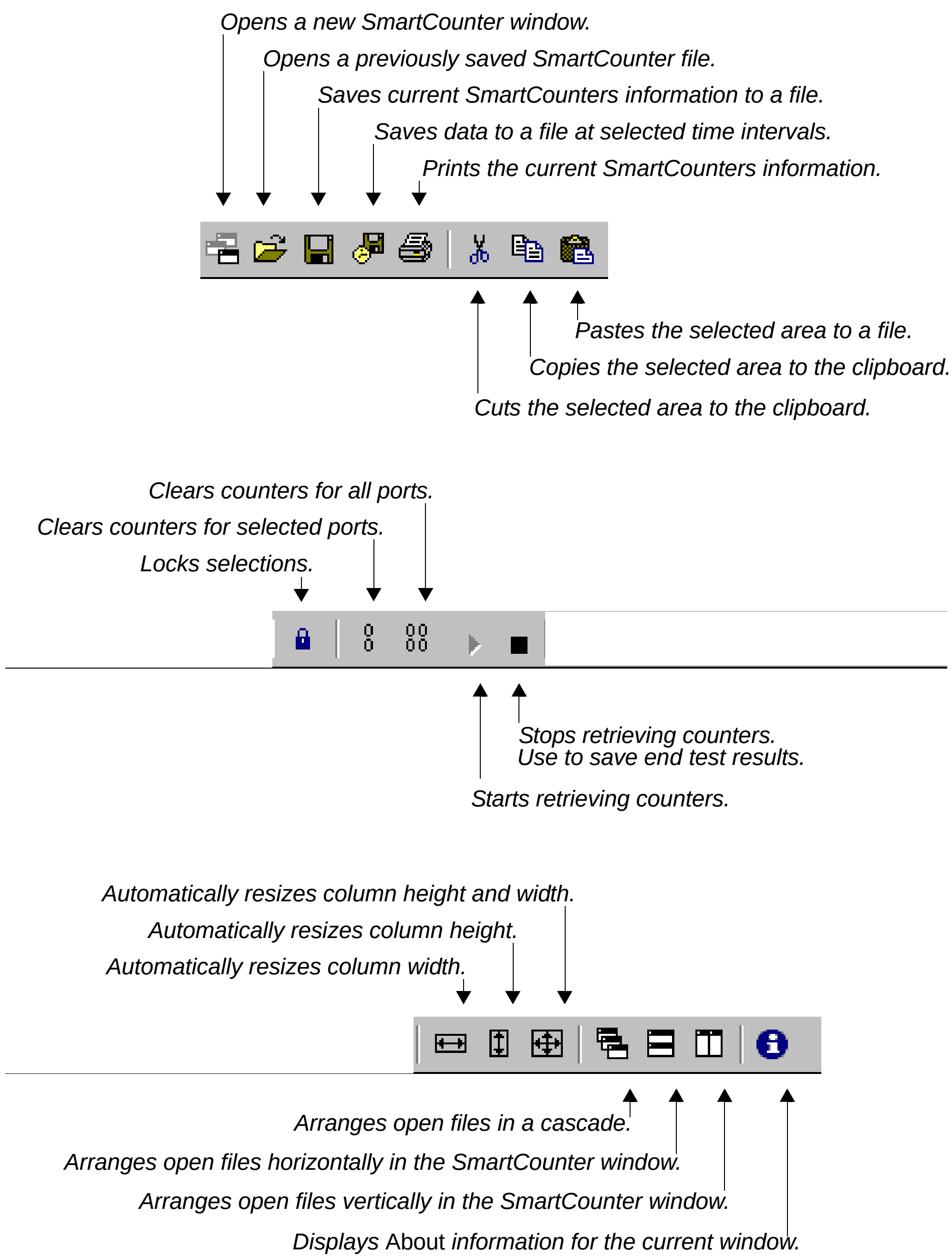


Figure 5-12. SmartCounters Toolbar

Other SmartBits 200/2000 Counters

SmartWindow includes other counters for specific uses. Each card has its own type of counter for displaying test results.

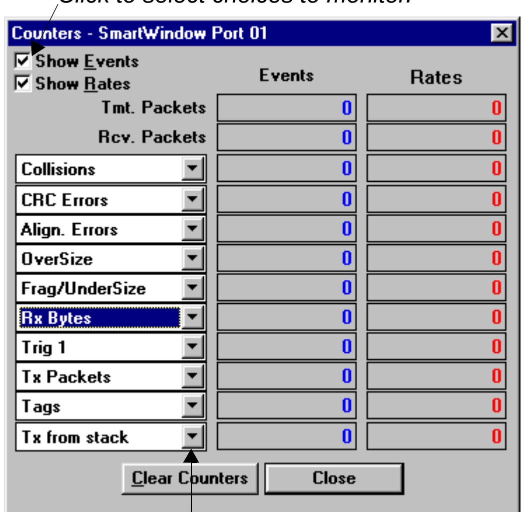
Port Counters for Ethernet SmartCards

The Ethernet SmartCards support nine counters, as shown below.

To view a counter for a specified port:

1 Click the port button and select **Display Counters**.
The *SmartCounters* window opens, with port counters displayed.

Click to select choices to monitor.



Use drop-down lists to change parameters.

2 Select the parameters to be displayed. Checkboxes at the top of the window control whether events, rates, or both events and rates are displayed.
Events. The number of occurrences of a certain type since last reset or clear.
Rates. The number of events per second.

Note: For the ML-7710 SmartCard only, the transmit packet event counter does not increment when management frames are transmitted.

3 Use the drop-down lists to select other parameters, such as collisions and CRC errors. (See *Table 5-7 on page 139* and *Table 5-8 on page 139* for descriptions of these parameters.)

Table 5-7. Packet Counters

Counter	Events	Rates
Tmt. Packets	The cumulative number of packets successfully transmitted from the referenced port. Retries (unsuccessful attempts to transmit owing to collisions) are not included in the number of packets transmitted.	The number of transmitted packets per second.
Rcv. Packets	The cumulative number of packets of legal size (between 64 and 1,518 bytes) with no errors received at the referenced port.	The cumulative number of packets of legal size (between 64 and 1,518 bytes) with no errors received at the referenced port.

Table 5-8. Counter Descriptions

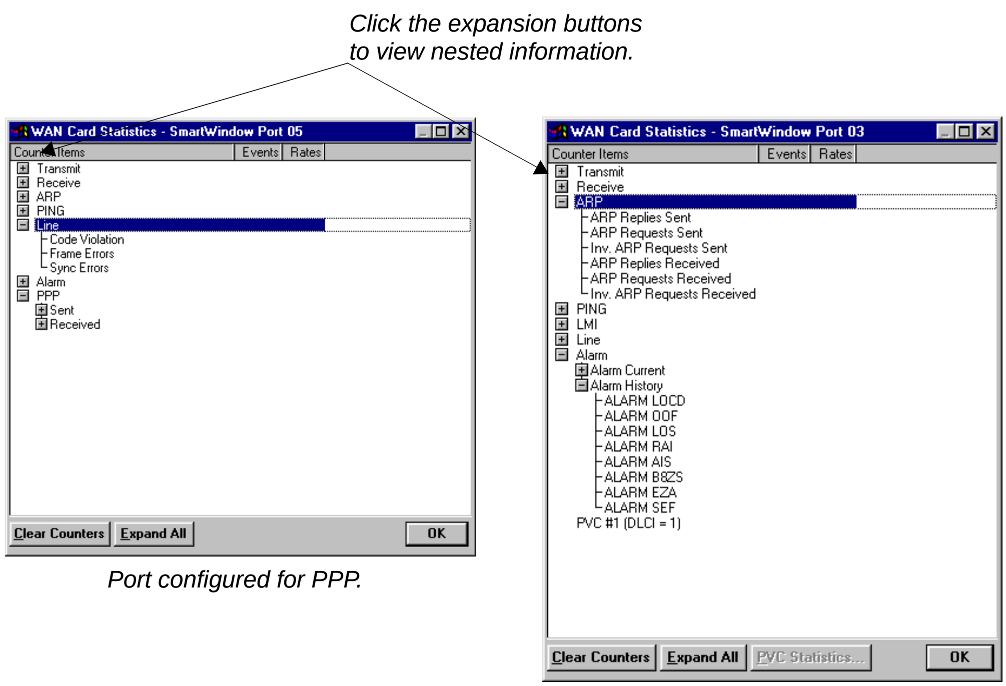
Counter	Description
Collisions	The collisions event counter indicates the cumulative number of collisions that have occurred on the transmitting port of the SmartCard/module. The collisions rate counter displays the number of collisions per second.
CRC Errors Counter	The CRC error event counter indicates the cumulative number of CRC errors that have occurred on the receiving port of the SmartCard/module. The CRC errors rate counter displays the number of CRC errors received per second. The CRC error event counter counts the number of packets received with a bad CRC of a length (excluding preamble bits but including CRC bytes) between 64 and 1,518 bytes, inclusive. Bad CRCs are not checked in packets greater than 2,033 bytes. In addition, receive bytes do not reflect the total number of bytes in the original packet.

Table 5-8. Counter Descriptions (continued)

Counter	Description
Alignment Errors	The alignment errors event counter indicates the cumulative number of alignment errors that have occurred on the receiving port. The alignment errors rate counter displays the number of alignment errors detected per second. An alignment error is a packet that does not end on the octet boundary (regardless of CRC). Alignment errors are not checked in packets greater than 2,033 bytes. In addition, receive bytes do not reflect the total number of bytes in the original packet.
OverSize Packets	The oversize packets event counter indicates the cumulative number of oversize frames (greater than 1,518 octets) that have arrived on the receiving port. The oversize packets rate counter displays the number of oversize packets received per second.
Fragments/ Under Size	The fragments/under size packets event counter indicates the cumulative number of undersize frames (less than 64 bytes) that have arrived on the receiving port. The fragments/under size packets rate counter displays events per second. When collisions occur, fragments are generated and are counted by the port receiving the fragments.
Byte	The byte counter indicates the cumulative number of data bytes that have been received. The byte rate counter counts the number of data bytes processed per second. CRC bytes are included in the count as well as bytes in frame fragments.

WAN Port Statistics

The display of the WAN port statistics window varies depending on whether the port is configured for frame relay or PPP. The counters behave in a similar manner to the Ethernet counters. In addition, you can use the expansion buttons to view nested information for a given parameter.

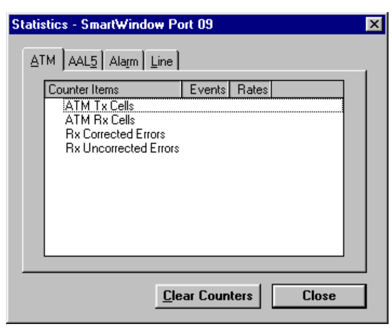


Port configured for PPP.

Port configured for Frame Relay.

ATM Port Statistics

ATM port statistics provide information on packet throughput, alarm notifications, and line errors. The counters behave in a similar manner to the Ethernet counters.



Counter Clearing and Window Control

The **Clear Counters** command on SmartCard menus resets all counters to zero, including the display field in SmartWindow.

The **Close** button closes the counter window. Even when a counter window is not open, the SmartCard is still counting all packet events.

Group Counters

Group counters are supported in SmartWindow versions before version 7.20. They are now obsolete and replaced by SmartCounters. (See *"SmartCounters" on page 131*.)

Smartbit.ini Files

The `smartbit.ini` files contains important settings that can help optimize SmartWindow performance (*Table 5-9*). In addition, certain SmartWindow features become available only when the appropriate entry is made into the `smartbit.ini` file.

Refer to the SmartWindow online Help for contextual settings.

There are two `smartbit.ini` files, one for each chassis series.

File Name	Description
`smartbit.ini`	Settings for SmartBits 200/2000 chassis and cards.
`smartbit.ini6k`	Settings for SmartBits 600x/6000x chassis and modules.

To open the `smartbit.ini file`:

1 Click the **Start** button on the Windows taskbar.

2 Choose **Run**.

3 Type `smartbit.ini` or `smartbit.ini6k` in the **Open** entry field, and click **OK**.

You can also locate the file in Windows Explorer and open it as any text file is opened. Both files are located in the Windows directory.

Table 5-9. SmartBit.ini File: Important Commands and Settings

Section	Command	Setting	Description
[Preferences]	Allow MultiInstance	1	Allow multiple instances of SmartWindow to run.
		0	Disallow multiple instances of SmartWindow to run.
	Show SplashBitmap	1	Show splash screen at SmartWindow startup.
		0	Do not show splash screen at SmartWindow startup.
	Chassis Number	n	Use a number to identify a chassis during SmartMetrics tests.
	Allow L2 ARP Replies	1	Allow Layer 2 ARP feature in SmartWindow.
		0	Disallow Layer 2 ARP feature in SmartWindow.

Table 5-9. SmartBit.ini File: Important Commands and Settings (continued)

Section	Command	Setting	Description
[Preferences] *(continued)*	Startup Connect	1	Try to connect to a SmartBits at SmartWindow startup.
		0	Do not try to connect to a SmartBits at SmartWindow startup.
	L3 Signature Control	1	Display *Signature* field column with checkbox for ML-5710/A, ML-6705, ML-6710, and ML-7710 SmartMetrics VTE Setup windows.
		0	Do not display *Signature* field column with checkbox for ML-5710/A, ML-6705, ML-6710, and ML-7710 SmartMetrics VTE Setup windows.
	Initialize on connect	1	Update SmartBits as soon as it is connected.
		0	Do not update SmartBits as soon as it is connected.
	ML-7710 Can Echo	1	Allow ML-7710 to echo.
		0	Disallow ML-7710 to echo.
	ML-7710 Can IGMP	1	Allow IGMP feature for ML-7710.
		0	Disallow IGMP feature for ML-7710.
	ATM VPI/VCI Hex	1	Display ATM VPI/VCI in hex.
		0	Display ATM VPI/VCI in decimal.
	Admin	1	Allow admin main menu functions on SmartBits 200/2000 chassis.
		0	Do not allow admin main menu functions on SmartBits 200/2000 chassis.
[Layer 3 Tests]	Simultaneous Start	1	With SmartMetrics cards, start all Tx cards transmitting simultaneously.
		0	With SmartMetrics cards, start Tx cards transmitting one-by-one (default).

Table 5-9. SmartBit.ini File: Important Commands and Settings (continued)

Section	Command	Setting	Description
[Packet Over SONET]	CRC32	1	Default CRC to 32 bits for POS cards.
		0	Default CRC to 16 bits for POS cards.
	Scramble	1	Default Scramble on for POS cards.
		0	Default Scramble off for POS cards.
	Encapsulation Type	33	Default to PPP encapsulation for POS cards.
		37	Default to Cisco HDLC encapsulation for POS cards.
[WAN Card Settings]	WAN Can IGMP	1	Allow IGMP feature for WAN cards.
		0	Disallow IGMP feature for WAN cards.
	WAN Transmit Dlg Frame Distribution	1	On the WN-3415 and WN-3420, enables radio buttons in the *WAN Transmit Setup* dialog box that can be used to select one of two frame distribution modes: uniform or back-to-back.
		0	Disables the selection radio buttons.
[Serial Numbers]	Serial Number	Name String	Display name string in the SmartWindow title bar to identify the SmartBits that it is connected to.
[Recent Hosts]	MRUHost1	<Host IP Address>	Store up to 10 of the most recently connected SmartBits IP addresses.
[Protocol Editor]	Default IP Transport Protocol	5	Set the default IP protocol type to **5** (encapsulated IP packets). This prevents an empty column from appearing in the Counters window.

Using Triggers and Capture

A trigger is a packet-counting tool. It is inserted into test packets by the transmitting SmartBits card/module, then used by the receiving card to count specific packets out of all packets received. When a trigger pattern is defined, the receiving card counts all packets that contain the trigger pattern and ignores all packets that do not contain it.

The trigger pattern must be defined both on the transmitting card and in the *Trigger Setup* dialog box on the receiving card. One or two triggers on each receiving card can be tracked, either singly or in combination.

Notes:

- This set of procedures, screen displays, and example explain how to use triggers and capture for the SmartBits 200/2000 cards.
- Most of these processes are identical for the SmartBits 600x/6000x modules. Comments are included in those cases where there are differences between the operation and/or display of the two types of hardware.
- On the POS-35*xx*-series modules, the trigger must not be set in the first four bytes. (The minimum byte offset value is **4**.)

To view the resulting trigger count, you send test traffic, then choose **Actions > SmartCounters** and review the **Rx Triggers** counters.

To view details of each triggered packet:

- Choose **Options > SmartMetrics Tests**, select **Test Type > Raw Packets Tags**, and run the test. (Click the **Start, Stop**, and **Results** buttons.)
  —or—
- Click the receive SmartCard, choose **Capture**, select **Capture Packets with Rx Triggers**, and send traffic to be captured.

Setting triggers and displaying counters

Example: *Figure 5-13 on page 146* shows a simple test setup for cards that use a SmartBits 200/2000 chassis. Refer to *Figure 5-20 on page 158* for a screen display of the *Streams Setup* window that is used for SmartBits 600x/6000x modules.

The first stream of Port 6 has an IP destination address of `192.006.001.006`. This targets the first stream of Port 2, which has the same address as its IP source address, as well as the MAC source address `00:00:00:00:20:06`. The MAC source address is used in the trigger setup. In this case, no custom transmit setup is necessary.

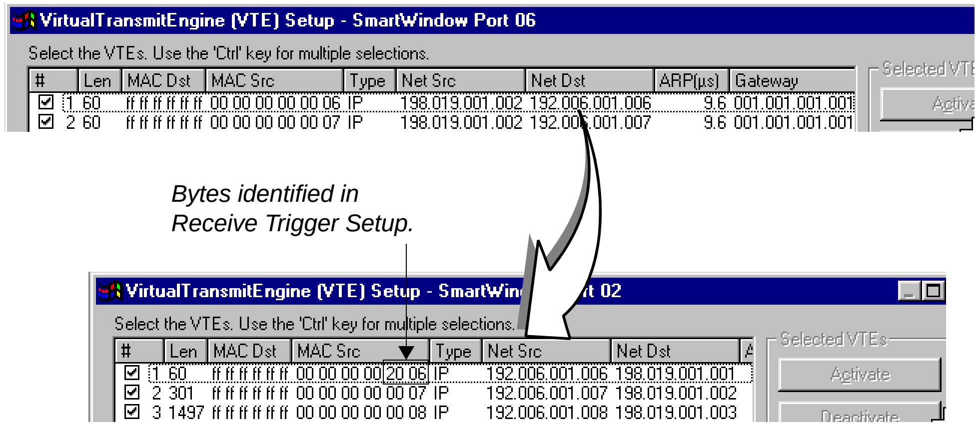
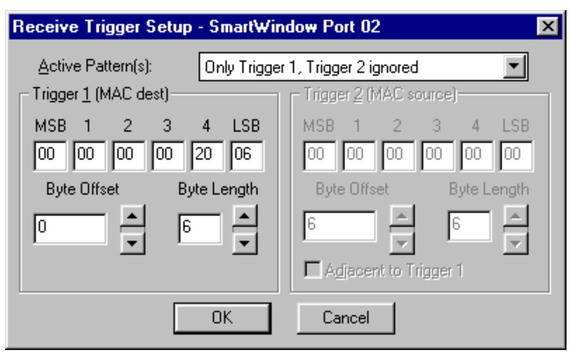


Figure 5-13. VTE Setup for Trigger Setup Example

To set up a trigger for packets sent from Port 6 to Port 2:

1. Click the Port 2 card and choose **Trigger Setup**.
2. In the *Receive Trigger Setup* dialog box, keep the default *Byte Offset* of **0** and the default *Byte Length* of **6**. (These values set the MAC source address as the trigger pattern.)
3. Enter the last 2 bytes of *Trigger 1 (MAC dest)*: `20 06`



4. Click **OK.**
5. Click **Start** on the Port 6 SmartCard to send traffic. Watch the **Trig 1** counters. (Refer to *Figure 5-11 on page 134* for a display of a SmartBits 200/2000 SmartCounter window. Refer to *Figure 5-14 on page 147* for a display of a SmartBits 200/2000 counter.)

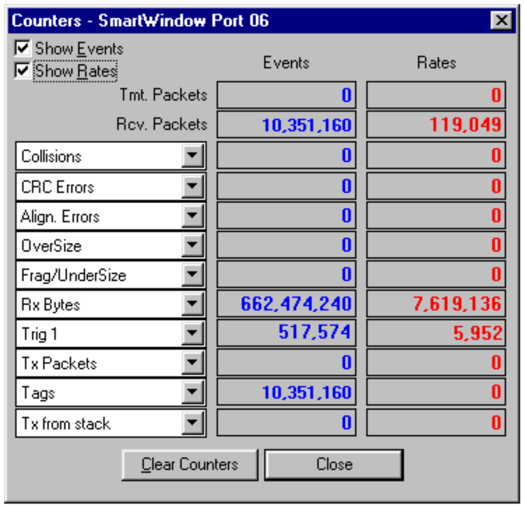


Figure 5-14. SmartBits 200/2000 Counter

Since *Trigger 1* represents stream 1, which is 1/20th of the total traffic sent, the *Trig 1* count of **517,574** is close to the expected count of **517,558**. The extra triggers may result from a number of causes, including duplicate packets sent, management packets, or counters not cleared.

Capturing Packets

Captured test data is displayed in two types of windows: *Classic* and *Decoder.* The *Classic* capture window contains two window panes to allow for viewing of multiple streams and a detailed view of one stream. The *Decode*r capture window contains three window panes that show multiple streams; selected decoded streams; and hex, decoded stream. (Refer to the online Help for a detailed description of the fields displayed in these windows.)

Notes:
- These capture window panes and associated capture functions are not available for cards used with the SmartBits 200/2000 units. Also, the captured frames differ in size between fibre channel and Ethernet. For fibre channel, the capture includes the Start of Header (SOH) and the End of Header (EOH). Ethernet does not include these values.
- See *"Using the Data Decoder" on page 167* for information on data decoding capabilities available through an optional data decoder such as the *Observer.*
- The LAN-3100A can perform capture on one port at a time.

The capture function is configured and initiated through the *Port* menu.

To capture packets (up to a maximum of approximateluy 500 packets) and look at the packet contents:

1. On the transmitting port, set up the desired transmit parameters, such as transmit mode and count, packet length (without FCS), etc.
2. Click the receiving port, and choose **Capture** from the **Card (Port)** menu. (See *Figure 5-15 on page 149*.)

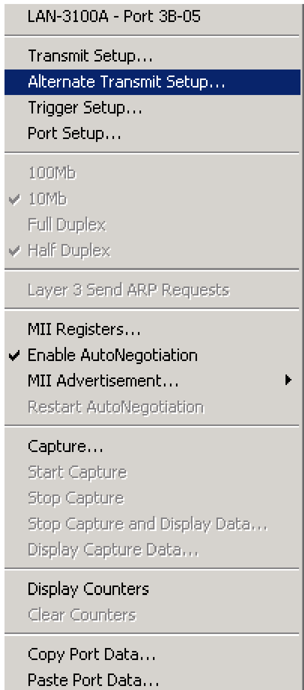


Figure 5-15. Port Menu

3 Select the desired **Capture Events** and other parameters. For this example, **All Frames** is selected. (Refer to *Figure 5-16 on page 150*.)

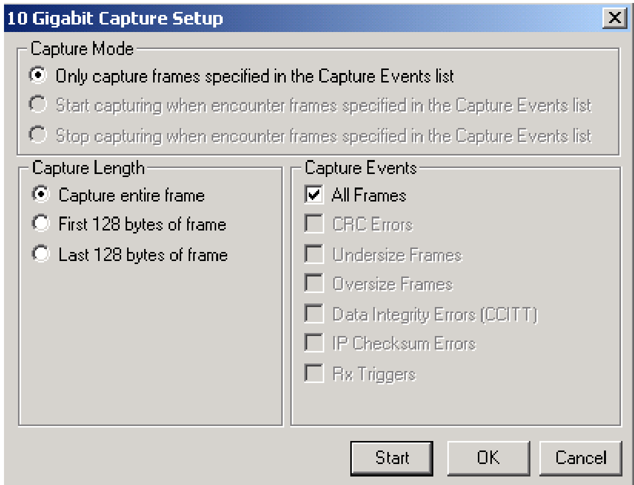


Figure 5-16. Capture Setup window

4 Start the capture on the receiving port. Do this in one of two ways:

- Select **Start Capture** from the Port menu.
- Select **Capture** from the Port menu and then select **Actions/Start** from the SmartCapture window.

5 Click the **Start** button on the transmitting port to begin sending test frames to the receiving card.

6 Select **Display Capture Data** on the **Port** menu, or access the **SmartCapture** window and select **View** to view the test stream(s). (*Figure 5-17 on page 151* shows the *SmartCapture* window filling with the results.)

The bottom of this window shows the time meter increasing as the test data is displayed. Adjacent to the time meter is a **Cancel** button that can be used to terminate the display at a particular point in time.

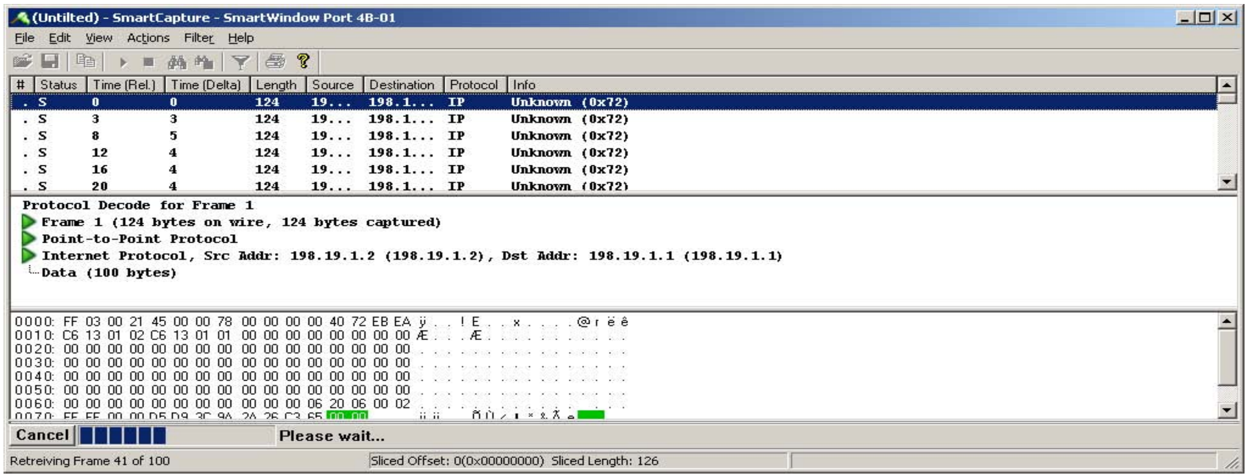


Figure 5-17. Capturing data in the Decoder View

Figure 5-18 on page 152 is a decoder *SmartCapture* window and has three window panes: *Frames List*, *Decode Tree*, and *Frame Content*. Another view of the captured frames consists of two window panes and is called the Classical view. This view displays both the *Frames List* and *Frame Content* window panes. Each of these views can be selected from the toolbar under *View*. (See *Figure 5-18 on page 152* and *Figure 5-19 on page 152*.)

Frames List

The *Frames List* pane is the topmost frame and displays nine parameters for each frame. These parameters are listed in a row (above each column) to provide a quick analysis of the frame. (Refer to the online Help for a description of each parameter.) *Table 5-10 on page 153* lists the status codes that can appear in the *Status* column of the *SmartCapture* window. See *Table 5-11 on page 154* for listing of the status codes for Fibre Channel, POS, and WAN.

Right-click this pane to export and decode the frame.

Decode Tree

The *Decode Tree* pane is available in the decoder view only and is positioned between the *Frames List* and *Frame Content* window panes. This window pane shows decoded variables such as protocol and data size.

Frame Content

The bottom-most window pane shows the hexidecimal values of the selected stream.

In *Figure 5-18 on page 152*, all packets contain the SmartBits signature field (**S**).

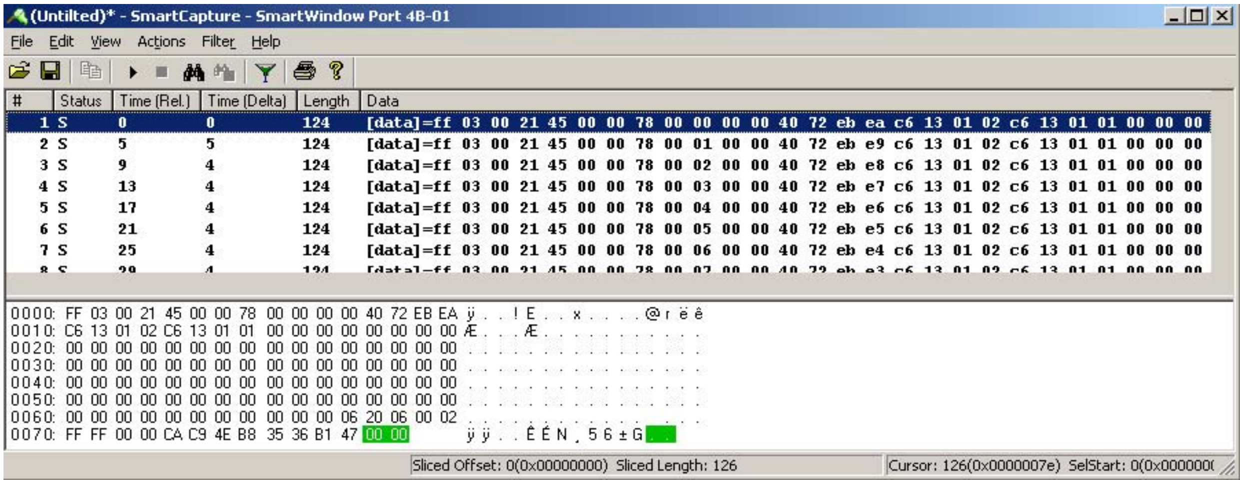


Figure 5-18. Classic Capture Window

The three panes of the *Decoder* window display different aspects of the captured data (*Figure 5-19*): test data streams (top); the decoded values of the selected stream (middle); and the decoded, hex values of the selected stream (bottom).

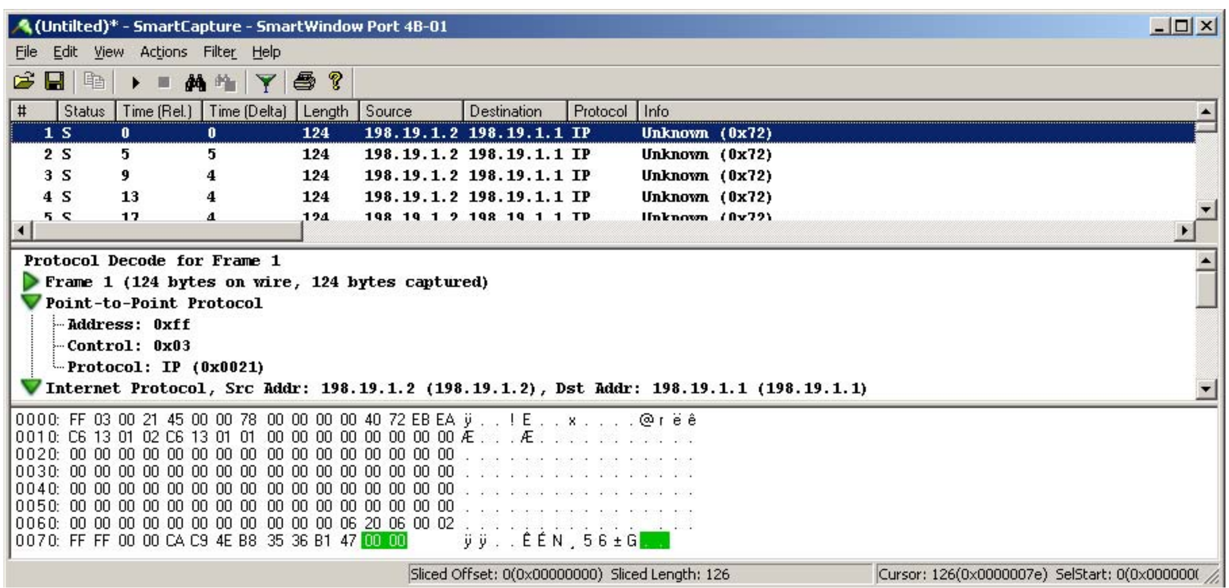


Figure 5-19. Decoder Capture Window

The *File* pull-down dialog option on the toolbar allows you to save files in three different formats for future decoding: Ethernet (.scap, .pcap, .enc, and .bfr); POS (.scap, .pcap, .syc); and FBC (.scap, .pcap, .bfr). The other *File* options provide a complete set of tools to export and import selected frames.

Table 5-10 lists the status codes in the *Status* column of the *SmartCapture* window

Table 5-10. Capture Packet Status Codes – Ethernet

Status Code	SX-7210 SX-7410/B	ML-7710 LAN-3101A/B	GX-1405B/Bs LAN-3200A/As	LAN-3100A	LAN-3201B/C LAN-3710AL/ AE/AS	Ethernet TeraMetrics-based Modules
A	Alignment	Alignment	N/A	Alignment/ Dribble	LAN-3710A only: OAM	Alignment
B	N/A	N/A	N/A	N/A	N/A	N/A
C	CRC	CRC	CRC	CRC	CRC	CRC
D	N/A	N/A	N/A	N/A	Data Integrity Error	Data Integrity Error
E	N/A	N/A	N/A	N/A	N/A	N/A
F	N/A	N/A	N/A	IP Frame	N/A	N/A
G	N/A	N/A	N/A	N/A	N/A	N/A
I	IFG Sub-minimum[1]	IFG Sub-minimum	IFG Sub-minimum	IFG Sub-minimum	IFG Sub-minimum	IFG Sub-minimum
J	N/A	Jumbo	N/A	N/A	Jumbo	Jumbo
K	N/A	N/A	N/A	IP Checksum	IP Checksum	IP Checksum
L	N/A	N/A	N/A	Collision	N/A	N/A
M	N/A	Data Integrity Marker	N/A	N/A	N/A	N/A
Mpls	N/A	N/A	N/A	N/A	MPLS	MPLS
N	N/A	N/A	N/A	N/A	N/A	N/A
O	Oversize	Oversize	Oversize	Oversize	Oversize	Oversize
P	N/A	N/A	N/A	Pause	N/A	N/A
R	N/A	N/A	Run Disparity (8B10B encoding error)	ARP	Run Disparity (8B10B encoding error)	Run Disparity (8B10B encoding error)
S	N/A	Signature	N/A	N/A	N/A	N/A
T	Trigger	Trigger	Trigger	Trigger	Trigger	Trigger
U	Undersize	Undersize	Undersize	Undersize	Undersize	Undersize
V	N/A	VLAN Tag	N/A	VLAN Tag	VLAN Tag	VLAN Tag

1 IFG = Interframe Gap

Table 5-11 lists the status codes for fibre channel, POS, and WAN.

Table 5-11. Capture Packet Status Codes – Fibre Channel, POS, WAN

Status Code	Fibre Channel	POS	WAN
A	N/A	N/A	Non-alignment Octet Frame
B	N/A	N/A	Frame Abort Error
C	CRC	CRC	CRC
D	Data Integrity Error	Data Integrity Error	N/A
E	N/A	N/A	N/A
F	N/A	N/A	N/A
G	N/A	N/A	N/A
I	N/A	N/A	N/A
J	N/A	N/A	N/A
K	N/A	IP Checksum	N/A
L	N/A	N/A	N/A
M	N/A	N/A	N/A
Mpls	N/A	MPLS	N/A
N	N/A	IP Options	N/A
O	Oversize	Oversize	Oversize
P	N/A	N/A	N/A
R	N/A	Run Disparity (8B10B encoding error)	N/A
S	N/A	N/A	N/A
T	Trigger	Trigger	Trigger
U	Undersize	N/A	Undersize
V	N/A	N/A	N/A

Sample Procedure Using Capture

The following steps provide a commonly used procedure for capturing ARP exchanges in a SmartBits system.

Note: This section describes the capture process for cards installed in the SmartBits 200/2000. Capturing test data streams for modules installed in the SmartBits 600x/6000x is described in *"Capturing Packets" on page 148*.

To capture ARP exchanges:

1 Attach devices to the SmartBits system.

2 From the SmartMetrics Ethernet menu, set up port and VTE configurations in the **Transmit Setup** windows to work with the attached devices.

3 Set up triggers (if needed) in the **Trigger Setup** window.

4 Specify addresses, etc., in the **Layer 3 Setup** or **Port Setup** dialog box**.**

5 Click **SmartMetrics Mode.**

6 Click **Capture** in the SmartMetrics Ethernet menu. Select **All Packets.**

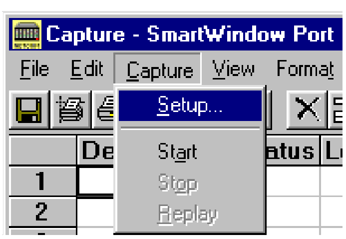
7 Choose the **Actions > Layer 3 ARP** (for all SmartMetrics cards) in the main Smart-Window window (or run the **Layer 3 Send ARP Requests** command in the Smart-Metrics Ethernet menu for a specific card) to initiate ARP exchange between the card(s) and attached device.

8 Click **Start** button in the **Capture Setup** window. A popup window with the message *Capture in Progress* appears.

9 Click the **View Results** button. Data appears immediately in the capture spreadsheet.

10 Save the data with the spreadsheet **File > Save As** command (into `.trc`, `.xls`, or `.vts` format), if helpful.

11 To capture more data directly from the capture spreadsheet, use the **Capture** menu with the **Setup**, **Start**, and **Stop** commands.



Open File, Save, or Print the Active Spreadsheet

The active spreadsheet behaves like most industry-standard spreadsheets. Manipulate highlighted information, such as copying it and then pasting it to another spreadsheet. Clear highlighted areas (such as an entire line) or remove current formatting.

Sending Ping, SNMP, and RIP Frames

The ping, SNMP, and RIP frames are supported on specific cards/modules. Refer to *Table 5-12* for a listing of this equipment. The ping frame has four separate counters that are displayed within the SmartCounter window:

- Ping replies sent
- Ping requests sent
- Ping replies received
- Ping requests received.

The SNMP and RIP frames are static frames based on RFC 1944. These are counted on specific modules within the SmartWindow **Tx from stack** or **Rx to stack** counters.

Refer to the online Help and *"SmartCounters" on page 131* for a complete description of these counters and others displayed in the *SmartCounters* window.

To set and send a ping, refer to *"Ping Each SmartCard" on page 271*.

Table 5-12. Ping, SNMP, and RIP Counters

Card/Module	Ping*	SNMP*	RIP*
LAN-31xxA	X		
LAN-3201x	X		
LAN-33xxA	X		
LAN-35xxA	X		
LAN-3710xx	X		
XLW-372xA	X		
XFP-373xA	X		
ML-77xx	X	X	X

*Typical values are: ping frequency 10, SNMP frequency 100, and RIP frequency 200.

Editing Frames

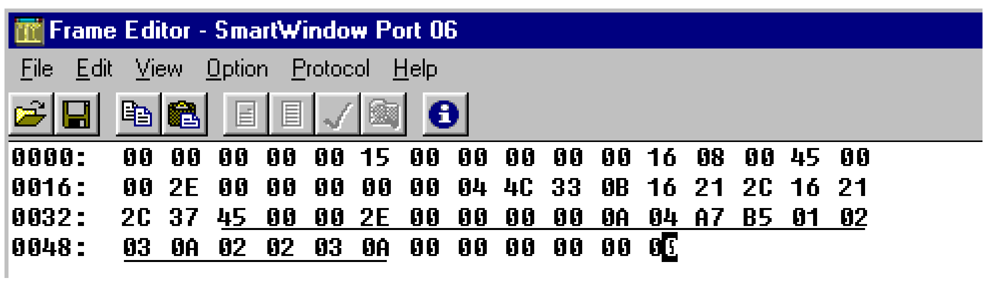
When the SmartMetric mode is enabled, the contents of test frames can be edited. With custom frames, contents can be specified byte-by-byte. When a standard protocol type is selected (such as IP), valid protocol parameters can be edited.

Caution: For a specific protocol such as IP or UDP, be careful to edit only valid protocol parameters. See *"Editing Protocol Bytes in Test Frames" on page 159*.

Reserved bytes

The last 18 bytes of a SmartMetrics mode stream is reserved for SmartBits usage. These bytes are used for SmartMetric Signature information. Any byte values inserted into the last 18 bytes are overwritten.

Example of what not to do: Below is an IP packet that has been edited in the underlined section. SmartBits overwrites the last 18 bytes of the packet. This packet should be a custom packet, not an IP packet. (See *"Creating Custom Frames"* below.) To be usable as a custom packet, the frame length (without FCS) would have to be extended to 72 bytes.



Creating Custom Frames

Custom test frames can be created with contents defined at the byte level. Here is an example using the ML-7710 Ethernet SmartMetrics SmartCard. (Open the *Card* menu by clicking the card image in SmartWindow.)

To create custom frames:

1. Open the *Card* menu and select **SmartMetrics Mode**.
2. From the *Card* menu, select **Transmit Setup**.
3. Click **Add** to add a second stream in the *Streams Setup* window. (Window contains one default stream.)
4. In the *Add Streams* dialog box, set **Protocol** to **Custom**. Accept all other default values. Click **OK** to close the window.
5. In the *Streams Setup* window, click stream #2 to highlight it, then select **Edit**.
   The *Streams Setup* dialog box appears.
6. Click the **Edit** button to open the Frame Editor (*Figure 5-20 on page 158*).
   Initially, no parameter values are assigned to the custom packet bytes. Edit the packet content according to test requirements.

7 When done, select **File** > **Save** to save the edited frame contents.

You can also select **File** > **Save As** to save your parameters to an `.s` (S-Record) file for repeated use.

8 Click the **Close** button ☒ in the corner of the window.

9 Click **OK** to close the stream-level *Streams Setup* dialog box.

10 Click **OK** to close the *Streams Setup* display window, with its streams list.

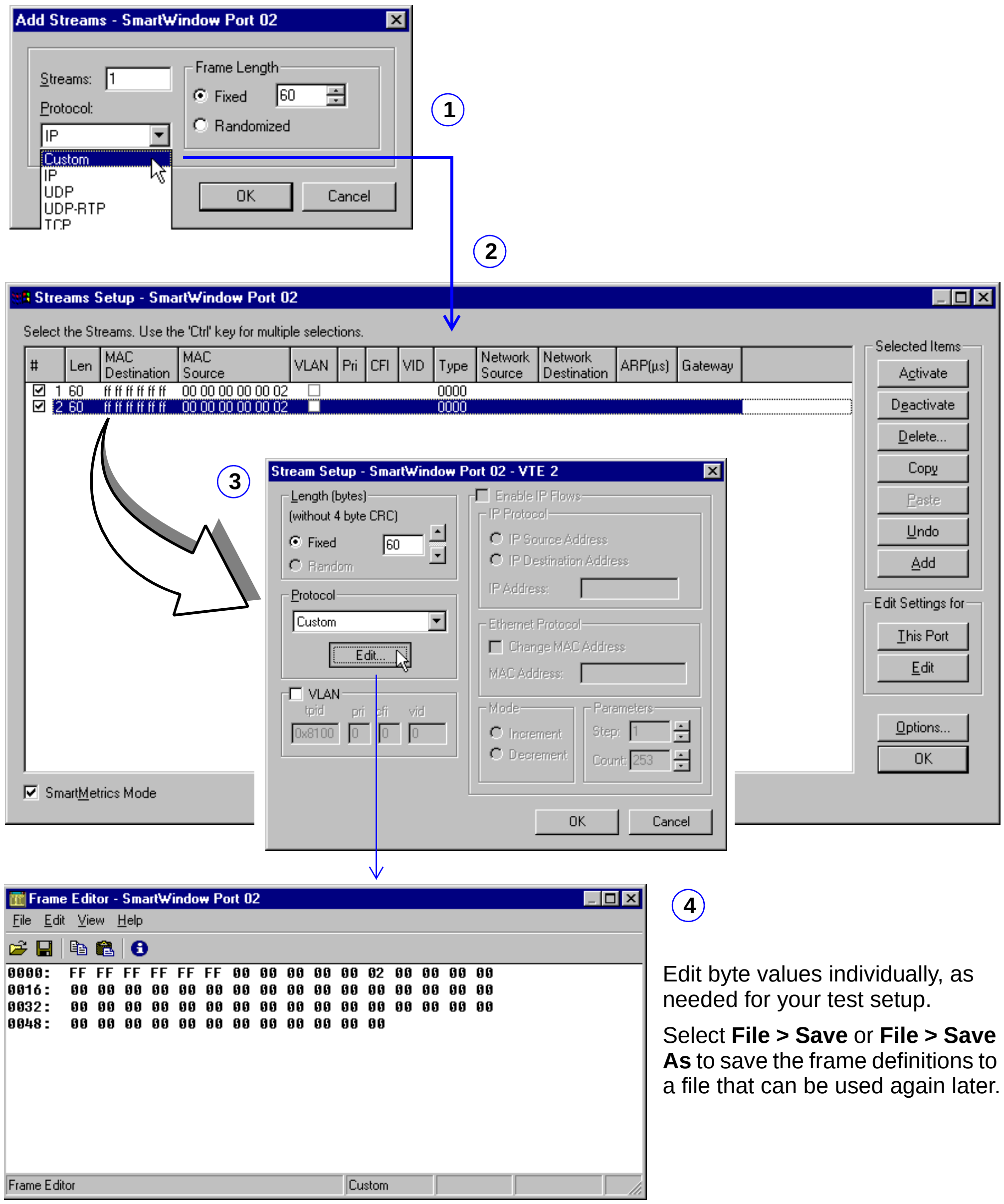


Figure 5-20. Editing a Custom Frame

Editing Protocol Bytes in Test Frames

When test frames are added based on a standard protocol (such as IP or UDP), selected protocol bytes can be edited.

Caution: With standard protocols, be careful to edit only valid protocol parameters. Remember that the last 18 bytes of each SmartMetrics mode stream is reserved for Smart-Bits usage. Values inserted into a custom packet in the last 18 bytes are overwritten.

Use the following procedure to edit the protocol bytes in test frames. This example uses the ML-7710 Ethernet SmartMetrics SmartCard. (Open the *Card* menu by clicking the card image in SmartWindow.)

To edit protocol bytes in test frames:

1. Open the *Card* menu and select **SmartMetrics Mode**.
2. From the *Card* menu, select **Transmit Setup**.
3. Click **Add** to add a second stream in the *Streams Setup* window. (Window contains one default stream.)
4. In the *Add Streams* dialog box, accept the default **Protocol** of **IP**. Accept all other default values. Click **OK** to close the window.
5. In the *Streams Setup* window, click stream #2 to highlight it, then select **Edit**.
   The *Streams Setup* dialog box appears.
6. Click the **Edit** button to open the Protocol Editor (*Figure 5-21 on page 160*).
7. Double-click in a cell to modify the displayed value.
8. When done, select **File** > **Save** to save the edited frame contents.
   You can also select **File** > **Save As** to save the header setup to a `.vts` (Formula One) file for repeated use.
9. Click the **Close** button [X] in the corner of the window.
10. Click **OK** to close the stream-level *Streams Setup* dialog box.

Modified values appear in the stream definition in the *Streams Setup* display window.

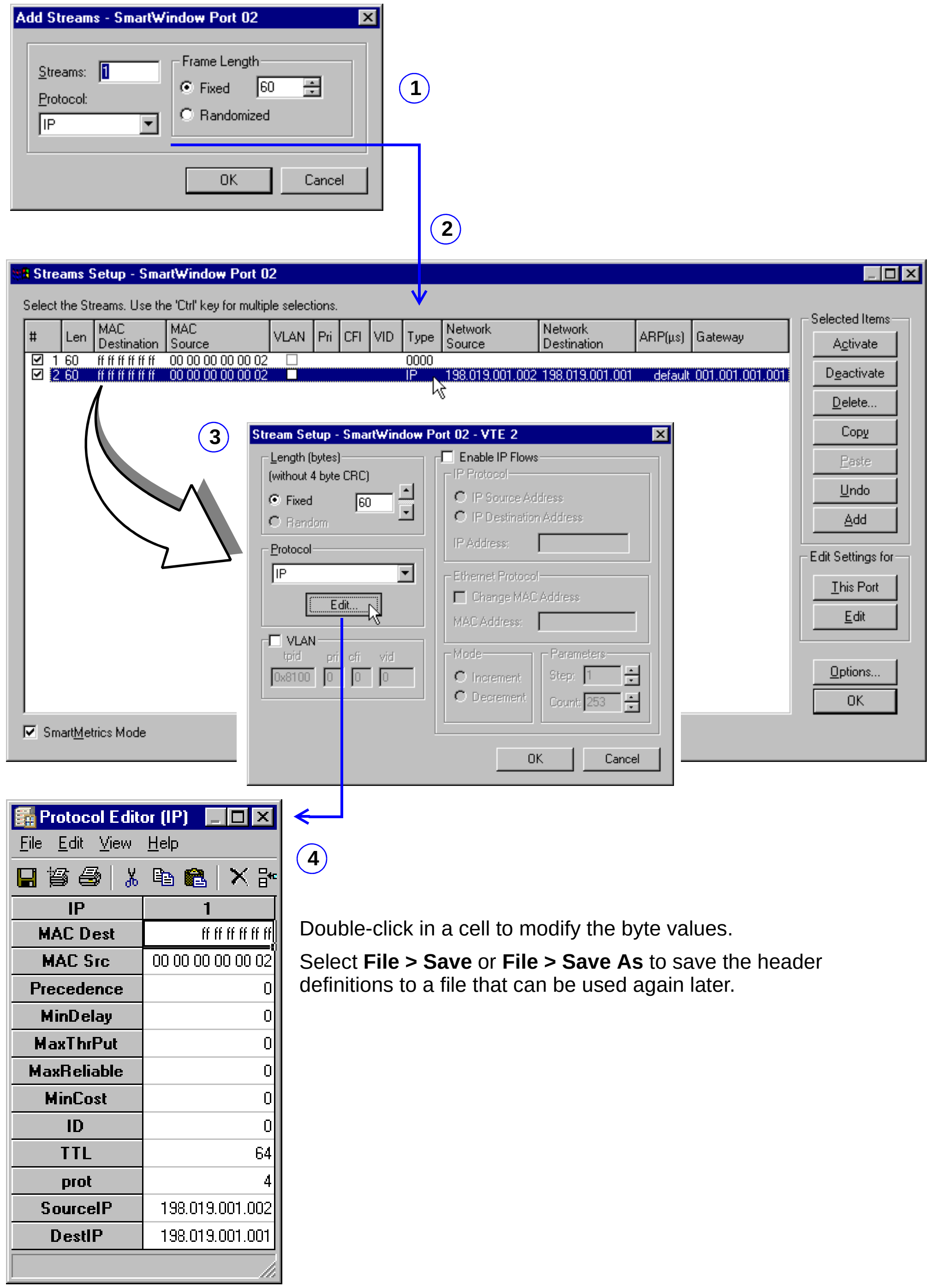
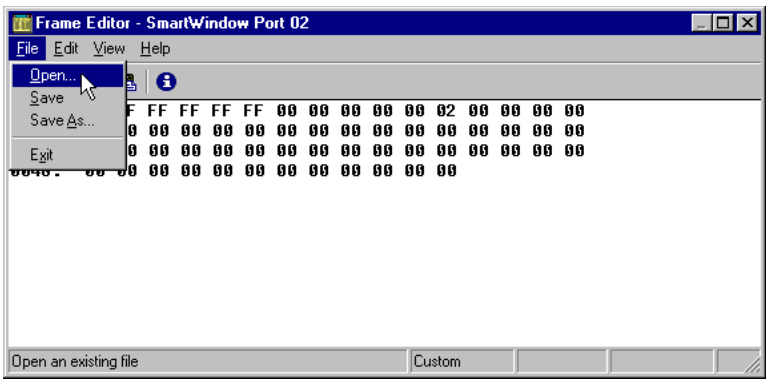


Figure 5-21. Editing Protocol Bytes in a Test Frame

Repeating a Custom Frame in Another Stream or Card

To insert the protocol data in SmartMetrics mode (or on another card):

1. Select the target stream in the *Streams Setup* window.
2. Set the length (without FCS) to the same value as the stream in the saved file.
3. Highlight the stream and select **Edit** to open the *Streams Setup* dialog box.
   The *Protocol* field should indicate **Custom**.
4. Select **Edit** to open the Frame Editor.
5. Select **File** > **Open**.



6. Select a saved file, and click **Open**.

Note: For the LAN-3325A module in the traditional mode, when the checksum value is changed in the Frame Editor, these changes are not saved or displayed in the *Packet Output* window.

7. Save (**File** > **Save As)**, update (**Actions** > **Update**), and transmit (click **Start** on the transmitting SmartCard), as required.

Tips for Testing a Specific Parameter

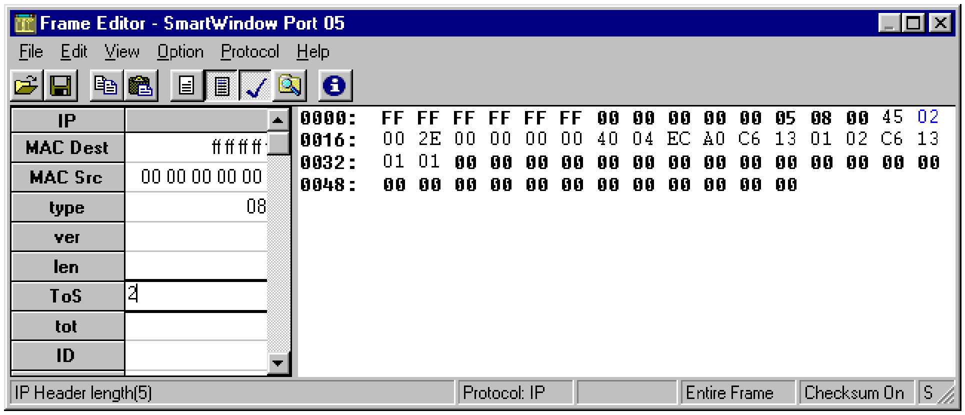
Test a protocol function by setting the related bits in the frame header, then viewing the SmartCounters for the trigger and/or capturing the trigger packets. Here is an example for the TOS bits in the IP packet.

To test a protocol function:

1. Open the *Card* menu and select **Transmit Setup**.
2. Select an IP stream in the *Streams Setup* list. Choose **Custom** as the protocol, then in the Frame Editor choose **Protocol** > **IP.** Now you can view the parameter byte locations on the right side and edit valid parameters on the left side.

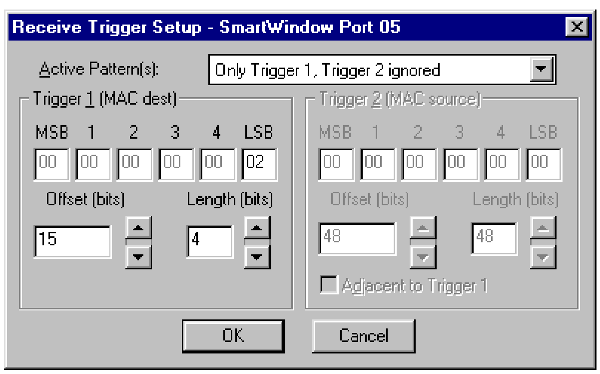
Caution: With a specific protocol such as IP or UDP, edit only the parameters that are displayed when the **Edit** button is clicked below the protocol entry. The last 18 bytes of each

SmartMetrics stream are reserved for SmartBits use. Any values inserted into a custom packet in the last 18 bytes are overwritten.



3 In this example, the TOS field is edited to be type 2, which appears at byte 16. (Therefore, the offset is 15.) Choose **File > Save**, click the **Close** button, and then click **OK**.

4 To set the receive trigger on the port 6 receive card, set the offset to 15 bytes, and enter 02 as the value to set the trigger. Click **OK**.



5 Click the port 6 SmartCard and select the **Capture** command. In the **Layer3 Capture Setup** window, click **Packets with Rx Triggers**.

6 Click the **Start** button on the transmitting SmartCard and check the *Capture* window.

MII Registers

Ethernet cards that are capable of autonegotiation use MII or GMII registers to define the interface between the MAC layer and the various PHY layers. When autonegotiation is enabled, the port link speed and duplex mode are selected through the autonegotiation protocol.

You can control the autonegotiation parameters by writing to the various MII registers on the internal or external transceiver. Access to the *MII Registers* dialog box is achieved in two ways:

- Click the **MII Registers** button in the **Transmit Setup** dialog box, *or*
- Click the SmartCard or port button, and select **MII Registers** from the menu.

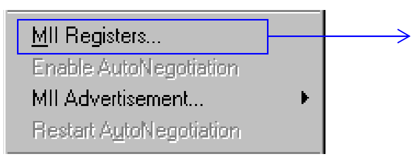
Shortcuts

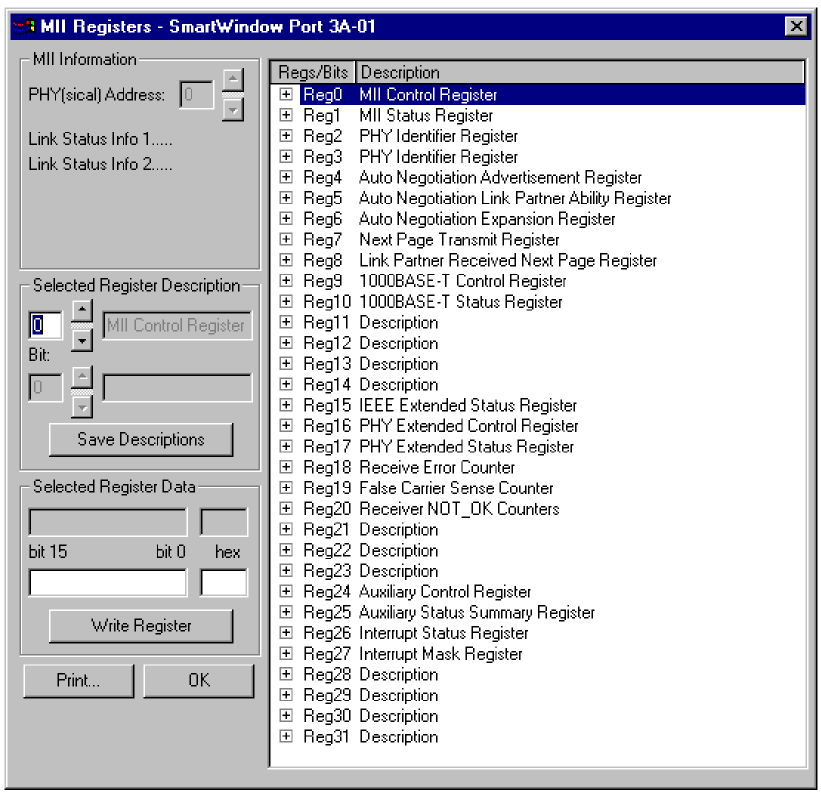
SmartBits 600x/6000x Ethernet modules include menu options to set or clear bits in the MII/GMII registers without opening the *MII Registers* dialog box.

Four figures (following) illustrate these menu options.

1

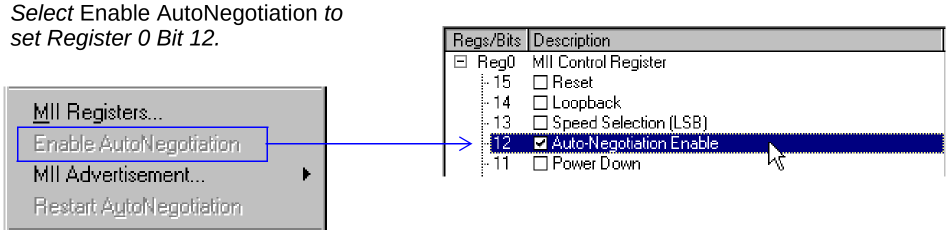
Select MII Registers *to open the* MII Registers *dialog box and set or clear register bits directly.*





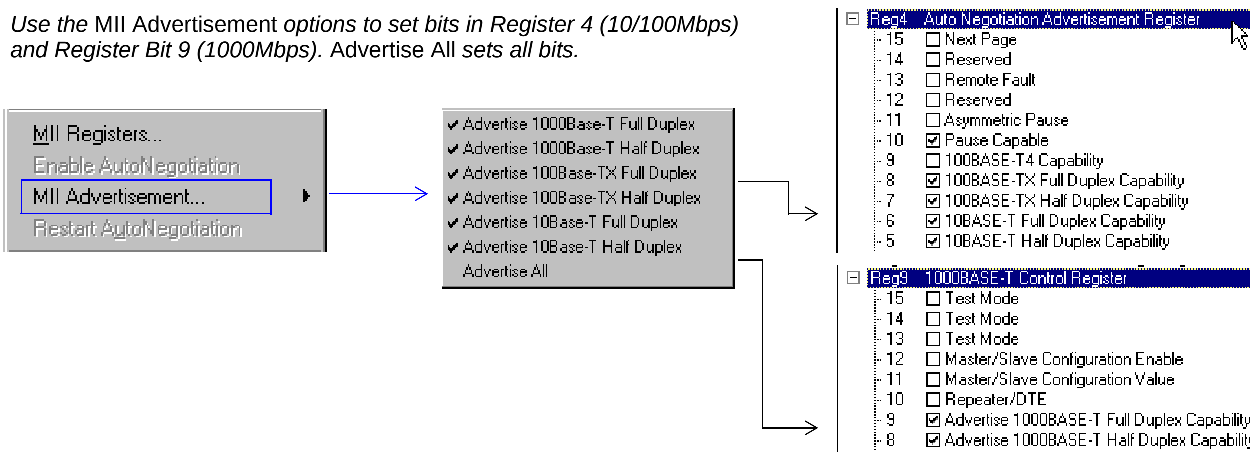
2

Select Enable AutoNegotiation *to set Register 0 Bit 12.*



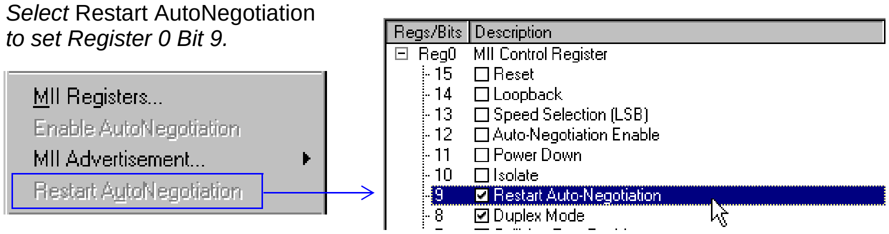
3

Use the MII Advertisement *options to set bits in Register 4 (10/100Mbps) and Register Bit 9 (1000Mbps).* Advertise All *sets all bits.*



4

Select Restart AutoNegotiation *to set Register 0 Bit 9.*



Enabling Autonegotiation

Although SmartBits recommends testing with port configurations fixed, autonegotiation functions may be required for device testing. For this reason, SmartBits cards and modules support many autonegotiation functions. For device testing of autonegotiation behaviors, use the *MII Registers* dialog box to set, write, and read port parameters. Testing may also include turning the card autonegotiation option off to expose the behavior of a device when linked ports are mismatched.

Use the *MII Registers* dialog box to view and modify the 32 MII addresses and registers.

To test autonegotiation without actually enabling autonegotiation:

1. From the SmartWindow menu bar, select **Options** > **Preferences**.
2. Select the **Allow MII Auto-Negotiate** checkbox.

Once autonegotiation is selected, speed and duplex selection for individual cards are disabled in the *7x10 Setup* menu and *SmartCard* main menu. However, autonegotiation can be reenabled using the MII registers.

Note: When this option is selected, autonegotiation is enabled globally for all ports on the card; the AN enabled bits are set in the port control registers. These settings always override the control register values saved in a *.prf configuration file. As a result, if you modify the global MII register bit settings, save the configuration file, and disconnect from the chassis, the global settings will take precedence over your file settings the next time that you connect to the chassis and load the configuration file.

Reading and Writing MII Registers

Work with the address/register combinations in the following ways. (See also *"Shortcuts" on page 163* for menu options that can be used to set MII register bits.)

Important: You can only write to the MII interface when the SmartBits system is actively connected to the SmartWindow user interface.

- Use the **Selected Register Description** field to display registers 1 to 31 one at a time. Use the arrow buttons to the right of the corresponding entry field or enter the desired value directly. Addresses 0-31 and registers 0-31 are supported. Click the arrows to the left of the **Bit** field to view register description.
- Use the **Selected Register Data** field to view and change bit settings for the selected register. Once you choose a register, the value of the register is displayed in binary and hexadecimal. To write a value to the selected register:

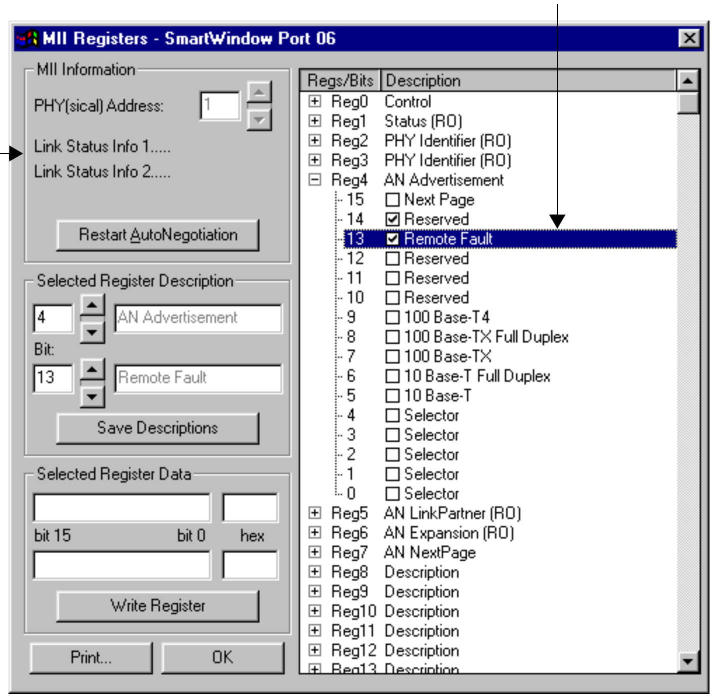
1. Enter the value to be written in either binary (in the binary entry area) or in hexadecimal (in the smaller hex entry field).
2. Press the **Write Register** button. The value is written to the MII register at that time.

Note: If you select a register that is read-only, the **Write Register** button is grayed.

- To change a register in the **Reg/Bits Description** window, select a register by clicking it, then press the space bar to toggle between select/clear.
- Use the **Print** button to print all registers and bit settings.

Select a register by clicking on it, then press the space bar to toggle between selected /cleared.

If register 2 or 3 is selected, information about the Organ-izationally Unique Identifier (OUI) assigned by IEEE is displayed.



For Register 4 Only

Once the register to view is selected, check the bits that you want for the register. Use the **Restart AutoNegotiation** button if changes were made to a register and you want to reset the connection according to those changes.

Using the Data Decoder

Optionally, along with SmartWindow, a third-party data decoder can be installed. One such decoder is the Observer. When the Observer is installed, SmartWindow offers menu access to its decoding functions for captured data. Use the Observer to analyze the contents of captured Ethernet packets byte-by-byte.

For steps to install a data decoder, see *Chapter 3, "SmartWindow Menus."*

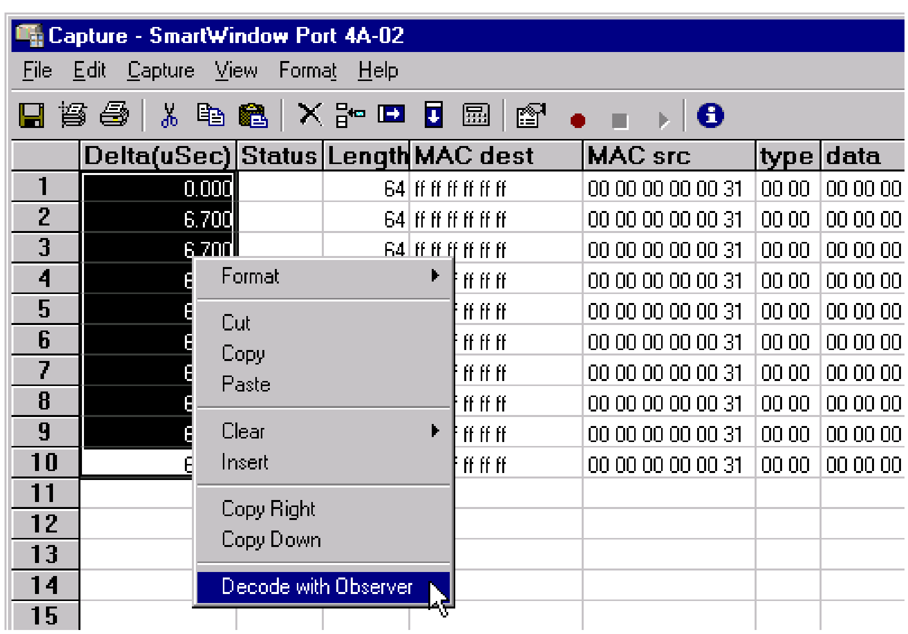
In SmartWindow 7.30 Beta 1, the Observer may be used to decode only Ethernet packets.

Frames lengths for frames (without FCS) decoded in SmartWindow do not include the CRC in the length count. If the frame is saved to disk and subsequently decoded with Observer, the frame length (without FCS) does include the CRC. Therefore, the length is four bytes greater than if decoded in SmartWindow.

Using the Observer

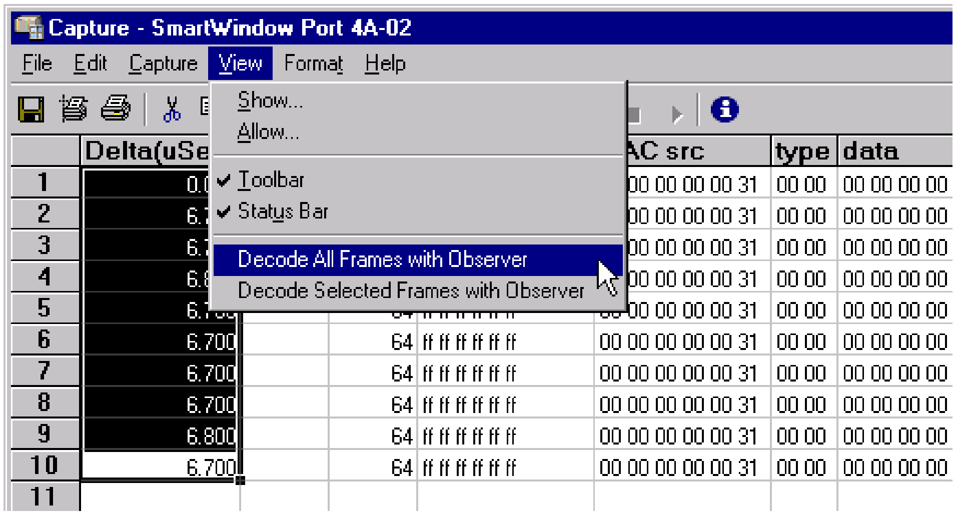
To decode captured Ethernet packets with the Observer:

1. Set up and start capture on the receiving port. (See *"Capturing Packets" on page 148* for steps.)
2. Send test traffic from the transmitting port.
3. Click **View Result** in the *Capture* window to fill the results window.
4. Select one or more entries in the *Capture* window, then right-click and select **Decode with Observer** from the menu.

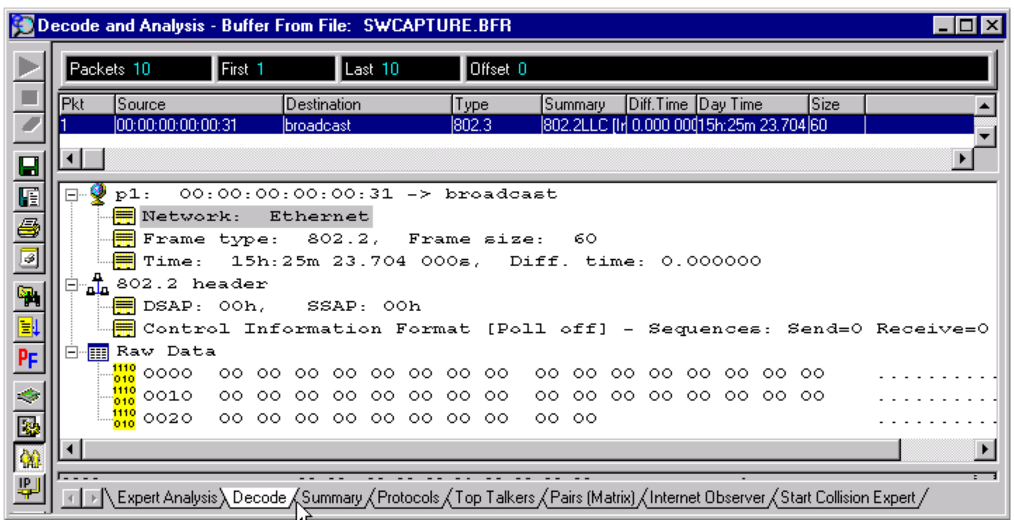


The Observer can also be enabled via menu commands. From the *View* menu in the *Capture* window, perform one of the following commands:

- **View > Decode All Frames with Observer**
- **View > Decode Selected Frames with Observer**



5 When the Observer launches, use its options to decode the captured packets.



Testing with IPv6 Streams

This section presents guidelines on working with IPv6-based streams. It covers the following topics.

- *"SmartBits Module Support for IPv6 Streams" on page 169*
- *"Frame Header Length" on page 169*
- *"Selecting an Address Display Format" on page 171*
- *"IPv6 Header Fields" on page 173*
- *"Calculating Protocol and Frame Size for IPv6 Streams" on page 175*
- *"Neighbor Discovery Protocol" on page 179*

Note: Refer to "Internet Protocol, Version 6 (IPv6) Specification," RFC 1883, December 1995 plus related RFCs and specifications for detailed information on IPv6.

SmartBits Module Support for IPv6 Streams

Test with IPv6 streams using the LAN-310*x*A/B SmartMetrics module and all TeraMetrics-based modules for the SmartBits 6000x family of chassis.

Frame Header Length

All the IPv6 stream types (IPv6, TCP-IPv6, and UDP-IPv6) require a stream header length of 128 bytes. This ensures that the frame is long enough to include the Signature field, data integrity marker, and other optional fields when enabled.

If required, add the IPv6 stream, using the required 128-byte frame length (without FCS), then reduce the frame length to less than 128. To do this, disable one or more of the optional fields (such as *Signature*), then adjust the *Len* value downward. However, remember that SmartMetrics tests depend on the *Signature* field.

Setting frame header length

Set the header length in the *Streams Setup* dialog box (*Figure 5-22 on page 170*). This setting is global; it applies to all streams generated by the port. If you add IPv6 streams, then attempt to reset the *Stream Header Length* value to 64 bytes, a message warns that this cannot be done. To change the header length value, first delete the IPv6 streams.

Number of Streams

The selected stream header length determines the maximum number of streams for the port. With the 128-byte header required for IPv6 streams, up to 2,048 streams on specific ports can be added. (See *Table 5-13 on page 170*.) In many cases, this is the same situation in regards to IPv4 streams that use a 64-byte length.

Table 5-13. IPv6 and IPv4 Streams

Module	Maximum Number of IPv6 Streams (128 Bytes)	Maximum Number of IPv4 Streams (64 Bytes)
XFP-373xA	2048[1]	2048[1]
XLW-372xA	512[1]	512[1]
LAN-332xA	2048	2048
LAN-330xA	256	512
LAN-331xA	256	512

1 These values require the latest firmware.

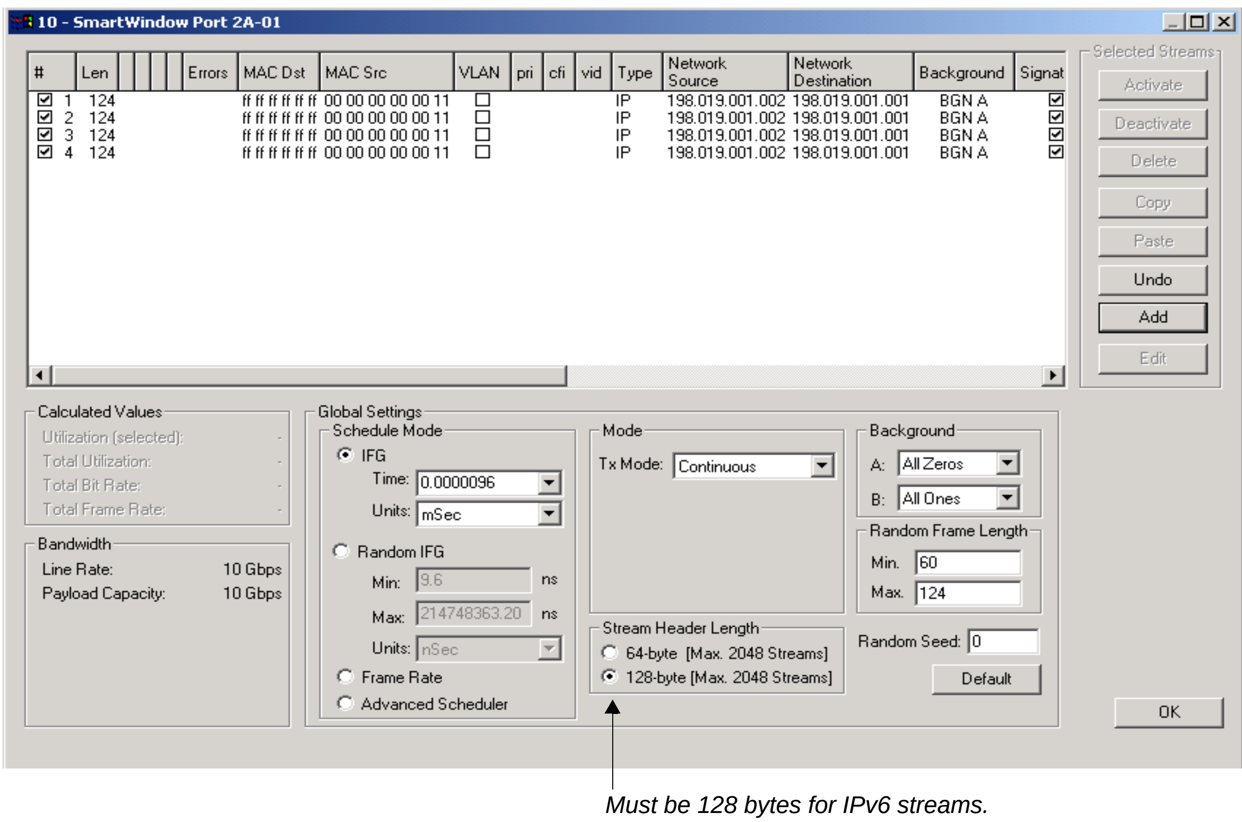


Figure 5-22. Setting Stream Header Length fir IPv6 Streams

Selecting an Address Display Format

RFC 2373 allows IPv6 addresses to be written and displayed in four ways. Select the display format by using the *Options* > *Preferences* dialog box that is accessed from the main menu. Your selection here applies to all streams set up and controlled in the SmartWindow session.

Select Options > Preferences *to choose an IPv6 display format.*

This setting applies to all IPv6 streams for the SmartWindow session.

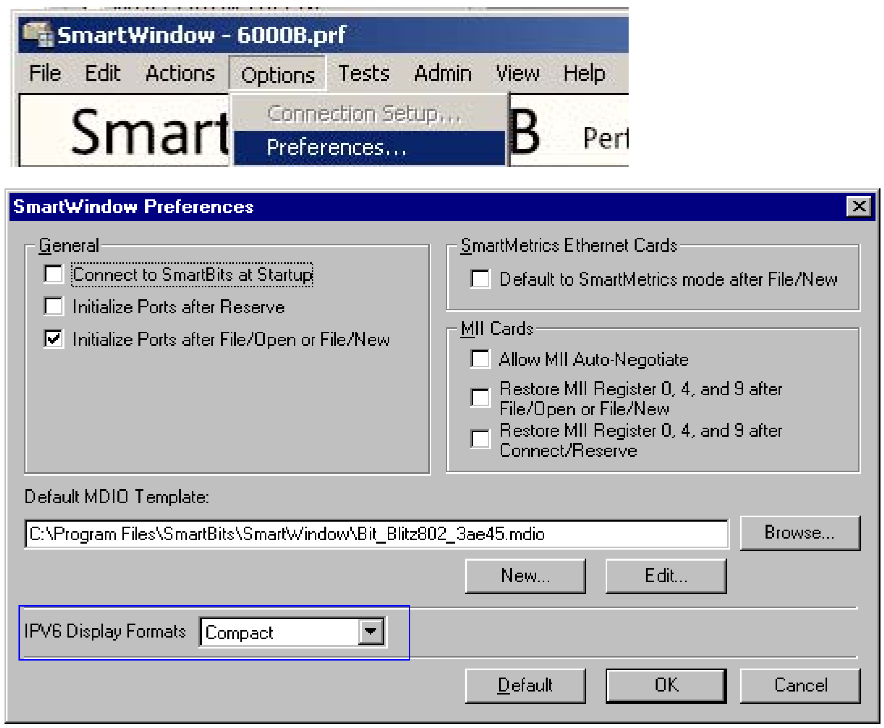


Figure 5-23. Selecting an IPv6 Display Format

Here is a summary of the available formats (as paraphrased from the RFC):

Hexadecimal

This is the preferred format: x:x:x:x:x:x:x:x, where the 'x's are the hexadecimal values of the eight 16-bit pieces of the address.

Examples:

```
FEDC:BA98:7654:3210:FEDC:BA98:7654:3210
1080:0:0:0:8:800:200C:417A
```

No leading zero

This format is similar to the *Preferred* format above, but the leading zeros in individual fields are omitted. (There must be at least one numeral in every field.)

Compact

Some methods of allocating IPv6 addresses result in addresses that contain long strings of zero bits. To simplify writing such addresses, a special syntax is available to compress the zeros. The use of "::" indicates multiple groups of 16-bits of zeros. The "::" can only appear once in an address. The "::" can also be used to compress the leading and/or trailing zeros in an address.

Examples:

Unicast address:

```
1080:0:0:0:8:800:200C:417A>1080::8:800:200C:417A
```

Multicast address:

```
FF01:0:0:0:0:0:0:101>      FF01::101
```

Loopback address:

```
0:0:0:0:0:0:0:1>           ::1
```

Unspecified address:

```
0:0:0:0:0:0:0:0>           ::
```

Mixed

This form can be more convenient when dealing with a mixed environment of IPv4 and IPv6 nodes. It is x:x:x:x:x:x:d.d.d.d, where the 'x's are the hexadecimal values of the six high-order 16-bit pieces of the address, and the 'd's are the decimal values of the four low-order 8-bit pieces of the address (standard IPv4 representation).

Examples:

```
0:0:0:0:0:0:13.1.68.3
(in compressed form:::13.1.68.3)
```

```
0:0:0:0:0:FFFF:129.144.52.38
(in compressed form:::FFFF:129.144.52.38)
```

IPv6 Header Fields

Table 5-14 lists the fields in the IPv6 header, as displayed in SmartWindow.

Table 5-14. IPv6 Header Fields

IPv6 Field	Minimum	Maximum	Default	Format	Editable?	Size (Bits)
Version	6	6	6	Decimal	No	4
Traffic Class	0	255	0	Decimal	Yes	8
Flow Label	0	1048575		Decimal	Yes	20
Payload Length	0	65535	128	Decimal	No	16
Next Header	0	255	0	Decimal	Yes	8
Hop Limit	0	255	0	Decimal	Yes	8
Source Address	0	2^128	::198.19.2.2	Mixed	Yes	128
Destination Address	0	2^128	::198.19.2.1	Mixed	Yes	128

Editing IPv6 Header Fields

You can edit most of the IPv6 header fields for a stream. Some values are not editable, as shown in *Table 5-14*.

To edit header values (*Figure 5-24 on page 174*):

1 Click the stream in the *Streams List* to highlight it.

2 Click **Edit**.
The *Tx Control Panel* opens.

3 Click **IPv6** to open the *SETUP: IPv6 (Internet Protocol v6)* pane.

4 Modify addresses and other header field values, as required.

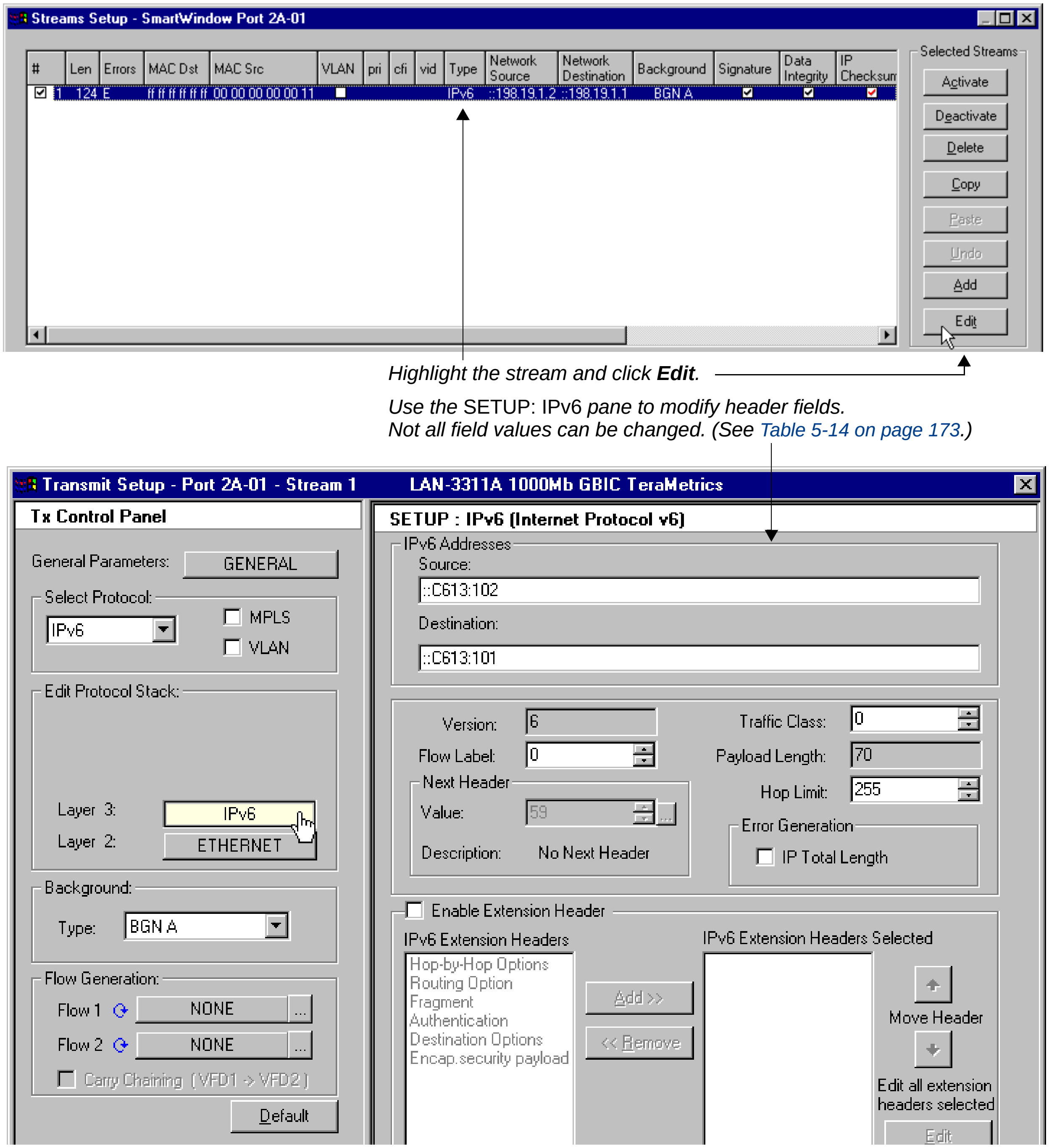


Figure 5-24. Editing IPv6 Header Fields

Calculating Protocol and Frame Size for IPv6 Streams

The tables in this section can be used when calculating frame length (without FCS) with different protocol layers; when optional fields (*Signature* and *Data Integrity Marker*) are included in the frame template; and when extension headers are included in the frame template.

- *Table 5-15* lists the fields in the IPv6 header, as displayed in SmartWindow.
- *Table 5-16 on page 176* shows frame length with optional fields.
- *Table 5-17 on page 177* shows IPv6 extension headers.
- *Table 5-18 on page 177* shows frame length with extension headers for Ethernet IPv6 frames.
- *Table 5-19 on page 178* shows frame length (without FCS) with extension headers for POS IPv6 frames.

Table 5-15. Size (Bytes) of Protocol Layers

	Protocol Layer	Protocol Header Size (Bytes)	Total Protocol Header Size (Bytes)
Ethernet	Ethernet (802.1)	14	14
	IP	20	34
	TCP	20	54
	UDP	8	42
	IPv6	40	54
	TCP/IPv6	20	74
	UDP/IPv6	8	62
POS	POS	4	4
	IP	20	24
	TCP	20	44
	UDP	8	32
	IPv6	40	44
	TCP/IPv6	20	64
	UDP/IPv6	8	52

Table 5-16. Frame Sizes with Optional Fields

	Selected Protocol	Optional Fields		Frame Length(without FCS)		Frame Header Length
		Signature	Data Integrity Marker	Minimum	Maximum	Minimum
Ethernet	IPv6	No	No	54	65536	64[1]
		Yes	No	72	65536	128
		Yes	Yes	90	65536	128
	TCP/IPv6	No	No	74	65536	128
		Yes	No	92	65536	128
		Yes	Yes	110	65536	128
	UDP/IPv6	No	No	62	65536	128
		Yes	No	80	65536	128
		Yes	Yes	98	65536	128
POS	IPv6	No	No	44	65536	128
		Yes	No	62	65536	128
		Yes	Yes	80	65536	128
	TCP/IPv6	No	No	64	65536	128
		Yes	No	82	65536	128
		Yes	Yes	100	65536	128
	UDP/IPv6	No	No	52	65536	128
		Yes	No	70	65536	128
		Yes	Yes	88	65536	128

1 SmartWindow requires a 128-byte header length for IPv6 streams.

Table 5-17. IPv6 Extension Headers

Extension Header Name	Minimum Length
Hop-by-Hop Options	8
Destination Options	8
Routing	24
Fragment	8
Authentication	26
Encapsulating Security Payload	16

Table 5-18. Frame Sizes: Ethernet IPv6 with Extension Headers

Protocol	Extension Header (Included = r)							
	Hop-by-Hop	Fragment	Authentication	Encapsulation Security Payload	Routing	Destination Options	Minimum Frame Length	Stream Header Length[1]
IPv6 Ethernet	r						72	128
	r	r					80	128
	r	r	r				96	128
	r	r	r	r			112	128
	r	r	r	r	r		136	128[2]
	r	r	r	r	r	r	144	128

1 Assumes that Data Integrity is enabled, which is the default.
2 Minimum frame length exceeds stream header length.

Table 5-19. Frame Sizes: POS IPv6 with Extension Headers

Protocol	Extension Header (Included = r)							
	Hop-by-Hop	**Fragment**	**Authentication**	**Encapsulation Security Payload**	**Routing**	**Destination Options**	**Minimum Frame Length (without FCS)**	**Stream Header Length[1]**
Packet Over SONET IPv6	r						72	128
	r	r					80	128
	r	r	r				96	128
	r	r	r	r			102	128
	r	r	r	r	r		126	128[2]
	r	r	r	r	r	r	134	128

1 Assumes that Data Integrity is enabled, which is the default.
2 Minimum frame length exceeds stream header length.

Neighbor Discovery Protocol

The *Port Setup* window contains a series of tabs used to configure IPv4, IPv6, autonegotiation, and other parameters, depending upon the capabilities of the installed module. The parameters used for the Neighbor Discovery processes (solicitations and advertisements) are located on the *IPv6 Stack/Address* tab. This tab contains two window panes that configure the source MAC address, source IP address, properties of the advertisements/solicitations, and other transmit/receive parameters. (See *Figure 5-25* for an illustration of the *Port Setup* window with the *IPV6 Stack/ Address* tab displayed.)

This section describes the following Neighbor Discovery processes:

- Definition of receive properties of solicitation.
- Initiation of solicitation.

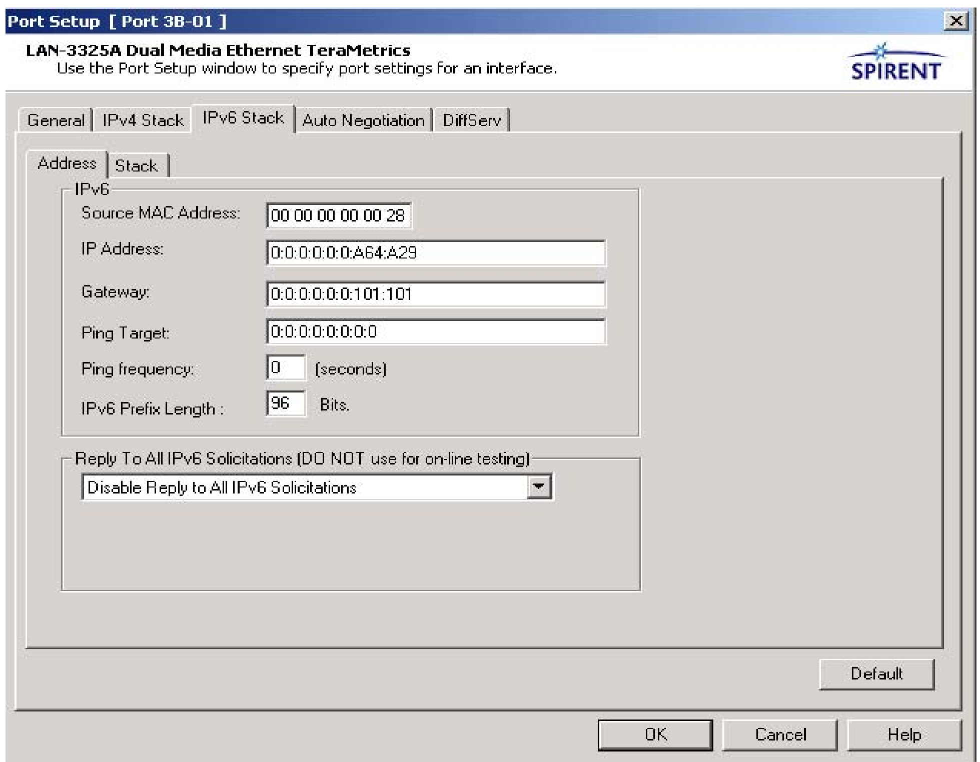


Figure 5-25. IPv6 Addresses in the Port Setup Window

There are three ways to define the receive properties of solicitations:

- Disable reply to all
- Reply using port MAC
- Reply using unique MAC.

Another method, using a unique solicitation MAC address, is available on the specific modules listed in *Table 5-20*.

Table 5-20. Module Support for Defining Unique Solicitation MAC

Module	Description
LAN-332*x*A	10/100/1000 Mbps and Gigabit Ethernet Fiber, 2/4/1-port, SmartMetrics XD and TeraMetrics XD
XLW-3720A XLW-3721A	10GBase Ethernet XENPAK MSA, 1-port, 2-slot, SmartMetrics 10GBase Ethernet XENPAK MSA, 1-port, 2-slot, TeraMetrics
XFP-3720A XFP-3721A	10GBase Ethernet XFP MSA, 1-port, 1-slot, SmartMetrics 10GBase Ethernet XFP MSA, 1-port, 1-slot, TeraMetrics
XFP-3730A XFP-3731A	10GBase Ethernet XFP MSA, 1-port, 1-slot, SmartMetrics 10GBase Ethernet XFP MSA, 1-port, 1-slot, TeraMetrics

Definition of Receive Properties

Receive properties for IPv6 solicitations are defined in this section. Receive properties for IPv4 ARP requests are defined in *"Defining Receive Properties of ARP Requests" on page 188*.

To define receive properties of solicitations for IPv6:

1. Access the **Port Setup** window and select the **IPv6 Stack/Address** tabs. Locate the bottom window pane and select (using pull-down arrow) the **Reply to All IPv6 Solicitations using Unique MAC** message. (See *Figure 5-26 on page 181*.)

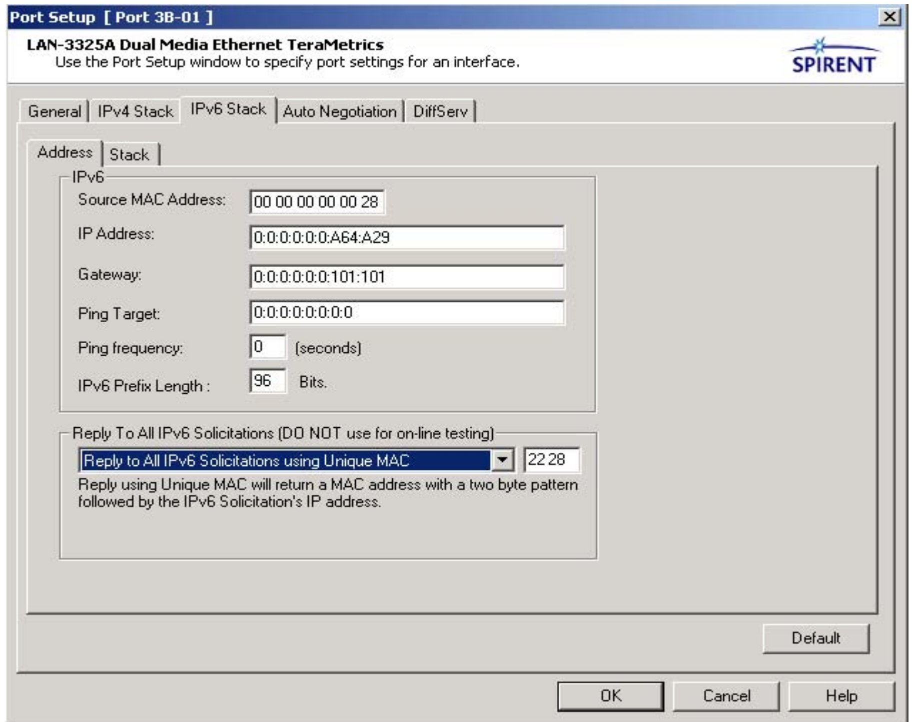


Figure 5-26. IPv6 tab of Port Setup window

2 Adjacent to the pull-down menu is an entry field. This field displays two static bytes of the solicitation MAC address. These bytes are set by you to form the MAC address range of the solicitations. The other four bytes of the MAC address are based on the Solicitation IP address.

Notes:

- The two static, MAC bytes are used by IPv4 (ARPs) and IPv6 (solicitations). There cannot be different static bytes for IPv4 and IPv6.
- The **Disable Reply to All ARP requests** is the default message.

3 Locate the bottom window pane and select (using pull-down arrow) the **Reply to All IPv6 Solicitations using port MAC** message. This selection allows you to use the port MAC address to define the solicitations.

4 Locate the right window pane and select (using pull-down arrow) the **Disable Reply to All IPv6 Solicitations** message. This selection disables the reply to all solicitations.

The following procedure is used for ARP requests as well as solicitations. It is considered a global procedure because it is accessed by the main toolbar through the *Actions* Menu.

To use the Actions menu to enable/disable replies to ARP requests/solicitations:

1. The enabling or disabling replies to ARP requests and solicitations are completed at a port level through the *Port Setup...* window or through the *Actions* menu. For an explanation of how to use the *Port Setup...* window for these procedures, see *"To define receive properties of solicitations for IPv6:" on page 180* and *"To define receive properties of ARP requests for IPv4:" on page 188*. To use the *Actions* menu, select **Actions > Set Reply To All ARP/ND Requests on All Cards**. (Refer to *Figure 5-27*.)

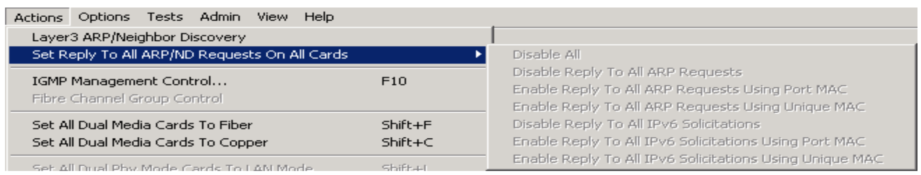


Figure 5-27. ARP Requests/Solicitations Global Dialog

Note: These global actions are available on specific modules that are listed in *Table 5-20 on page 180*.

2. Two of the global actions require definitions of the MAC address: **Enable Reply to All ARP Requests Using Unique MAC** and **Enable Reply to All IPv6 Solicitations Using Unique MAC**. These definitions are explained in:
   - For solicitations, see *"To define receive properties of solicitations for IPv6:" on page 180*.
   - For ARP requests, see *"To define receive properties of ARP requests for IPv4:" on page 188*.

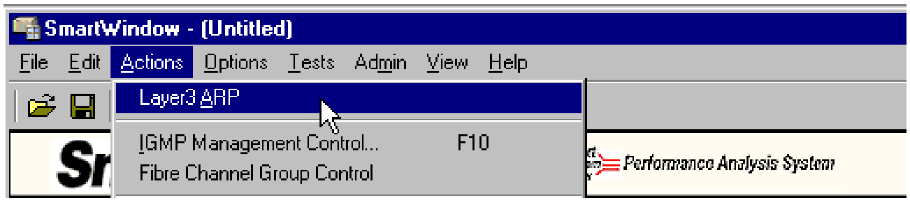
There are two methods for initiating neighbor solicitation messages:

- *Actions > Layer 3 ARP* on the main menu.
- *Layer 3 Send ARP Requests* on the *Port* menu.

When selected, both options cause IPv6 neighbor solicitation messages to be sent to the device under test.When this process is initiated, the ARP requests are also sent.

To initiate neighbor solicitation messages for IPv6:

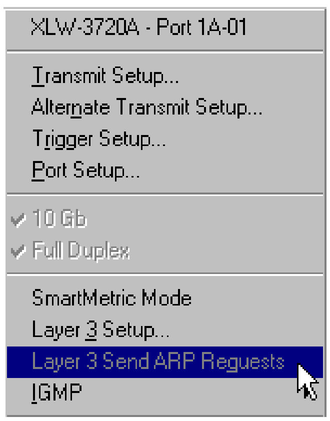
1. Select **Actions** > **Layer3 ARP** from the main menu. Neighbor solicitation messages then are sent on behalf of all Layer 3 modules. This should be done each time the device or devices under test are connected, powered up, or reset. (See *Figure 5-28 on page 183*.)



This option sends neighbor solicitation messages for all ports.

Figure 5-28. Using Actions › Layer3 ARP on the Main Menu

2. Neighbor solicitation messages can be sent for a single port by selecting **Layer 3 Send ARP Requests** from the port menu.



This option sends neighbor solicitation messages for the specific port.

Figure 5-29. Using Layer 3 Send ARP Requests on the Port Menu

Jumbo Frames

Selected TeraMetrics-based modules support the use of jumbo frames. These are frames that are “oversize” with respect to the Ethernet standard, but are not counted as oversize frames by the receiving port. A jumbo frame can be up to 10, 000 bytes long.

Module Support

The following modules support the use of jumbo frames:

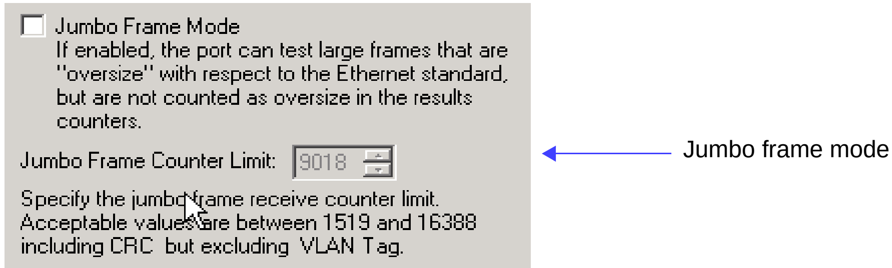
Table 5-21. Module Support for Jumbo Frames

Module	Description
LAN-3101A/B LAN-3102A LAN-3111A LAN-3111As	10/100Base-T Ethernet, 6-port, SmartMetrics 10/100Base-T Ethernet, 2-port, SmartMetrics 10/100Base-FX Ethernet, 6-port, multi-mode, 1300nm, SmartMetrics 10/100Base-FX Ethernet, 6-port, single mode, 1310nm, SmartMetrics
LAN-332*x*A	10/100/1000 Mbps and Gigabit Ethernet Fiber, 2/4/1-port, SmartMetrics XD and TeraMetrics XD
LAN-3710AE LAN-3710AL LAN-3710AS	10GBase-ER Ethernet, 1-port, 2-slot, single mode, 1550nm 10GBase-LR Ethernet, 1-port, 2-slot, single mode, 1310nm 10GBase-SR Ethernet, 1-port, 2-slot, single mode, 850nm
XLW-3720A XLW-3721A	10GBase Ethernet XENPAK MSA, 1-port, 2-slot, SmartMetrics 10GBase Ethernet XENPAK MSA, 1-port, 2-slot, TeraMetrics
XFP-3730A XFP-3731A	10GBase Ethernet XFP MSA, 1-port, 1-slot, SmartMetrics 10GBase Ethernet XFP MSA, 1-port, 1-slot, TeratMetrics

Enabling Jumbo Frames

To enable a port to send and receive jumbo frames via the Port Setup window:

1. Choose the **Port Setup** > **General** tab.
2. Select the **Jumbo Frame Mode** checkbox.



Exceptions

There are two cases in which frame sizes can legally exceed the Ethernet standard (1,518 bytes) and not be considered oversized frames. These cases are:

- When VLAN tags are enabled in the stream definition. VLAN tags add four bytes to the frame size.
- When jumbo frame mode is enabled. A jumbo frame can be up to 10,000 bytes long.

Enable these two options (VLAN or jumbo frames) either separately or together. *Table 5-22* shows how these options affect frame size in terms of "oversize" counts.

Note: For XD and XENPAK modules, the jumbo frame size can be adjusted. The minimum frame size for XLW-372xA and XFP-373xA is 49 for Layer 2 mode and 42 for Layer 3 mode.

Table 5-22. Legal Oversize Frames with VLAN or Jumbo Frame Mode

Jumbo Enabled?	VLAN Enabled?	Oversize Size	Jumbo Size
No	No	1,519 >= bytes	N/A
No	Yes	1,523 >= bytes	N/A
Yes	No	9,019 >= bytes	1,518 - 9,018 bytes
Yes	Yes	9,023 >= bytes	1,522 - 9,022 bytes

Using Jabber Count to Simulate Jumbo Frames

Some SmartBits 200/2000 SmartCards allow you to set a "jabber count" for transmitted test frames. Each unit of jabber adds 8K to each packet. For example, specify **2** to add 16K of jabber to create a jumbo frame that can be used to assess the DUT ability to handle oversize frames.

Jabber count is set in the *Gigabit Setup* dialog box of SmartCards that support it.

Virtual Flow Cyclic ARPs and ARP Requests

For specific TeraMetrics modules that use IPv4 and IPV6, the transmitting port can be configured to generate virtual flow cyclic ARPs. When the option is enabled, the SmartBits port sends an ARP request for each iteration of a configured cyclic flow, i.e., a sequence of test packets in which the source or destination address(es) of the stream(s) are varied as frames are sent. This feature can be used to load and test the DUT ARP cache.

For specific modules using IPv4 and IPv6, vary two ARP/solicitation MAC bytes to define a unique ARP/solicitation MAC destination address. This MAC is defined in the receive properties of an ARP request/solicitation and described in *"To define receive properties of ARP requests for IPv4:" on page 188* and *"To define receive properties of solicitations for IPv6:" on page 180* for IPv6.

Module Support

Table 5-23 and *Table 5-24 on page 187* list which SmartBits 600x/6000x modules support virtual flow cyclic ARPs as well as the definition of ARP request MAC addresses.

Table 5-23. Module Support for Virtual Flow Cyclic ARPs

Module	Description
LAN-3101A/B LAN-3102A LAN-3111A LAN-3111As	10/100Base-T Ethernet, 6-port, SmartMetrics 10/100Base-T Ethernet, 2-port, SmartMetrics 10/100Base-FX Ethernet, 6-port, multi-mode, 1300nm, SmartMetrics 10/100Base-FX Ethernet, 6-port, single mode, 1310nm, SmartMetrics
LAN-3300A LAN-3301A LAN-3302A	10/100/1000Base-T Ethernet, Copper, 2-port, SmartMetrics 10/100/1000Base-T Ethernet, Copper, 2-port, TeraMetrics 10/100Base-T Ethernet, Copper, 2-port, TeraMetrics
LAN-3310A LAN-3311A	1000Base-X Ethernet, GBIC, 2-port, SmartMetrics 1000Base-X Ethernet, GBIC, 2-port, TeraMetrics
LAN-332*x*A	10/100/1000 Mbps and Gigabit Ethernet Fiber, 2/4/1-port, SmartMetrics XD and TeraMetrics XD
XLW-3720A XLW-3721A	10GBase Ethernet XENPAK MSA, 1-port, 2-slot, SmartMetrics 10GBase Ethernet XENPAK MSA, 1-port, 2-slot, TeraMetrics
XFP-3730A XFP-3731A	10GBase Ethernet XFP MSA, 1-port, 1-slot, SmartMetrics 10GBase Ethernet XFP MSA, 1-port, 1-slot, TeraMetrics

Table 5-24. Module Support for Defining ARP MAC Address

Module	Description
LAN-332*x*A	10/100/1000 Mbps and Gigabit Ethernet Fiber, 2/4/1-port, SmartMetrics XD and TeraMetrics XD
XLW-3720A XLW-3721A	10GBase Ethernet XENPAK MSA, 1-port, 2-slot, SmartMetrics 10GBase Ethernet XENPAK MSA, 1-port, 2-slot, TeraMetrics
XFP-3720A XFP-3721A	10GBase Ethernet XFP MSA, 1-port, 1-slot, SmartMetrics 10GBase Ethernet XFP MSA, 1-port, 1-slot, TeraMetrics
XFP-3730A XFP-3731A	10GBase Ethernet XFP MSA, 1-port, 1-slot, SmartMetrics 10GBase Ethernet XFP MSA, 1-port, 1-slot, TeraMetrics

Summary

The *Port Setup* window contains a series of tabs used to define aspects of the port. The *IPv4 Stack* and *IPv6 Stack* tabs are used to configure the source MAC address, source IP address, properties of the ARP requests/solicitations, and other transmit/receive parameters. This section explains how to implement these configurations and use them to:

- Define receive properties of ARP requests
- Define properties of virtual flow cyclic ARPs
- Enable virtual flow cyclic ARPs
- Start ARPs.

Refer to the following locations for additional information on ARP requests, solicitations, and advertisements:

- *"Neighbor Discovery Protocol" on page 179*
- *"Gratuitous ARP Mode" on page 196*
- *"Address Resolution Protocol (ARP)" on page 243*.

The right-most segment of the *IPv4 Stack* tab contains two window panes. The top window pane defines the receive properties of ARP requests. The bottom window pane defines the transmit ARP properties. (See *Figure 5-26 on page 181* for an illustration of the *Port Setup* window with the *IPv4 Stack* tab displayed.)

Defining Receive Properties of ARP Requests

There are three ways to define the receive properties of ARP requests: disable reply to all ARP requests, reply using port MAC address, and reply using unique ARP MAC address.

Notes:

- Review *"Neighbor Discovery Protocol" on page 179* for a description of how these functions are used with IPV6 protocol.
- See *Table 5-24 on page 187* for a listing of the modules that can use a unique ARP MAC address.
- See *"To use the Actions menu to enable/disable replies to ARP requests/ solicitations:" on page 182* for an explanation of how these functions are implemented globally.

To define receive properties of ARP requests for IPv4:

1 Access the **Port Setup** window and select the **IPv4 Stack** tab. Locate the right window pane and select (using pull-down arrow) the **Reply to All ARP requests using Unique MAC** message. (See *Figure 5-30*.)

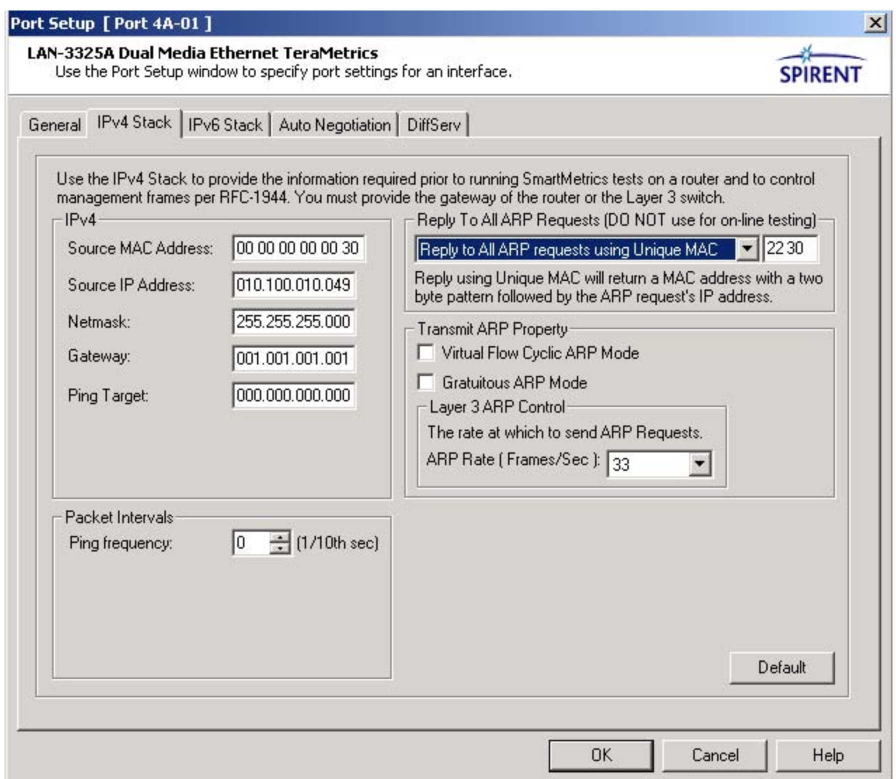


Figure 5-30. ARP Request using Unique MAC

2 Adjacent to the pull-down menu is an entry field. This field displays two static bytes of the ARP MAC address. These bytes are set by you to form the MAC address range of the ARP requests. The other four bytes of the MAC address are based on the ARP IP address.

Notes:
- The two static, MAC bytes are used by IPv4 (ARPs) and IPv6 (solicitations). There cannot be different static bytes for IPv4 and IPv6.
- The **Disable Reply to All ARP requests** is the default message.

3 Locate the right window pane and select (using pull-down arrow) the **Reply to All ARP requests using port MAC** message. This selection allows you to use the port MAC address to define the destination ARPs.

4 Locate the right window pane and select (using pull-down arrow) the **Disable Reply to All ARP requests** message. This selection disables the reply to all ARP requests.

Defining Properties of Virtual Flow Cyclic ARPs

The pane located directly below the *Reply to All ARP Requests (DO NOT use for online testing*) pane is labeled *Transmit ARP Property*. Located within this pane is the checkbox that is used to enable virtual flow cyclic ARPs. (See *Figure 5-30 on page 188*. *Table 5-25* provides a quick overview of how to set up virtual flow cyclic ARPs.)

Table 5-25. Module Support for Virtual Flow Cyclic ARPs

Step	Description
1	Enable **Virtual Flow Cyclic ARP Mode** in the *Port Setup* window.
2	Enable **SmartMetric Mode** on the *Port* menu.
3	Open the *Streams Setup* window and add test streams.
4	Select the stream(s), then click **Edit** to open the *Tx Control Panel*.

Table 5-25. Module Support for Virtual Flow Cyclic ARPs (continued)

Step	Description
5	Use the *Flow Generation* fields to create cyclic flows. Select the following values (or combinations of these values): • IP ADDR. SOURCE. *This must be present as one value, and it must be set in every defined stream.* • IP ADDR. DEST. • MAC ADDR. SOURCE • MAC ADDR. DEST. • VFD 1 • VFD 2 • VLAN • OX_ID • Sequence ID (Fibre channel) • Sequence Count (Fibre channel) • NONE If VFD2 is selected, observe the following required values: • *State* = **Increment** or **Static** • *Start Value = Any allowed value* • *Offset* = **6** • *Stutter Count* = **0** • *Step = Any allowed value* • *Cycle Count = Any allowed value*
6	Observe the following guidelines and restrictions: • When one stream is configured, the maximum cycle count is 4,009,600. When 512 streams are configured, the maximum cycle count is 8,000. • The IP source address must be one of the flow variables. • *Carry Chaining* is not permitted. (It is enabled/disabled in the *Flow Generation* pane.) • Avoid setting addresses and cycle counts in cyclic flows so that the IP address ranges of different streams overlap. (See *page 194*.) • When VFD2 (MAC source address) is used as a flow variable, the *State* variable may be set only to **Increment** or **Static**. • *Stutter Count* must be zero.

To enable virtual flow cyclic ARPs:

1. Access the **Port** menu. When offline, this can be done without reserving the module. When online (i.e., SmartWindow is connected to the SmartBits chassis), reserve the module first. Right-click anywhere on the module image except the port button, and select **Reserve This Module**.
2. Select **Port Setup...**
3. Select the **IPv4** tab in the *Port Setup* window. (There are multiple tabs that vary in number and type, depending on what module is accessed.)
4. Locate the bottom right pane labeled *Transmit ARP Property*, and select the **Virtual Flow Cyclic ARP Mode** checkbox (*Figure 5-31*).
5. Locate the *Layer 3 ARP Control* pane. Use the pull-down menu to set the **ARP Rate (Frames/Sec)** value that sends the ARP requests. (Default value is 33.)
6. Click **OK** to close the window.

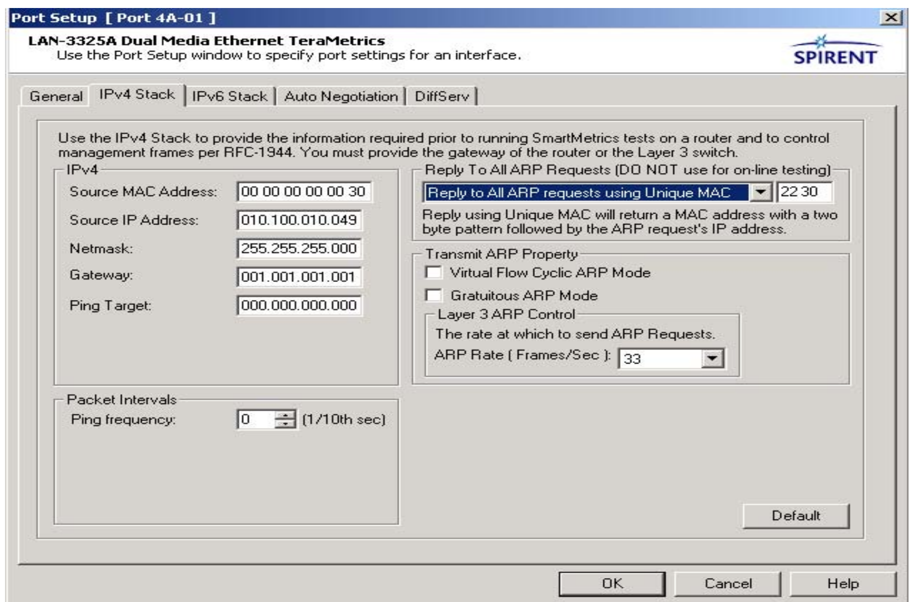


Figure 5-31. Enabling Virtual Flow Cyclic ARPs

The next series of procedures use the *Streams Setup* window and other windows to configure the cyclic flows.

To set up cyclic flows:

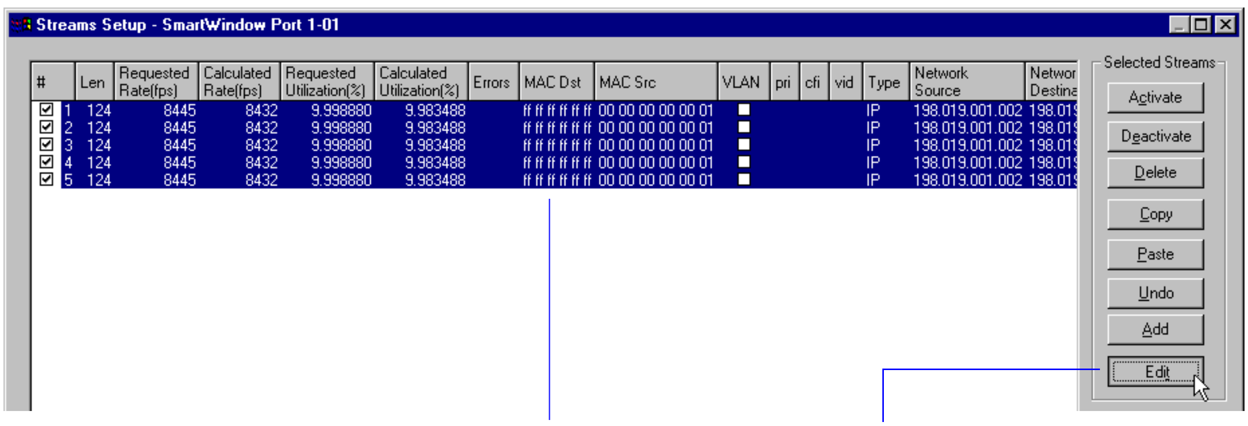
1 Add the test streams.

For an example of how to add streams, refer to the procedure for the LAN-3301A module in *Chapter 7, "SmartMetrics Testing"*. (See *"Set up Port Addresses" on page 248*.)

2 Select (highlight) the stream or streams in the *Streams Setup* window (*Figure 5-32*).

3 Click **Edit**.

The *Tx Control Panel* opens.



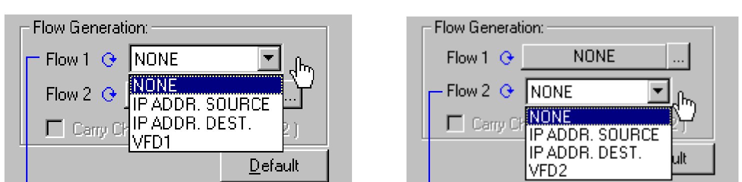
Highlight the stream(s), then click Edit *to open the* Tx Control Panel.

Figure 5-32. Editing Streams

Cyclic flows are created by sending test frames while incrementing a selected address field (or fields) in each frame.

Select which address field(s) to vary in the *Flow Generation* pane of the *Tx Control Panel*. You can set up two cyclic flows, flow 1 and flow 2.

Note: The IP source address (IP ADDR. SOURCE) must be selected as one of the two flow generation options. It must be set in every stream defined in the streams setup list.



The Flow Generation *fields set the address(es) to vary in cyclic flows.*

Allowed address combinations

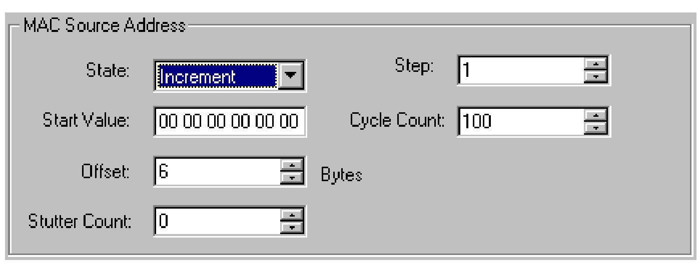
Three combinations of the address options are permitted for virtual flow cyclic ARPs.

	Flow 1	**Flow 2**	**Example**
1	IP ADDR. SOURCE	NONE	
2	IP ADDR. SOURCE	IP ADDR. DEST.	
3	IP ADDR. SOURCE	VFD2	

Required values for VFD2

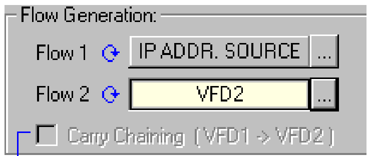
When VFD2 is selected for flow 2 (choice #3 above), VFD2 corresponds to the MAC source address. The related values must be set as follows:

Field	**Required Value**
State	**Increment** or **Static**
Start Value	*Any*
Offset	**6**
Stutter Count	**0**
Step	*Any*
Cycle Count	*Any allowed value*



Carry chaining must be disabled.

The *Carry Chaining* checkbox is cleared, which is the default.

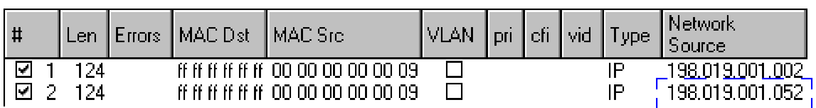


Carry Chaining *must not be enabled.*

Do not overlap address ranges.

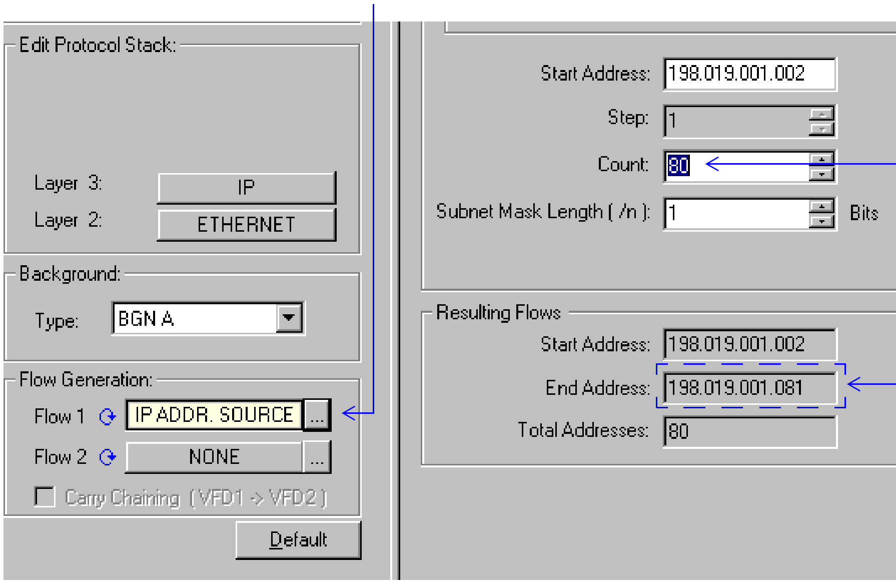
Set up cyclic flows so that, as addresses increment, the addresses do not overlap an address range of another stream.

Here is an example:



1. Two streams, with IP source addresses separated by 50 *steps.*

2. For Stream 1, Flow 1 *cyclic flow is based on IP source address.*



***3.** The flow* Count *of* **80** *causes the incremented addresses for stream 1 to overlap the IP source address for stream 2.*

MAC address cylic flows

The MAC address fields can also be used for flow generation. These fields are configured in the same manner as the IP address fields with the exception of the following examples. (For more information on this flow control process, refer to the extensive descriptions in the online Help.)

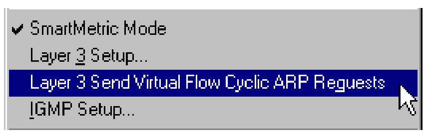
1 Example 1: When the **Initial Address** is ff ff ff ff ff f1, the **Last Address** value (using maximum parameters) is 00 00 fe ff fe ff.

2 Example 2: When the **Initial Address** is ff ff ff ff 00 00, the **Last Address** value (using maximum parameters) is 00 00 fe fe ff 00. (First two bytes are not reserved.)

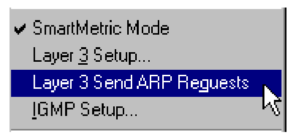
Note: This function is supported on the following modules: LAN-330xA, LAN-331xA, LAN-332xA, XLW-372xA, and XFP-373xA.

How ARPs are Sent

When virtual flow cyclic ARPs are enabled, the *Port* menu option for sending ARP requests changes.



Virtual flow cyclic ARP enabled.



Normal (port-level) ARP

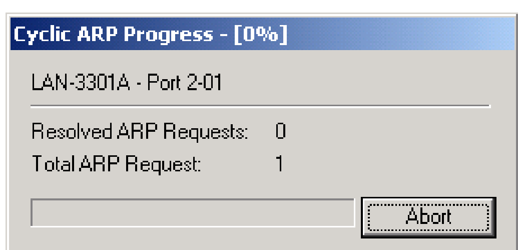
To start and stop ARPs:

1 Select **Layer 3 Send Virtual Flow Cyclic ARP Requests** from the *Port* menu.

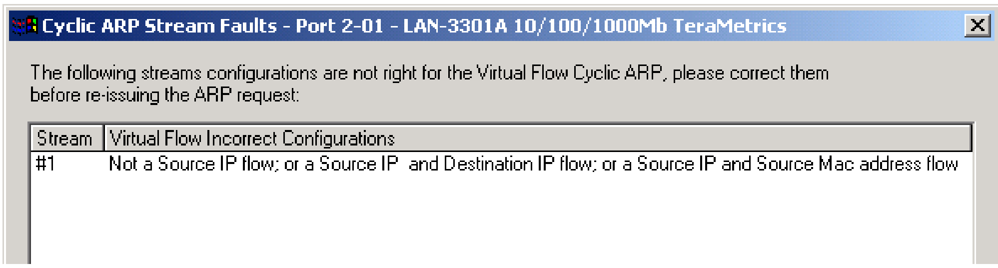
If the stream configurations are correct (*"To set up cyclic flows:" on page 192*), the module begins sending ARP requests. (All other processing stops.)

SmartWindow displays the *Cyclic ARP Progress* window to show activity, including the number of ARP requests to be sent (*Total ARP Request*) and the number resolved.

2 Stop the ARP cycle by clicking the **Abort** button.



If a stream configuration is flawed in some way, SmartWindow opens the *Cyclic ARP Stream Faults* window. Use this information to correct the configuration of virtual flows. Then reissue the ARP request, by selecting from the *Port* menu.



Gratuitous ARP Mode

The *Gratuitous ARP Mode* checkbox is located on the *IPv4* tab of the *Port Setup* window on TeraMetrics-based Ethernet modules. When this option is enabled, the SmartBits port processes gratuitous ARP packets that it receives. (SmartBits ports do not generate gratuitous ARP packets, but the ports respond to the packets, when received.)

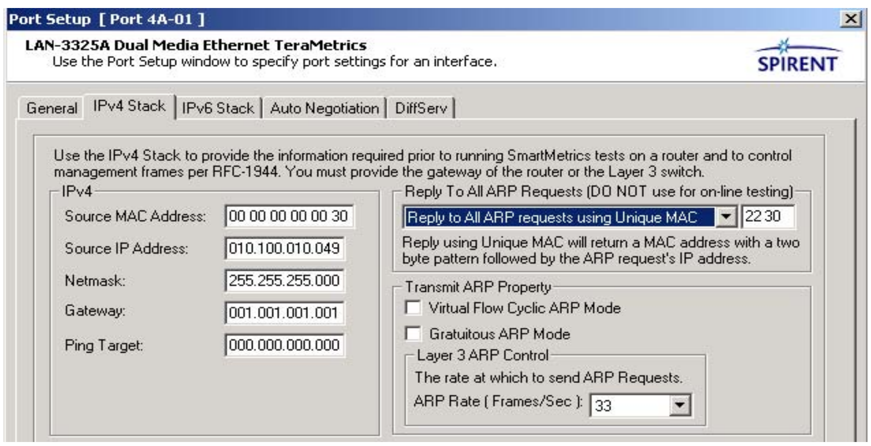


Figure 5-33. Port Setup Window with Gratuitous ARP Option

A network node sends a gratuitous ARP packet to cause other nodes to update an entry in their ARP caches. ARP cache entries match protocol-level addresses (such as IP addresses) to hardware-level addresses (such as MAC addresses).

In a gratuitous ARP packet, the sender IP address and target IP address have the same value. When a SmartBits port receives a gratuitous ARP packet, it examines these address fields to determine whether the contents are identical. More specifically, the port performs the following steps:

1 Stops transmitting test traffic.

2 Checks the destination IP and gateway addresses of all configured IPv4 protocol streams to determine if there is a match with the sender IP address in the gratuitous ARP packet.

3. Updates the stream destination hardware address with the address from the gratuitous ARP packet.
4. Resumes transmission as quickly as possible, leaving counters and settings unaffected by the interruption.

Counters

When gratuitous ARP mode is enabled, gratuitous ARP packets received by the port are listed in the SmartCounters window. These packets are identified as gratuitous ARP requests received.

Gratuitous ARP Counter Behavior on TeraMetrics Cards

Incrementing the Gratuitous ARP Counters

The gratuitous ARP counter does not count the number of gratuitous ARPs received by the port. It increments by one for each incoming gratuitous ARP that matches one or more of the streams configured on the port. Once a stream is changed by a gratuitous ARP, subsequent identical gratuitous ARPs are ignored and do not result in further incrementaiton of the counter.

Zeroing the Gratuitous ARP Counter

The gratuitous ARP counter is zeroed on any port when:

- All counters are cleared on the port.
- ARPs are initiated from the port.
- The ARP mode is changed on the port (from gratuitous to standard or standard to gratuitous).

Chapter 6

Traditional LAN Testing

SmartWindow is a highly effective front panel GUI designed for developers and QA personnel who need to create both traditional and custom tests. SmartWindow offers test parameters recommended in the following supported RFCs:

- RFC 1242 – Benchmarking Terminology for Network Interconnection Devices
- RFC 2544 – Benchmarking Methodology for Network Interconnect Devices
- RFC 2285 – Benchmarking Terminology for LAN Switching Devices

In this chapter...

Traditional Testing vs. SmartMetrics

LAN SmartCards and some LAN modules provide two types of Ethernet testing: traditional mode and SmartMetrics mode. Other cards/modules only provide traditional mode testing. Each of these two testing modes uses different windows and displays in the user interface. For this reason, be sure to review the text and illustrations for specific model numbers that identify what mode(s) are supported by the card/module that is being used.

Traditional Mode (for Simulating Layer 2 and Layer 3)

Refers to the basic capabilities of all cards, which include:

- Customizing packet content with a protocol editor, including the ability to intersperse alternate traffic with regular streams.
- Monitoring and validating packets with user-definable triggers.
- Defining and using VLAN tags.
- Adjusting preamble length, auto-negotiation, frame capture, and packet counting based on events.
- Generating packets up to and beyond wire speed plus variety of transmission modes as well as ability to dynamically vary packet gap and length (without FCS) during transmission.

Figure 6-1 shows the *Port Setup* window for the LAN-3100A (traditional mode only module). Refer to *Chapter 4, "Basic Operational Theory"*, *Chapter 5, "Advanced Operational Theory"*, and the online Help for additional information on traditional mode testing.

Notes:

- SmartBits 200/2000 SmartCards and SmartBits 600x/6000x modules each use different versions of SmartCounters.
- For the two types of SmartCounters, a listing of cards/modules is given in *"SmartCounters" on page 131*. This chapter and *Chapter 7, "SmartMetrics Testing"* describes the SmartCounters display that is used for SmartBits 200/2000 SmartCards. *Chapter 8, "Testing Gigabit Routers,"Chapter 11, "Testing POS Routers,"* and *Chapter 13, "Testing Storage Area Networks"*describe the SmartCounters used for the SmartBits 600x/6000x modules.
- The LAN-3100A provides counters for dribble values. Other traditional mode and traditional/SmartMetrics mode cards/modules do not have this capability. The online Help has a complete description of this function.

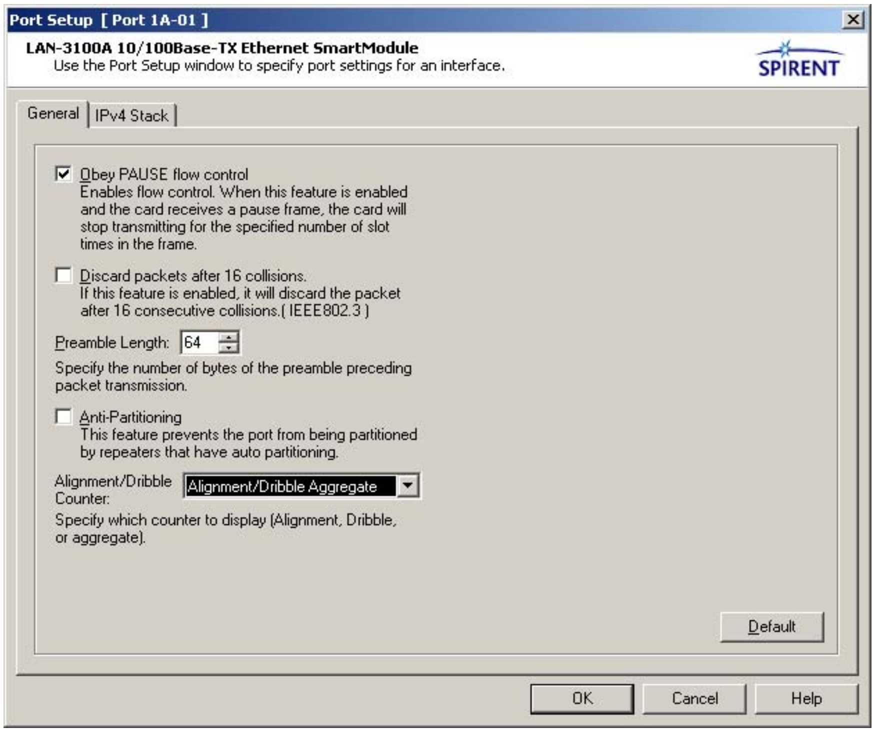


Figure 6-1. Port Setup for LAN-3100A

SmartMetrics

New, faster, smarter networks require new test metrics, methodologies, and performance analysis solutions. To respond, SmartBits SmartMetrics cards are capable of:

- Generating up to 1,000 fully customizable streams, up to and beyond wire speed.
- Simulating up to 1,000 flows with different priority levels.
- Measuring throughput, latency, packet loss, and sequence tracking of each packet on a continuous basis, based on a unique signature field.
- Running a full IGMP and IP protocol stack, enabling the card to respond to an ARP directed at its streams.
- Integrating testing for IP over ATM to Ethernet as well as ATM to frame relay.

Figure 6-2 on page 202 shows the *Port Setup* window for the XLW-3721A (traditional/ SmartMetrics mode module). Refer to *Chapter 7, "SmartMetrics Testing"*, *Chapter 8, "Testing Gigabit Routers"*, and the online Help for additional information on SmartMetrics mode testing.

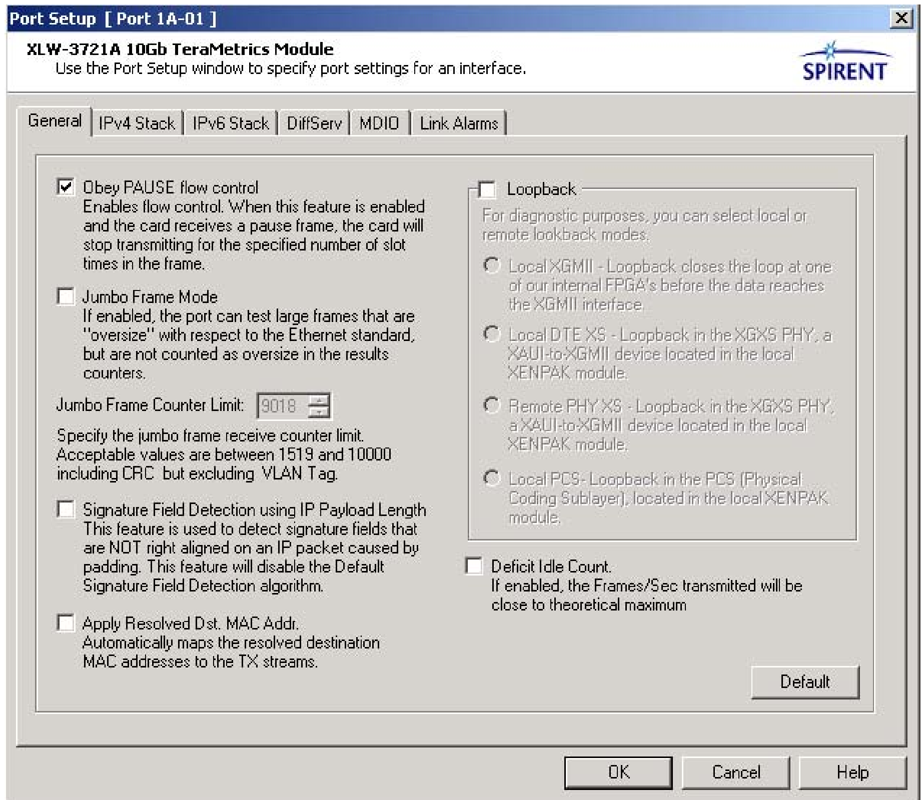


Figure 6-2. Port Setup for XLW-3721A

Testing Cable Modems

USB is a an emerging transport media for connecting to broadband access technologies, such as cable modems and xDSL. The ML-5710/A is a SmartMetrics SmartCard with one 10Mbps Ethernet (RJ-45) and one USB (series A) port. Its USB port enables you to simulate full-field testing conditions of cable modem systems.

The test described below uses the USB transport capabilities of the ML-5710/A SmartCard to test the transmission of Ethernet frames over USB. In addition, an ML-7710 SmartCard is used to capture, count, and compare Ethernet frames that are reassembled by the head end router.

Figure 6-3 illustrates a typical test environment:

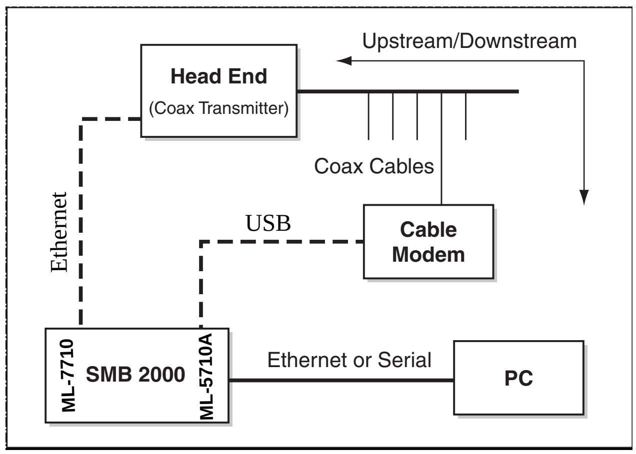


Figure 6-3. Head End to Home Topology

General Guidelines

Device forwarding tables should be initialized before each test run, whenever necessary. ARP requests may be sent from all SmartCards using the assigned MAC addresses by SmartWindow for source and destination. See *Table 6-1, "Global vs. Individual Card Query," on page 213* for information on setting MAC addresses with SmartWindow.

Usually, you should deactivate all SNMP functionality, proprietary polling, and spanning tree on the DUT, so that these types of frames do not adversely affect measurements. The Packet Loss test described in this chapter is set up so that only frames transmitted between SmartCards are counted.

Set up SmartWindow for traditional Layer 2 or Layer 3 "packet blasting" tests as well as SmartMetrics tests, thus simulating actual conditions for:

- Background traffic to be generated by head ends or by modems.
- Downstream traffic to be generated by head ends to the modems.
- Upstream traffic to be generated by the modems to the head ends.

Packet Loss Test

This sample test uses a series of procedures:

Procedure	Description
1	Use triggers and the Protocol Editor, and set up bi-directional frames.
2	Transmit briefly in both directions to give the DUT time for address learning.
3	Capture packets to ensure that the correct frames are being received.
4	Clear SmartCounters.
5	Start the test.
6	Use SmartCounters to compute.

Required Setup

The illustrated test configuration is based on the following setup:

- A SmartBits 2000 chassis with one ML-7710 SmartCard installed in slot 6 and one ML-5710/A SmartCard installed in slot 31.
- The SmartBits chassis is connected to a PC with SmartWindow via an Ethernet port.
- Port 4 is connected to a head end router, and port 31 is connected to a cable modem.

The ML-5710/A card allows you to test the performance of head end routers, whether the CPE is Ethernet or USB. For this Layer 2 test, configure slot 31 (ML-5710/A card) and slot 4 (ML-7710 card) for bi-directional USB transmission.

Connecting the Cables

To set up cabling:

1. Connect one end of the USB cable to the USB port in the ML-5710/A card in slot 31 and the other end to the USB port on the cable modem.
2. Connect one end of an Ethernet cable to the ML-7710 card in slot 4 and the other end to an Ethernet port on the head end router.

The capabilities of the system can now be tested.

Preparing the SUT

Configure the System Under Test (SUT) according to test needs. This simple Packet Loss test does not require extensive pre-configuration.

Testing Packet Loss in Traditional Mode

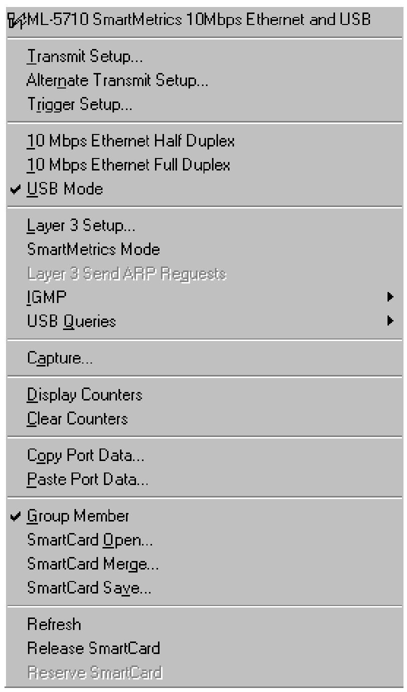
Simple packet loss tests during USB transmission can be managed using SmartWindow traditional (Layer 2) capabilities.

Notes:
- This test setup uses the ML-7710 and ML-5710/A.
- To perform the test in Ethernet mode, the ML-7710, SX-7410/B, or other SmartCard can be substituted for the ML-5710/A.

To test packet loss in traditional mode:

Configure the ML-5710/A for USB.

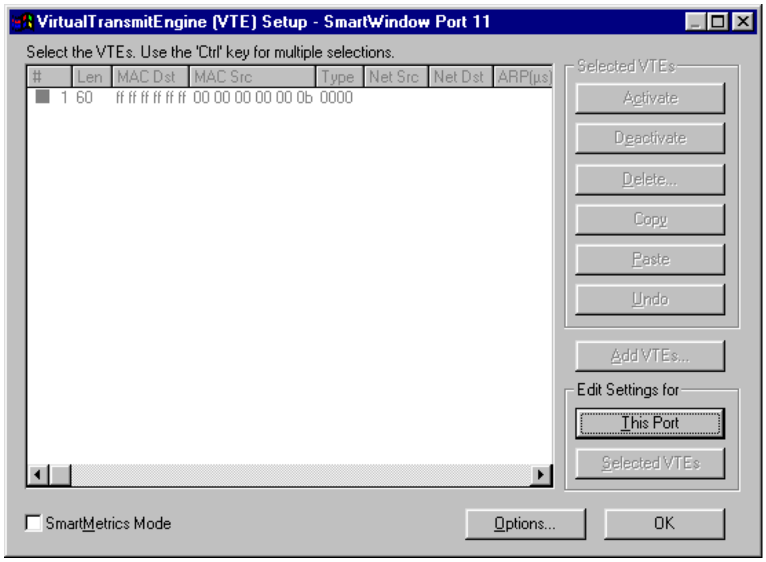
1 Right-click the port 31 SmartCard image. The drop-down menu appears.



2 Choose **USB Mode**.
The card is now configured for USB.

Configure the ML-7710 and ML-5710A for bi-directional transmit/receive.

3 From the drop-down menu on port 31, choose **Transmit Setup**. The *VTE Setup* dialog box appears.



4 Do not select the **Smartmetrics Mode** checkbox.

5 Click the **This Port** button.

Configure port 31 (ML-5710A) to transmit 5,000 frames to port 4 (ML-7710).

6 To configure a burst of 5,000 packets, select **Single Burst** from the **Mode** field and then type in **5000** in the **Count** field to send the specified packets from port 31 through the SUT to port 4 and then stop transmission.

7 Set **Interpacket Gap** to one of the available values. (See *Figure 6-5 on page 207.)*

8 Set **Length (Bytes)** to **62** in order to set a trigger right after the Collision window in the frame so that counted packets are not runts.

Important: USB "packeting" does not work in the same way as Ethernet "framing." To transport Ethernet frames, USB first breaks Ethernet frames into 64-byte packets. The interpacket gap is inserted at the end of the Ethernet frame. (See *Figure 6-5 on page 207* for interpacket gap values.)

For example, a 512-byte Ethernet frame is broken into 64-byte fragments, with the specified interframe gap value appended at the end of the frame. The 64-byte USB frames are transmitted, and the Ethernet frame fragments are extracted and reassembled on the other end.

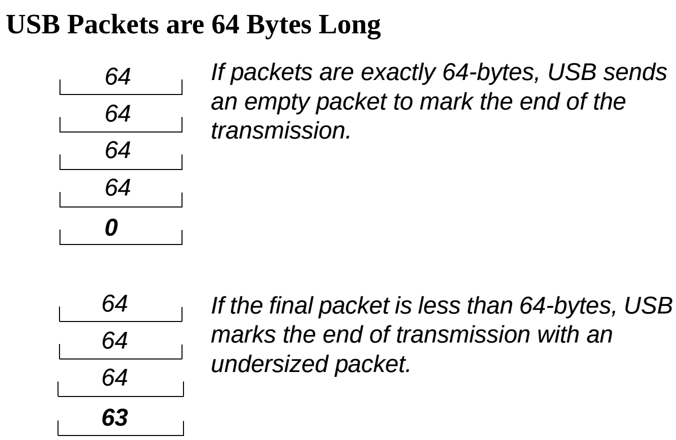


Figure 6-4. USB Packeting

The cable modem always adds the CRC to the Ethernet frame. For example, if you transmit a 1,514-byte Ethernet frame, the cable modem adds the 4-byte CRC so that the received Ethernet frame is 1,518 bytes.

Interpacket gap refers only to the gap between Ethernet frames. Whichever value is selected, USB transmission is full line rate. Set **Interpacket Gap** to one of the values shown below:

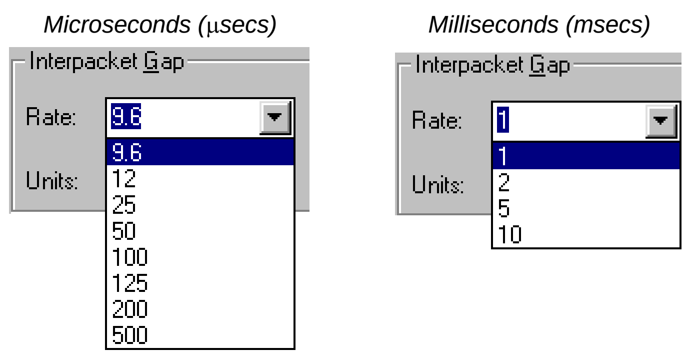
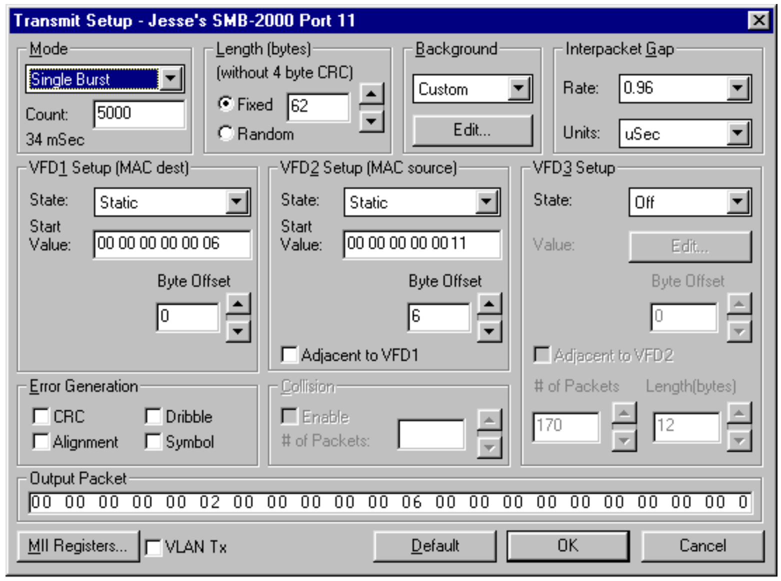


Figure 6-5. Ethernet Frame Interpacket Gap Values for USB Encapsulation

9 To configure the destination MAC address, select **Static** from the **State** drop-down menu in the **VFD1 Setup** field. Then type `00 00 00 00 00 06` in the **Start Value** field. Do not change the **Byte Offset** field value. (Default is **0**.)



10 To set the source MAC address, edit VFD2 by selecting **Static** from the **State** drop-down menu in the **VFD2 Setup** field. By default, the MAC address is set to the address of port 31. Change the MAC address to the cable modem MAC address.)

11 Save and close the **Transmit Setup** dialog box.

Notes:

- The source MAC address is the MAC address of the cable modem attached to the ML-5710/A card, not the MAC address of the card itself. The modem acts as a device belonging to its host SmartCard.
- In Layer 2, manually configure VFD2 with the correct source MAC address. Obtain the correct address by using menu commands.
- In Layer 3, use menu commands to automatically configure the MAC addresses of all cards and streams.

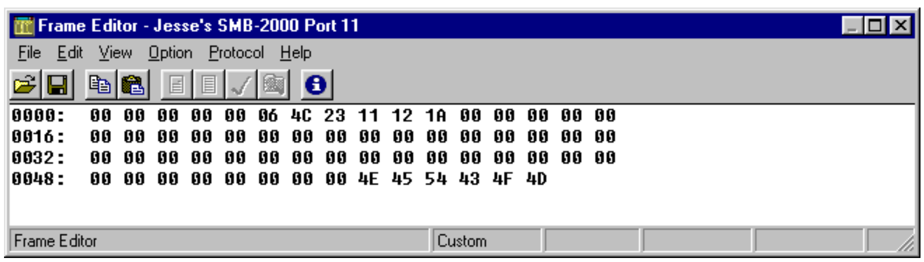
Obtain the source MAC address.

12 Click the card image in port 31 and choose **USB Queries > Query and View USB Modem MAC Address**. The following dialog box appears that contains the MAC address of the cable modem.

13 Type `4c 23 11 12 1a 00` in the **Start Value** field. Do not change the **Byte Offset** field value. (Default is **6**.) Select the **Cycle Count** checkbox, and type **5000** to match the **Single Burst** count.

Note: See *Table 6-1 on page 213* for information on how to replace the default MAC addresses with the true cable modem addresses attached to ML-5710A SmartCards.

14 Click **Edit** in the **Background** field to set a value on which to trigger. The Protocol Editor appears.



15 Beginning at byte 56, type the following trigger definition: `4E 45 54 43 4F 4D` (hex for the ASCII characters in the word NETCOM).

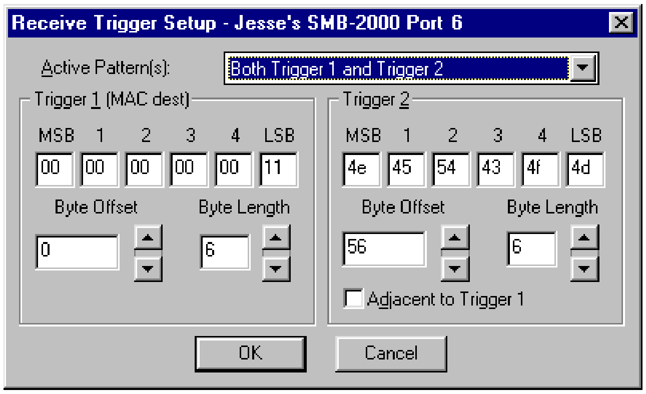
16 Save the changes in the Protocol Editor.

17 Click **OK** twice to save the configuration.

Set up triggers to verify that only the packets sent from the SmartCards are being counted in the Packet Loss test.

18 Click port 4 and choose **Trigger Setup**.

19 Set up triggers as follows:



- Select **Both Trigger 1 and Trigger 2** from the **Active Pattern(s)** drop-down menu.
- Set trigger 1 to **`00 00 00 00 00 06`**
- Set trigger 2 to **`4E 45 54 43 4F 4D`** and set **Byte Offset** to **56**. As noted, this places trigger 2 after the Collision window, so the packet is not discarded as a runt.

Configure port 4 (ML-7710) to transmit 5000 packets to port 31 (ML-5710A).

20 The only changes necessary for port 4 are the VFD and trigger 1 settings:

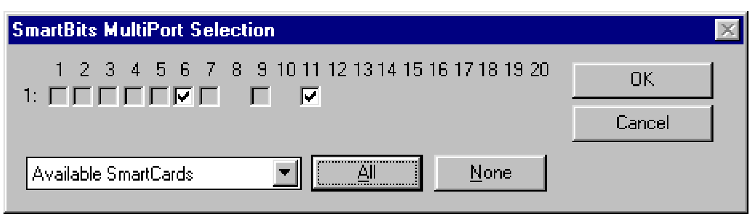
- VFD1–Set the MAC address to `00 00 00 00 11`
- VFD2–Set the MAC address to `00 00 00 00 06`
- Trigger 1–Set trigger 1 to `00 00 00 00 06`

21 Click **OK** and save the configuration.

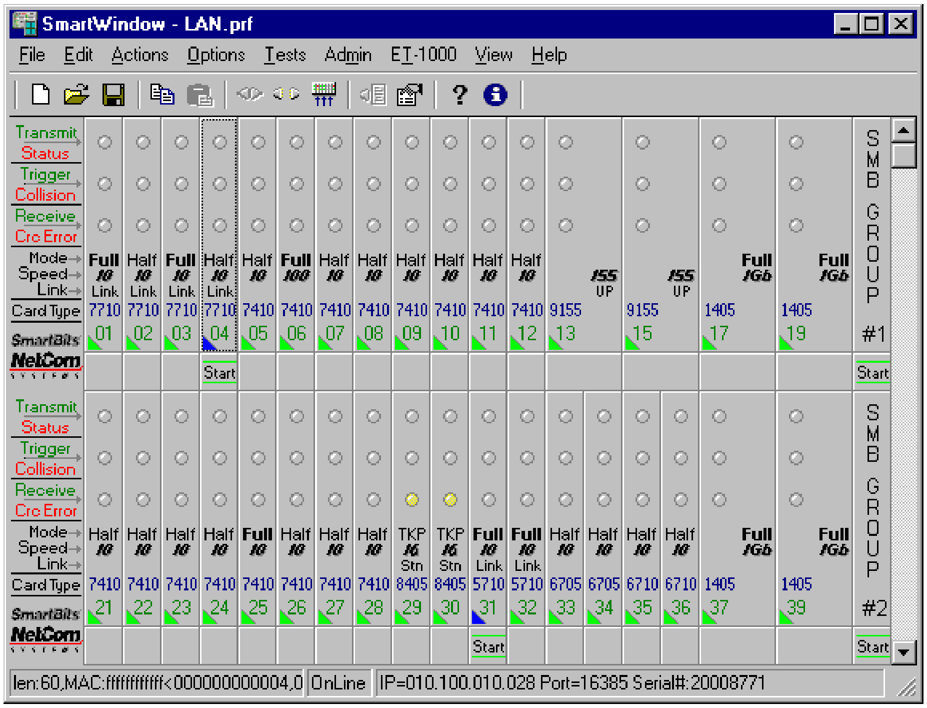
Do a trial run to populate the router address tables.

22 Open SmartCounters.

23 To be able to start both ports running at once, set up ports 4 and 31 as a group. Right-click the **SMB Group** image and choose **Set Group**.

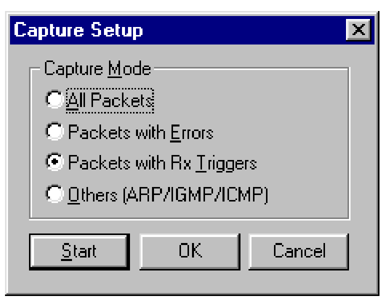


The chassis image should resemble the following:



Tip: Use capture to confirm that the frames being sent are correct.

24 Click port 31 and choose **Capture**. To capture only the frames that are transmitting and not any other traffic, click the **Packets with Rx Triggers** button.



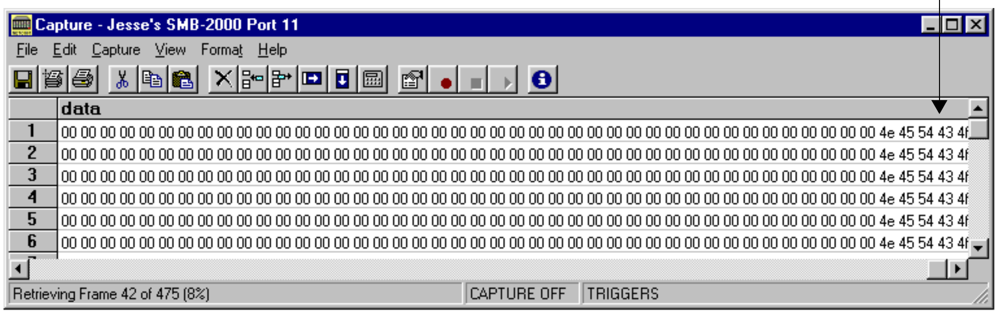
25 Click the **Start** button on the **SMB Group** image to run a trial so that the head-end router can populate its address table.

26 After a few seconds, the addresses are learned so the trial run can be stopped. In this example, because it is a single burst, the test stops automatically.

27 Click **Start**.

28 To view the captured frames, click the **View Results** button.

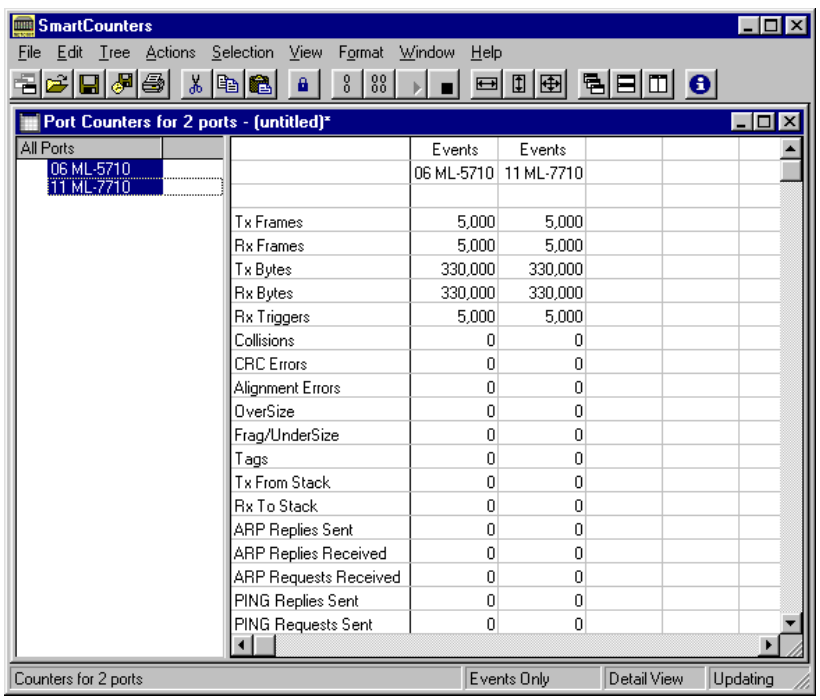
The trigger appears in the captured data.



29 Clear the SmartCounters.

Run the test!

30 Run the test again. When the test finishes automatically after 5,000 packets, Smart-Counters should look like this:



USB Query

USB mode provides menu options that can be used to query and change or view modem MAC addresses. Changing the MAC address means that SmartWindow obtains the MAC address from the cable modem, then replaces the default MAC address in VFD2 for all specified streams with the true cable modem MAC address.

Table 6-1. Global vs. Individual Card Query

Individual Card Query	Menu choice	Result
Click the card image and choose **USB Queries**.	Query And Change All Streams With Modem MAC Address	Changes all MAC addresses for all streams on specified card.[1]
	Query And View USB Modem MAC Address	Displays the MAC address for the connected cable modem.
Global Query		
Choose **Actions** > **USB Queries**.	Query And Change All Streams With Modems MAC Addresses	Changes all MAC addresses for all streams on all cards in chassis.[2]
	Query And View All USB Modems MAC Addresses	Displays the MAC addresses for all cable modems attached to cards in chassis.

1 Available in SmartMetrics mode only. Layer 2 does not update VFD2. Source MAC address must be manually entered.
2 Available in SmartMetrics mode only. Layer 2 does not update VFD2. Source MAC address must be manually entered.

SmartMetrics Testing

In addition to the traditional test in this document, ML-5710A supports the use of SmartMetrics tests in *Chapter 7, "SmartMetrics Testing."* Use this chapter to set up the preceding test in SmartMetrics mode. SmartMetrics allows you to test Latency as well as Packet Loss, Sequencing, and ARP exchange time.

Testing VLAN Tagging Across a Gigabit Uplink

Using six ML-7710 SmartCards and one GX-1420B SmartCard, a series of meaningful tests on 10/100Mbps switches with a copper Gigabit port can be performed. These SmartCards working in traditional mode can test the DUT VLAN capabilities for:

- Flooding and leakage
- Packet loss.

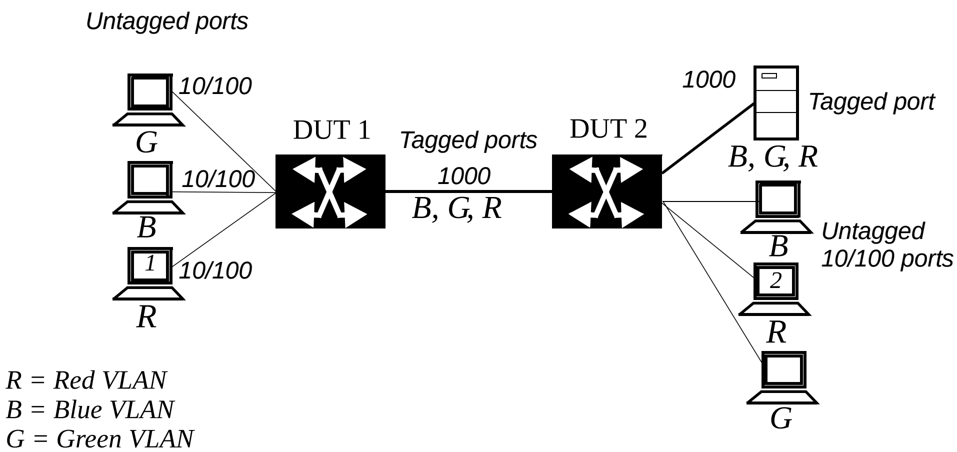


Figure 6-6. VLAN Topology

Note: This test setup uses the ML-7710A and GX-1420B SmartCards. Additional SmartCards that support this test include the following:

- One LAN-3100A can be substituted for the ML-7710, and one LAN-3201B/C can be substituted for the GX-1420B.
- An SX-7410/B can be substituted for the ML-7710.

In *Figure 6-6 on page 214*, three VLANs are configured on two switches, labeled DUT 1 and DUT 2. An untagged frame is sent from host 1 on the red VLAN to host 2 across the network. Once DUT 1 receives the frame, it learns the host 1 source MAC address. It adds a VLAN tag to the frame from untagged host 1. The VLAN tag contains the following information and is inserted between the source MAC address and the original Ethernet type field:

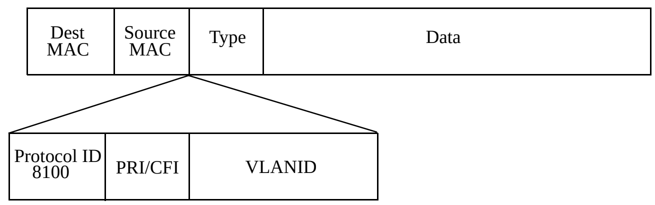


Figure 6-7. Placement of VLAN Tag in Ethernet Frame

DUT 1 forwards the tagged frame to other red VLAN members; in this case, flooding it across its tagged uplink to DUT 2. DUT 2 receives the frame and sends it to all red VLAN members, eventually to host 2, a member of the red VLAN, and to its other tagged port. The access port to which host 2 is attached strips off the VLAN tag.

Trunk ports keep the tag; access ports add the tag at ingress and strip it off at egress. Both of these actions can tax the DUT ability to work at wire speed.

The following configuration tests a VLAN switch for flooding and leakage:

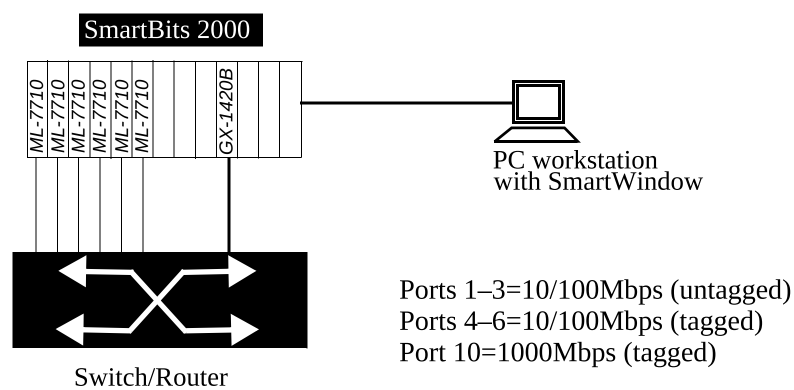


Figure 6-8. VLAN Testing Topology

Preparing the Device Under Test (DUT)

To test whether Tx frames are equal to Rx frames, configure the following VLANs on the DUT. Configuration entails setting up VLANs with the DUT command line:

- Red VLAN = ID2
- Green VLAN = ID3
- Blue VLAN = ID4.

Table 6-2. VLAN Member Test Configuration

	Tagged				
Untagged	**Ports**	4	5	6	10
	1	Red	/	/	Red
	2	/	Green	/	Green
	3	/	/	Blue	Blue

Important: SNMP functionality, proprietary polling, and spanning tree frames generated by the DUT may lower the measured performance of the DUT. It is recommended that all traffic generated by the DUT is turned off to obtain the performance of the switching fabric.

Setting up the Test

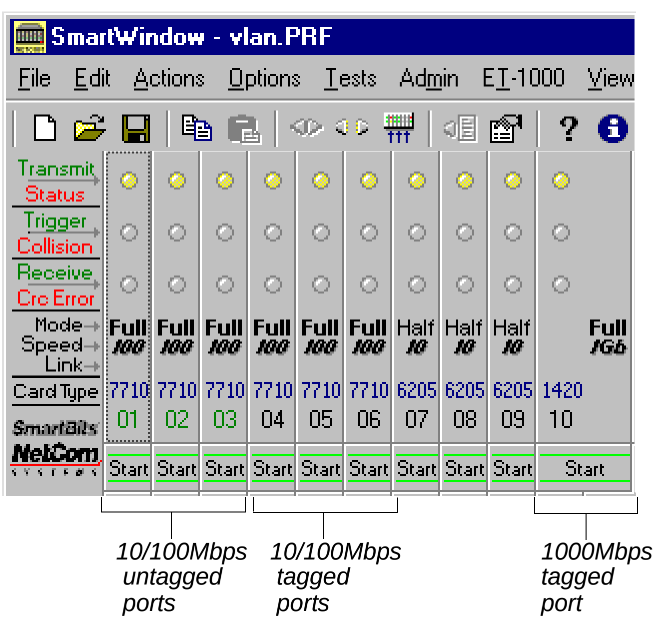
Table 6-3 describes how to configure the tests.

Table 6-3. Test Setup

Test Phase	Untagged Ports	Tagged Ports	Test Objective
1	Ports 1–3 are set up to send frames to members of the three VLANs: red, green, and blue. Ports 1–3 transmit as a group.	Ports 4–6 and port 10 are set up to receive and trigger on frames from ports 1–3.	Ports 4–6 and port 10 monitor the DUT ability to add VLAN tags and then strip them off. The total number of Rx frames on ports 4–6 should equal the frames received on port 10. If the counts are not equal, it can be assumed that the DUT has trouble adding tags at wire speed.
2	Ports 1–3 are set up to receive packets from tagged port 10.	Port 10 is set up to transmit to ports 1–3.	If the counts are not equal, it can be assumed that the DUT has trouble stripping off tags for frames on the access ports at wire speed.

To set up the test:

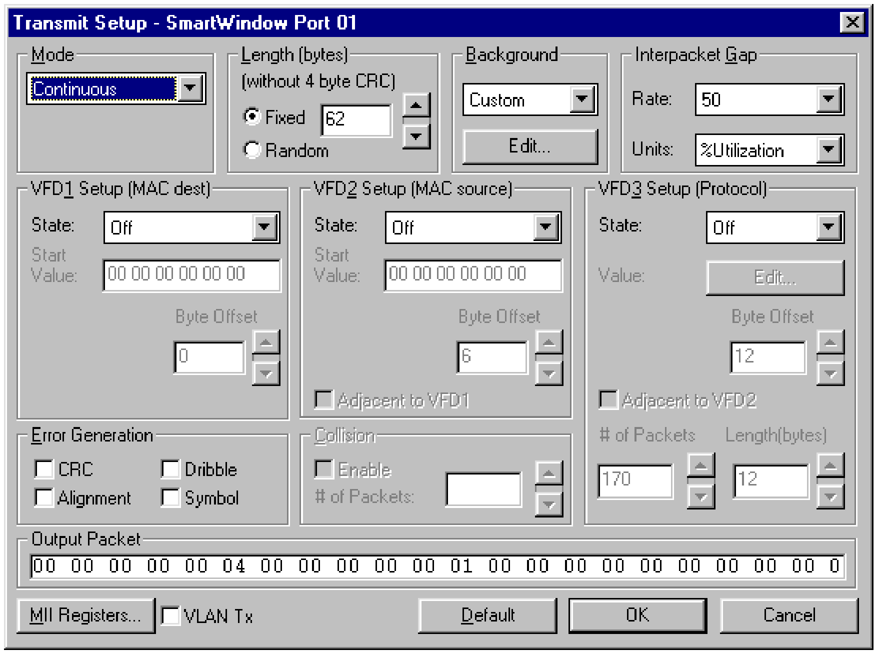
1 Configure a SmartBits 2000 chassis for both test phases at the same time:



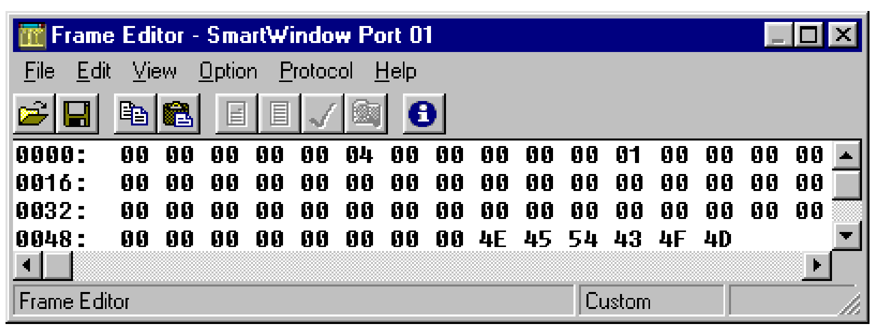
Configure ports 1–3 transmit setup.

2 Click the port 1 image and choose **Transmit Setup** > **This Port**.

3 Configure the ML-7710 card in port 1 as follows. Be sure to match the frame size and other values:



4 Click the **Edit** button in the **Background** pane, and edit the frame as shown below:

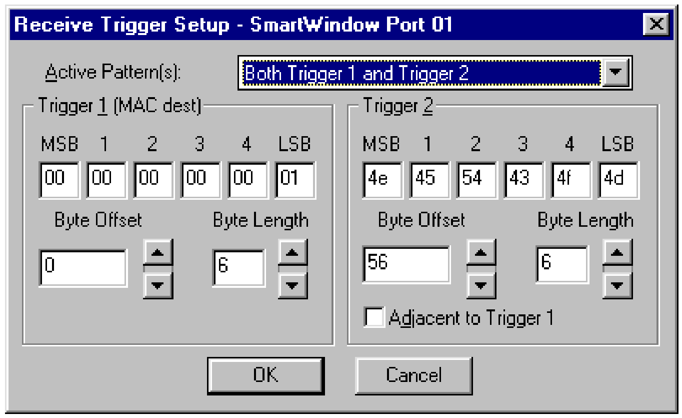


Port 1 is transmitting to port 4. Refer to *Step 5 on page 219* for an explanation of why the outgoing trigger value begins at byte 56.

Configure ports 1–3 trigger setup.

5 To set up the port 1 trigger, choose *Trigger Setup*. Port 1 uses two triggers:

- **Trigger 1** – Its own MAC address.
- **Trigger 2** – The hex equivalent of the ASCII value of N-E-T-C-O-M (at the correct offset).

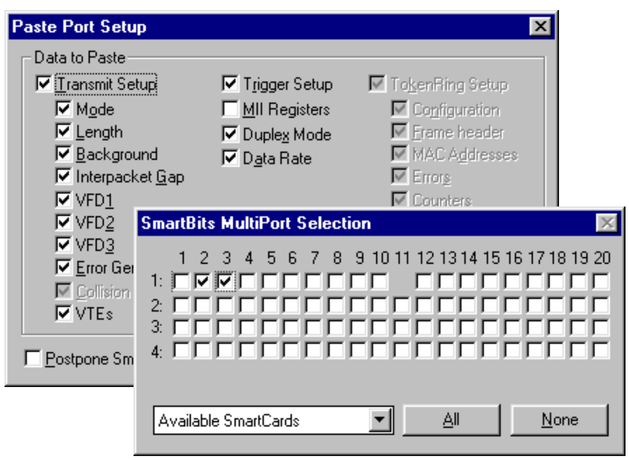


6 Save the configuration.

Configure port 1 data to ports 2–3.

7 To copy the port 1 configuration to ports 2 and 3, click the port image and choose **Copy Port Data**.

8 Right-click again and choose **Paste Port Data**. The following dialog boxes appear.



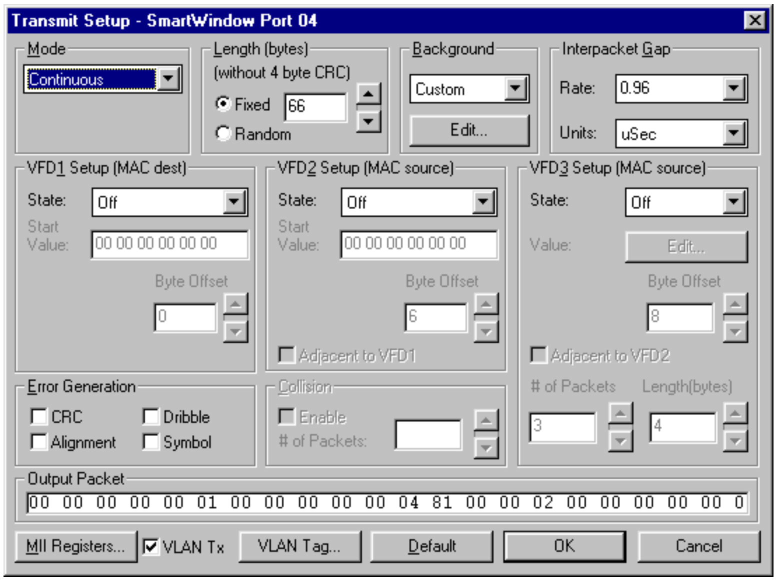
9 Select the ports to which to paste data and the **Data to Paste** option, then click **OK**.

The basic configuration data is pasted to the specified ports.

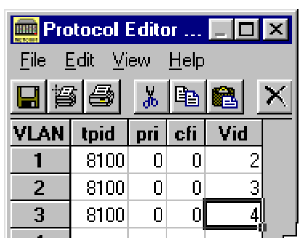
Now custom edit transmit and trigger setup to agree with the VLAN relationships in *Table 6-2, "VLAN Member Test Configuration," on page 216* (e.g., port 2 transmits to port 5, etc.)

Configure ports 4-6 transmit setup.

10 Configure the ML-7710 card in port 4 as follows. Be sure to match the frame size and other values:

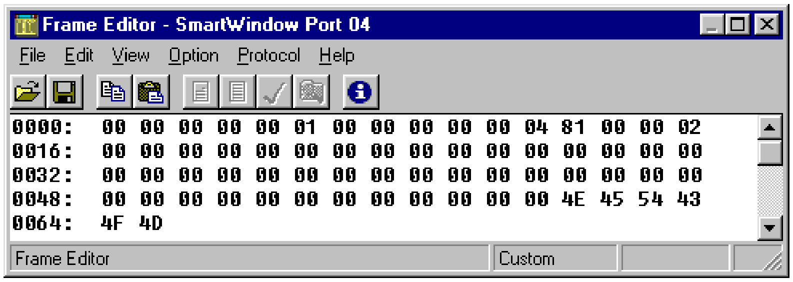


Notice that the **VLAN Tx** checkbox is selected. This option accesses the Protocol Editor that is used to edit the VLAN tag, automatically inserting the tag after byte 12 when finished.



11 Add the tags for all the VLANs as indicated in *"Preparing the Device Under Test (DUT)" on page 216*, then save the tag.

12 Click the **Edit** button in the **Background** pane to view the frame:

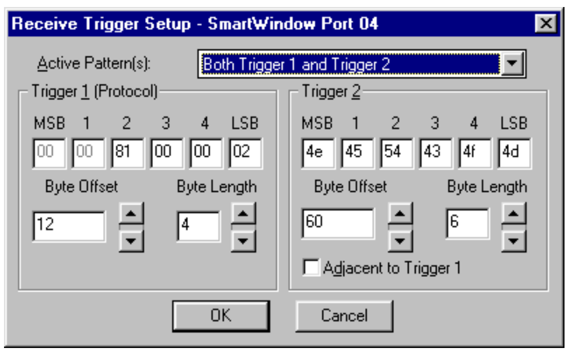


Port 4 is transmitting to port 1. Refer to *Step 5 on page 219* for an explanation of why the outgoing trigger value begins at byte 60.

Configure ports 4-6 trigger setup.

13 To set up port 4's two incoming triggers, choose *Trigger Setup*:

- **Trigger 1** – Red VLAN tag `00 00 81 00 00 02`. (VLAN ID `01` is reserved for the default VLAN on this DUT so the red VLAN must be set up as VLAN 02.)
- **Trigger 2** – Hex equivalent of the ASCII value of N-E-T-C-O-M.



14 Click **OK** to save the configuration.

Copy port 4 data to ports 5-6.

15 To copy the port 4 configuration to ports 5 and 6, right-click the port image and choose **Copy Port Data**.

16 Right-click again and choose **Paste Port Data**.

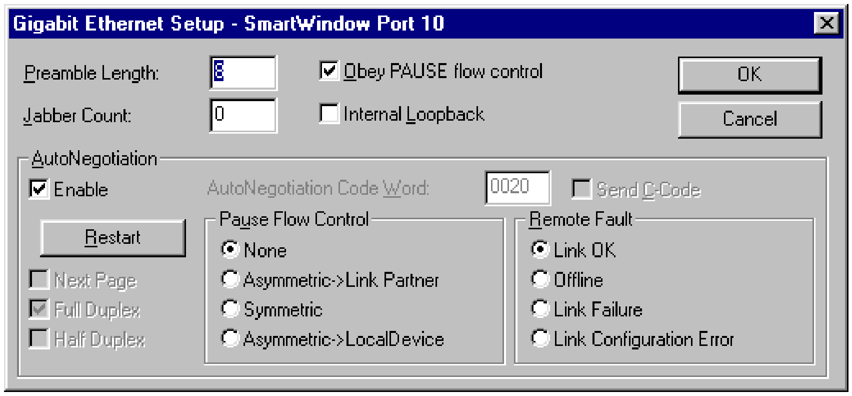
17 Select the ports to which to paste data and the **Data to Paste** option, and then click **OK**.

The basic configuration data is pasted to the specified ports. Now custom edit transmit and trigger setup to agree with the VLAN relationships in *Table 6-2, "VLAN Member Test Configuration," on page 216* (e.g., port 2 transmits to port 5, etc.)

18 Right-click the Gigabit card in slot 10 and choose **Gigabit Setup**.

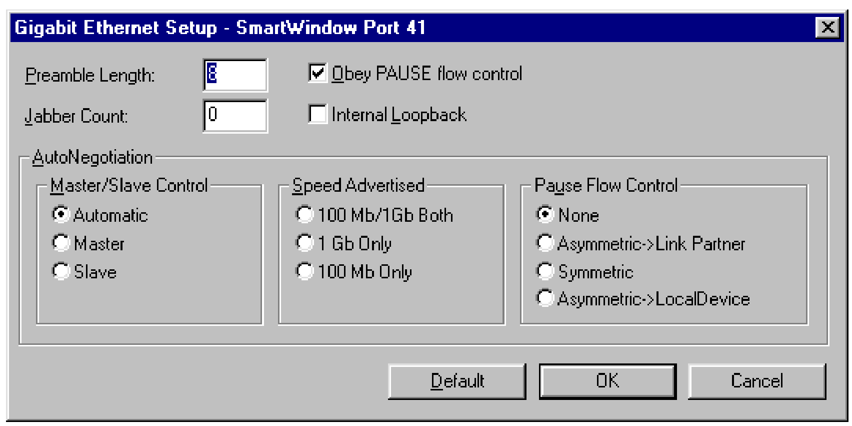
One of the following dialog boxes appears, depending on the type of GX-1420B card installed.

Configure the GX-1420B Gigabit card setup.



Select the **Enable** checkbox in the **AutoNegotiation** pane if the DUT is set to autonegotiate. Otherwise, turn off autonegotiation and then set the duplex manually.

Configure the GX-1420B Gigabit card setup.



The GX-1420B card does not allow you to turn off autonegotiation so per *Table 6-4*, set which card controls the flow of data and, by setting the advertised speed, what kind of connection is made.

For instance, if the GX-1420B card should not connect to a SX-7410/B card, set the advertised speed to *1Gb Only*.

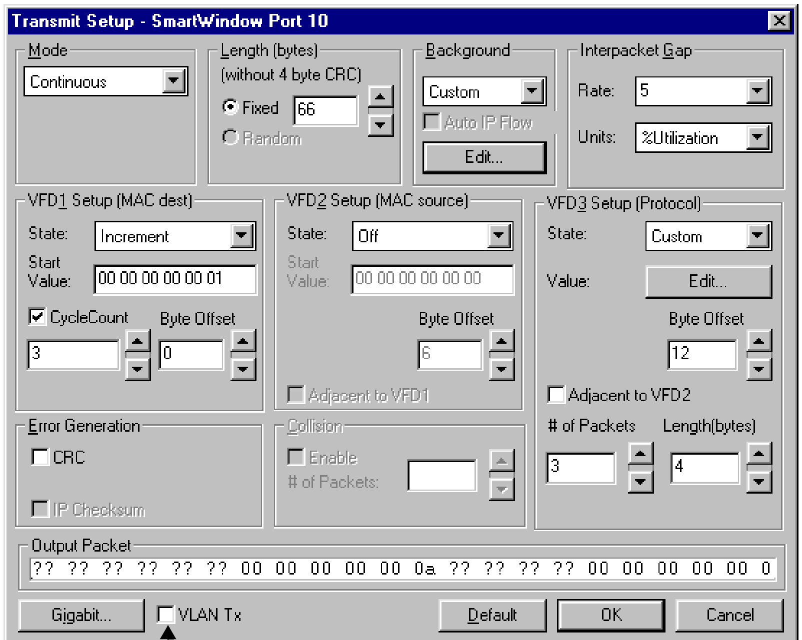
Table 6-4. Master/Slave Precedence

Allow	Card A	Card B
4	A[1]	A
4	M[2]	A
4	S[3]	A
4	A	M
6	M	M
4	S	M
4	A	S
4	M	S
6	S	S

1 Automatic
2 Master
3 Slave

19 Click **OK**.

20 Choose **Transmit Setup**. The following dialog box appears.

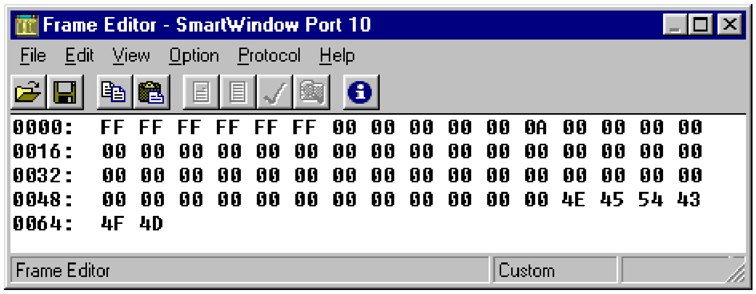


This test features manual configuration of VLANs on the GX-1420B. It could be configured automatically (as in the previous section) by selecting this checkbox.

21 Set the parameters to match the above:

- The **Interpacket Gap Units** to **%Utilization** of 5%. (The 10/100 ports should be set to 50%.)
- The frame length (without FCS) in bytes to 66.
- VFD1 to **Increment** with a **CycleCount** of 3.

22 In the **Background** pane, choose **Custom,** and click the **Edit** button. Configure the frame as follows:



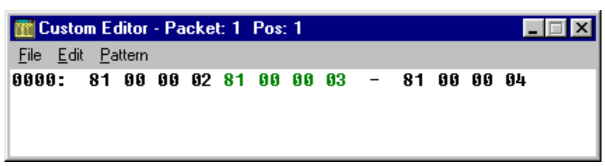
- VFD1 cycles the destMAC three times `01–03`, replacing the background “all ffs” with an incremental MAC address and sending one frame each to ports 1–3 during a given cycle.
- Bytes 61–66 need to be edited to constitute the outgoing trigger 2 pattern, in this case, the hex value of N-E-T-C-O-M.

23 Click the **Close** button, and save the frame to return to **Transmit Setup**.

Using VFD3 to set up VLAN tags.

24 For the VLAN ID, set **VFD3** to **Custom** and set the following parameters:

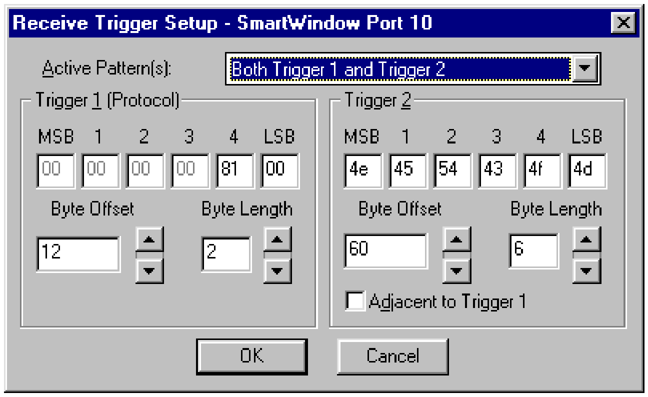
- **Byte Offset** to **12**
- **# of Packets** to **3**
- **Length(bytes)** (without FCS) to **4**.



Three VLAN tags are created for each of the three VLANs. When the GX-1420B card transmits, it inserts a VLAN tag for each of the three cycling frames created with VFD1. Counters on ports 1–3 can then evaluate how fast and how well the DUT strips off the VLAN tag and delivers the frame to the target VLAN.

Note: Remember that the first of the three VLAN tags begins with `02` because the default VLAN on the DUT is usually `01`.

25 Right-click the card image and choose **Trigger Setup**. The following dialog box appears:



26 To set up two incoming triggers for port 10, set up triggers as follows:

- **Trigger 1** – Partial VLAN tag of `81 00`. (This allows the GX-1420B card to trigger on all VLAN frames sent from ports 1–3. The number of frames received on port 10 should equal the total number of frames received on ports 4–6.)
- **Trigger 2** – Hex equivalent of the ASCII value of N-E-T-C-O-M.

27 Open SmartCounters, start **Capture**, and run the test.

Between Layer 2 and Layer 3

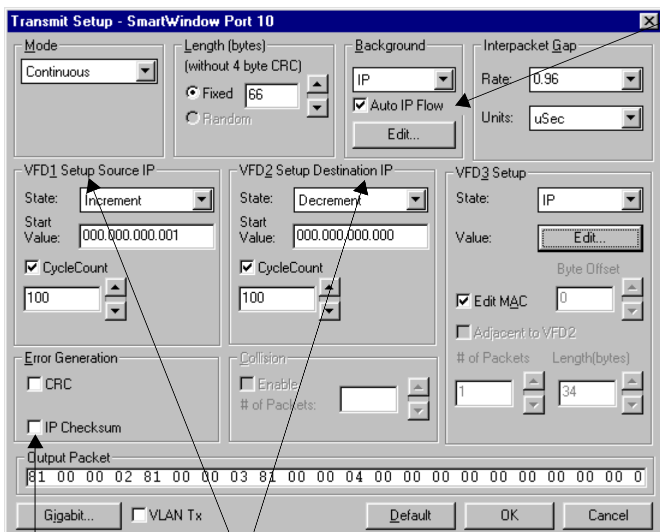
Although considered Layer 2 cards, both the LAN-3100A module and GX-1420B Gigabit copper SmartCard have an auto IP flow capability that allows a single stream to cycle through multiple IP addresses. This feature tests:

- The ability of a router to cycle through IP address hosts on a subnet.
- ARP caching.
- QOS by using VFD3 to modify the TOS field.

When the *Auto IP Flow* checkbox is selected, the GX-1420B hardware is used to cycle through IP addresses and then calculate and validate the IP checksum for both Tx and Rx.

To use auto IP flow:

1. Right-click the card image on the chassis.
2. Choose **Transmit Setup**, select **IP** in the **Background** pane, and then select the **Auto IP Flow** checkbox. Edit the **Transmit Setup** dialog box accordingly:



When the Auto IP Flow *checkbox is selected, two field displays—IP checksum plus VFDs 1 and 2—are modified.*

1) The IP Checksum *checkbox is activated, allowing each packet to generate a checksum error.*

2) VFD1 and VFD2 change to allow cycling of IP addresses.

Note: Compare the above dialog box (with the **Auto IP Flow** checkbox selected) with the same dialog box (when the **Auto IP Flow** checkbox is clear) in *Step 20 on page 224*.

Testing QOS for Gigabit Routers

The following test uses two GX-1420B cards in auto IP flow mode to cycle through the hosts on a subnet of Gigabit router with copper connectors. In addition, VFD3 can be manipulated to accommodate QOS testing.

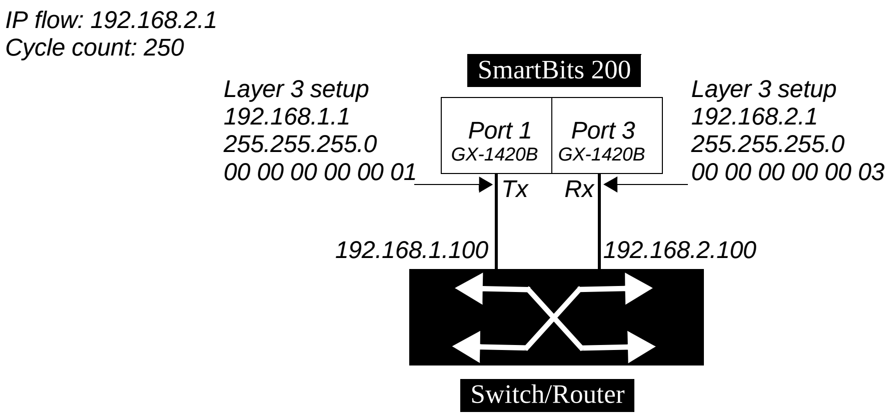
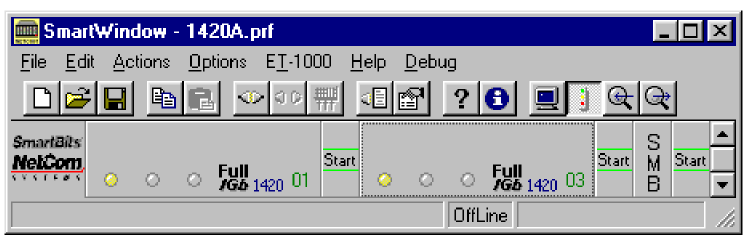


Figure 6-9. QOS Test Topology

Note: This test uses two GX-1420B SmartCards. Additional SmartCards that support this test include the following:

- Two LAN-3100A modules can be substituted for the GX-1420B SmartCards to perform the same test for Fast Ethernet.

Configure the DUT.



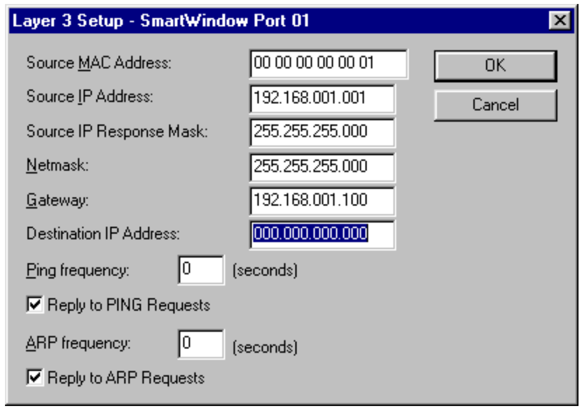
To test QOS for Gigabit routers:

1 Configure the Gigabit router.
Use **Gigabit Setup** on the SmartCards to match the setup requirements of the DUT.

Configure the GX-1420B in port 01.

2 Right-click the card image in port 1, and choose **Layer 3 Setup**. The *Layer 3 Setup* dialog box appears.

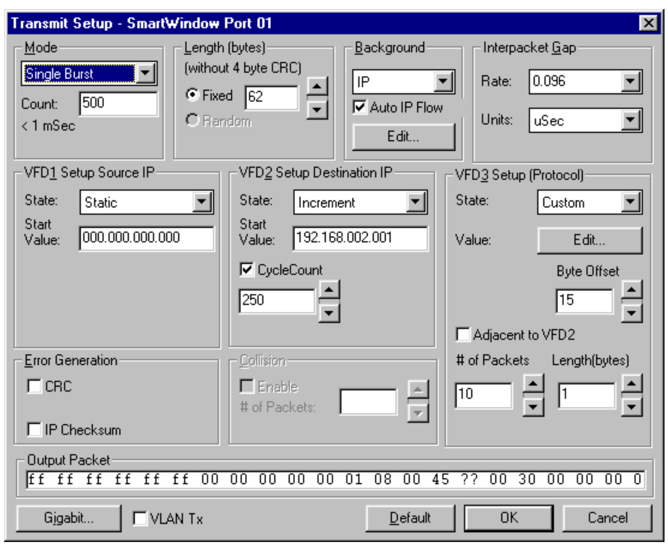
3 Configure Layer 3 setup as follows:



4 Right-click the card image in port 1 and choose **Gigabit Setup**. Make sure that parameters such as flow control, speed, and duplex match the setup of the DUT.

5 Click **OK**, then right-click the card image and choose **Transmit Setup**. The *Transmit Setup* dialog box appears.

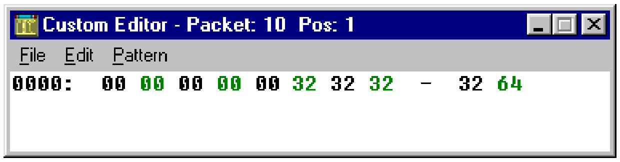
6 Configure transmit setup as follows:



7 In the *VFD3 Setup (Protocol)* pane, click the **Edit** button. The Custom Editor appears.

Note: When auto IP flow is selected, **Custom** is the only VFD3 drop-down menu choice.

8 For this example, configure ten 1-byte values to replace the background values in the TOS field as each flow cycles through.



Note: For the ten packets that make up a simulated cycle, VFD3 substitutes the following values:

- One **64** to simulate video/voice frames
- Four **32**s to simulate database frames
- Five **0**s to simulate HTTP frames.

Higher priority traffic should experience lower latency, even though (in this test) no packet loss is expected. A variation of this test might be to use an ML-7710 on the receiving end and then slightly overbook it by setting the GX-1420B to transmit at 11% of line rate.

9 Close all dialog boxes and save the configuration.

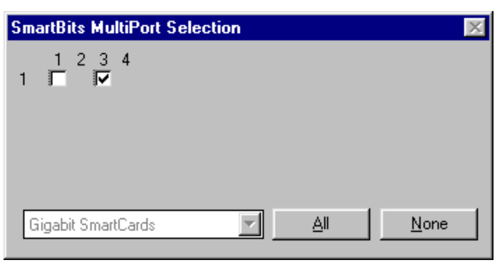
Configure the GX-1420B in port 03.

10 Using the information for port 03 in *Figure 6-9 on page 228*, configure the GX-1420B in port 03.

Note: You need to configure Gigabit setup, Layer 3 setup, and transmit setup. Do this quickly by copying, then pasting the transmit setup data for port 01 to port 03.

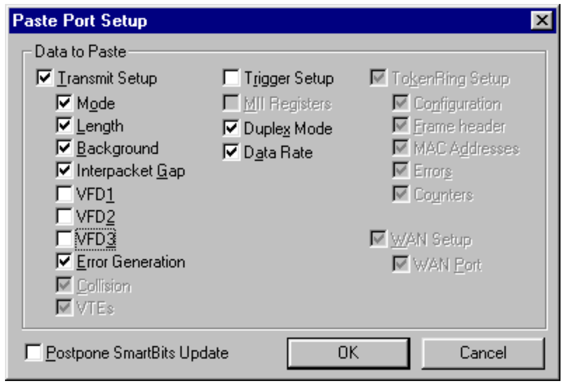
11 Right-click port 01, then choose **Copy Port Data**. A message states that the data has been copied.

12 Right-click port 03, then choose **Paste Port Data**.The following dialog box appears.



13 Check the port 03 checkbox.

14 Select the parameters to paste as follows:



15 Click **OK**. The data from port 01 has been pasted into port 03.

16 Edit the port 03 data to make it conform to the data in *Figure 6-9 on page 228*. Save and close all dialog boxes.

17 Connect to the selected chassis, and click **Download** on the menu bar.

Group the two cards, open SmartCounters, and start Capture.

18 Right-click the **SMB** field in the chassis image, and choose **Set Group**.

19 Choose **Actions > SmartCounters**, then open a new SmartCounter.

20 Right-click the port 03 image, and choose **Capture**.

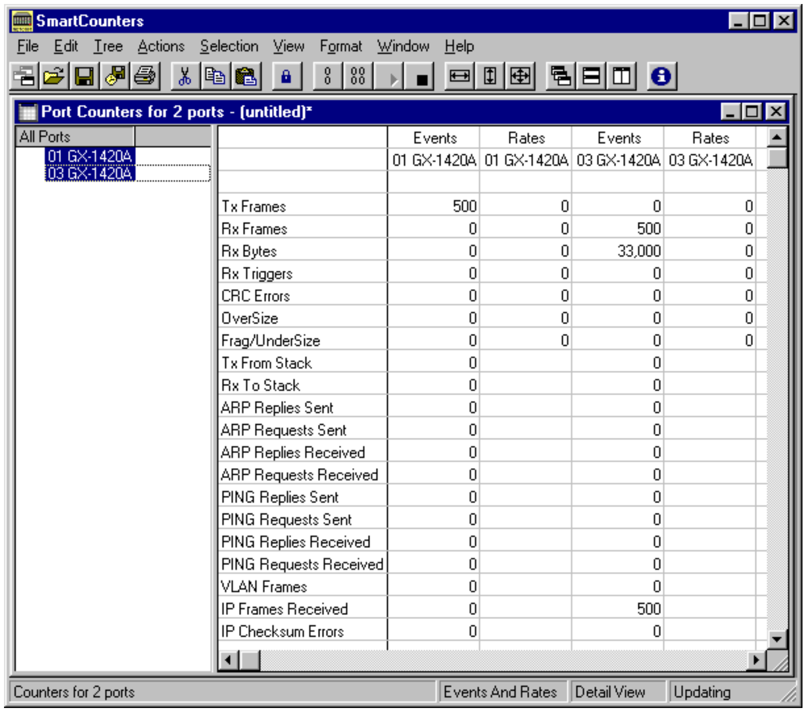
21 Select **Entire Frame** in the *Capture Setup* dialog box, and click **OK**.

Run the test and check the results!

22 Click the group **Start** button.

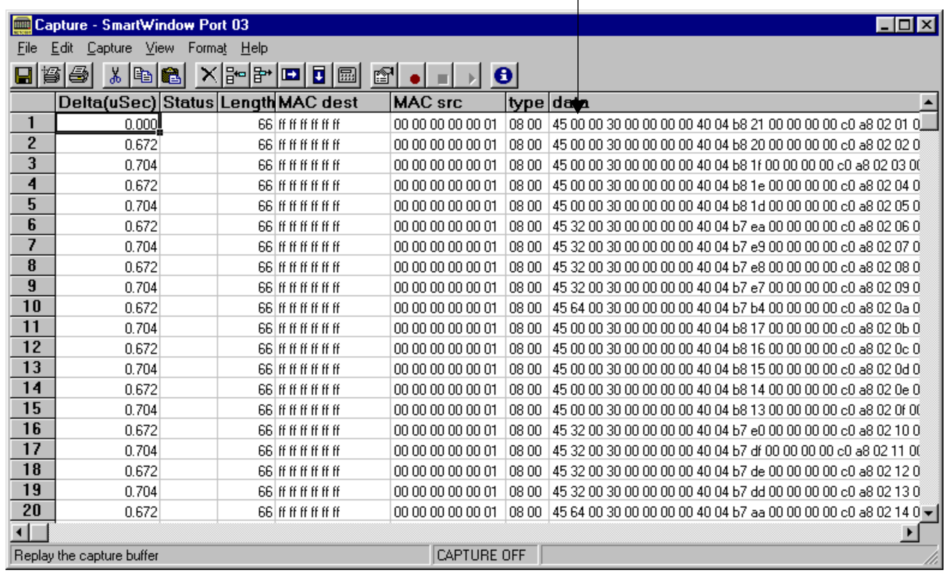
The test is configured to send 500 frames.

23 View SmartCounters to verify that good frames were sent and received.

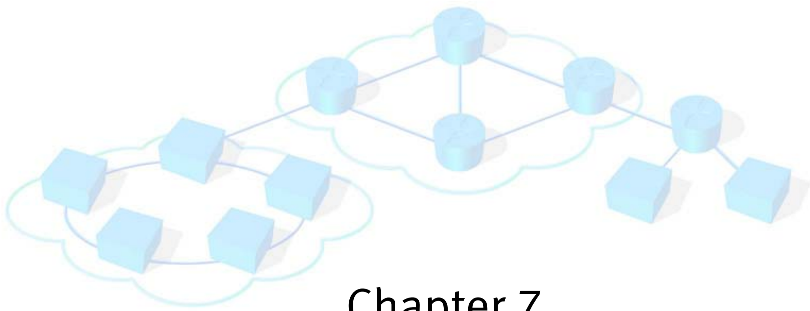


24 View captured frames to verify that QOS values were correctly inserted. Check for packet loss. Verify that high priority frames were handled correctly.

Contents of this byte are the QOS values inserted by VFD3.



	Delta(uSec)	Status	Length	MAC dest	MAC src	type	data
1	0.000		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 00 00 30 00 00 00 00 40 04 b8 21 00 00 00 00 c0 a8 02 01 0
2	0.672		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 00 00 30 00 00 00 00 40 04 b8 20 00 00 00 00 c0 a8 02 02 0
3	0.704		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 00 00 30 00 00 00 00 40 04 b8 1f 00 00 00 00 c0 a8 02 03 00
4	0.672		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 00 00 30 00 00 00 00 40 04 b8 1e 00 00 00 00 c0 a8 02 04 0
5	0.704		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 00 00 30 00 00 00 00 40 04 b8 1d 00 00 00 00 c0 a8 02 05 0
6	0.672		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 32 00 30 00 00 00 00 40 04 b7 ea 00 00 00 00 c0 a8 02 06 0
7	0.704		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 32 00 30 00 00 00 00 40 04 b7 e9 00 00 00 00 c0 a8 02 07 0
8	0.672		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 32 00 30 00 00 00 00 40 04 b7 e8 00 00 00 00 c0 a8 02 08 0
9	0.704		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 32 00 30 00 00 00 00 40 04 b7 e7 00 00 00 00 c0 a8 02 09 0
10	0.672		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 64 00 30 00 00 00 00 40 04 b7 b4 00 00 00 00 c0 a8 02 0a 0
11	0.704		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 00 00 30 00 00 00 00 40 04 b8 17 00 00 00 00 c0 a8 02 0b 0
12	0.672		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 00 00 30 00 00 00 00 40 04 b8 16 00 00 00 00 c0 a8 02 0c 0
13	0.704		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 00 00 30 00 00 00 00 40 04 b8 15 00 00 00 00 c0 a8 02 0d 0
14	0.672		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 00 00 30 00 00 00 00 40 04 b8 14 00 00 00 00 c0 a8 02 0e 0
15	0.704		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 00 00 30 00 00 00 00 40 04 b8 13 00 00 00 00 c0 a8 02 0f 00
16	0.672		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 32 00 30 00 00 00 00 40 04 b7 e0 00 00 00 00 c0 a8 02 10 0
17	0.704		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 32 00 30 00 00 00 00 40 04 b7 df 00 00 00 00 c0 a8 02 11 00
18	0.672		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 32 00 30 00 00 00 00 40 04 b7 de 00 00 00 00 c0 a8 02 12 0
19	0.704		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 32 00 30 00 00 00 00 40 04 b7 dd 00 00 00 00 c0 a8 02 13 0
20	0.672		66	ff ff ff ff ff ff	00 00 00 00 00 01	08 00	45 64 00 30 00 00 00 00 40 04 b7 aa 00 00 00 00 c0 a8 02 14 0



Chapter 7

SmartMetrics Testing

SmartWindow is a highly effective tool for both traditional and custom tests. SmartMetrics SmartCards such as the ML-5710A and ML-7710 can simulate up to 1,000 hosts per port, sending varied or uniform traffic to the Layer 3 switch. They can fully characterize the switch for both Layer 2 and Layer 3. The LAN-3101A/B SmartMetrics modules, with six ports per module, provide even higher traffic density for extended testing. A TeraMetrics module like the LAN-3321A offers full SmartMetrics capabilities along with the TeraMetrics open architecture. All these cards enable you to perform a range of tests for Layer 3 functions—including SmartMetrics tests—and allow testing of complex protocol sensitive application and systems scenarios.

In this chapter...

Layer 3 Switching

In most cases, a Layer 3 switch is in fact a fast protocol-based router minus certain router functions. A Layer 3 switch typically works with only one or two protocols, performs at or close to wire speed, is good at keeping streaming packets in order, and makes routing decisions based on ASICs (unlike a router which is software-based).

The 10 Mbps, 100 Mbps, and Gigabit Ethernet Layer 3 switches are expected to operate at full line-rate at Layer 2 and furnish wire-speed IP routing at Layer 3 simultaneously on all ports with zero packet loss and extremely low latency.

Test Methodology

The SmartWindow tests and results that demonstrate the performance capability of the switch include the following topics:

- 20+ counters (transmit and receive packets and bytes, packet loss, triggers, tags, collisions, errors, plus ARP and ping counters)
- Sequence tracking data
- Latency distribution data
- Latency over time data.

Note: The types of tests are dependent on the hardware and version level of SmartWindow used. Refer to the specific description of the test(s) for qualifications and details.

About Streams

It is essential to understand SmartMetrics streams, which provide the basis for using the traffic and test capabilities of SmartMetrics cards and modules.

Each stream, generated by its own Virtual Transmit Engine (VTE), represents a repeated packet template with the following characteristics:

- Design that is able to set up traffic for testing Layer 2 (switching) or Layer 3 (routing).
- A signature field in each packet contains its source and destination location, its sequence in the traffic flow, and when it was sent and received.
- Each stream has its own IP/MAC source and destination addresses, frame length (without FCS), protocol or custom packet, IP gateway for routing, and statistics/histogram tracking capability.
- With IP, each stream also has ARP request and response ability.
- The stream of one card typically transmits to the stream of another card, simulating transmission from one host computer to a second host computer. Both can be on the same subnet or on different subnets.
- If 10 streams are defined, the 10 packets are transmitted in the order created, then re-cycled to transmit the next 10, until the transmission is stopped. If only one stream is created for a card, then the traffic is comprised of the one packet type.

- An ML-7710 or LAN-3101A/B can transmit up to 1,000 streams per port and track statistics/histogram information on approximately 80,000 streams.

Older SmartCards, such as the SX-7410/B Ethernet SmartCard, are essentially packet blasters for hubs and switches. In contrast, each port on an ML-7710 SmartCard or LAN-3101A/B modules can generate the equivalent of 1,000 IP connections, condensed into a simple format for creating 1,000 streams that closely mimic real world traffic.

With the ML-7710 SmartCards, 20 cards can be placed into each SmartBits chassis, then four chassis can be stacked. With 80 cards, up to 80,000 streams can be simulated.

The LAN-3101A/B SmartMetrics module provides higher port density per chassis. A SmartBits 6000x can accommodate 12 LAN-3101A/B modules. With six ports per module, each chassis can generate traffic from 72 ports, enabling you to simulate up to 72,000 streams from each chassis.

LAN-33*xx*A TeraMetrics-based modules provide two ports per module. A SmartBits 6000x can accommodate 12 modules (24 ports total).

Hard Disk Requirements for Streams

The setup configuration for each stream requires 4.5 KB per stream per port. For each 1000 streams (one port), you may need to allocate 5 to 7 MB of hard drive. Multiply this by the number of ports in use and, if applicable, by the number of chassis.

In addition, in order to make histogram measurements, double the estimated hard drive requirement.

Example for ML-7710. If using ML-7710 SmartCards in four stacked SmartBits 2000 chassis, multiply the needed hard-disk space (5 to 7 MB) as follows:

- One port per card, 20 cards per SmartBits 2000 chassis
- Required: Approximately 6 MB per port
- Multiply by 20 cards = 120 MB of hard drive per test setup
- Multiply by 4 chassis = 480 MB of hard drive per test setup.

Example for LAN-3101A/B and related modules: If using LAN-3101A/B modules in a SmartBits 6000x chassis, multiply the needed hard-disk space (5 to 7 MB) as follows:

- Six ports per module, 12 modules per SmartBits 6000x chassis
- Multiply by 12 modules (72 ports) = 432 MB of hard drive per test setup.

Example for LAN-3301A and related modules: If using LAN-33*xx*A modules in a SmartBits 6000x chassis, multiply the needed hard-disk space (5 to 7 MB) as follows:

- Two ports per module, 12 modules per SmartBits 6000x chassis
- Multiply by 12 modules (24 ports) = 144 MB of hard drive per test setup.

Required Steps for SmartMetrics (Layer 3) Testing

The following sections apply to SmartMetrics testing using either of the card types shown as examples in this chapter (LAN-3301A and ML-7710). The sections describe the steps used to set up addresses (*"Port Setup"* below) and the use of ARP exchange (*"Address Resolution Protocol (ARP)" on page 243*). Both are necessary to route packets properly through attached devices.

Important: Testing routers requires some preparatory work. You must set up addresses and learn to use ARP exchange in the order presented before running any of the SmartMetrics tests.

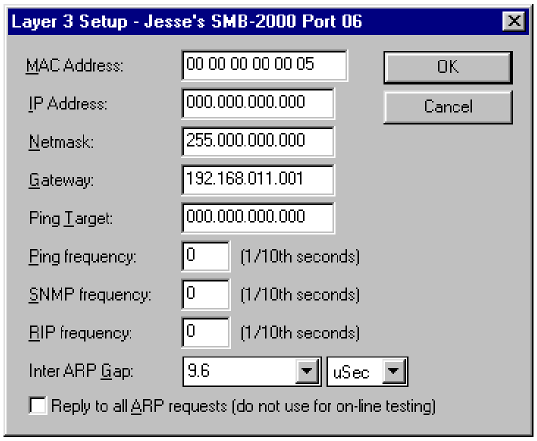
Port Setup

Use the *Port Setup* (SmartBits 600x/6000x chassis) or *Layer 3 Setup* (SmartBits 200/2000 chassis) dialog box to configure the required information before running SmartMetrics tests on a router and to control management frames per RFC-1944. You must provide the gateway of the router or the Layer 3 switch.

Caution: Never select the **Reply to all ARP requests** checkbox (SmartBits 200/2000) or the **Reply to All Requests** checkbox (SmartBits 600x/6000x) when connected to a live network. SmartMetrics SmartCards automatically respond to ARP requests. Use these checkboxes/selections only for back-to-back testing. You can still automatically update the router ARP table for each stream by selecting **Layer 3 Send ARP Requests** from the SmartCard's popup menu or **Layer 3 ARP** from the **Actions** menu for the SmartBits 200/2000 chassis only.

To configure Layer 3 setup:

1. Open the card menu.
   - Click the SmartCard (SmartBits 200/2000 chassis) —*or*—
   - Click the port button (SmartBits 600x/6000x chassis).
2. Ensure that **SmartMetric Mode** is selected on the drop-down menu.
3. Now set the Layer 3 address information.
   a. SmartBits 200/2000: Open the card menu again and select **Layer 3 Setup**.



b SmartBits 600x/6000x: Open the *Port* menu and select **Port Setup**.

Select the **General** tab.

Note: The fields and checkboxes on your screen may be different from those shown here. The actual display is dependent on the version of SmartWindow and the type of module used.

Table 7-1 on page 240 describes the use of each checkbox.

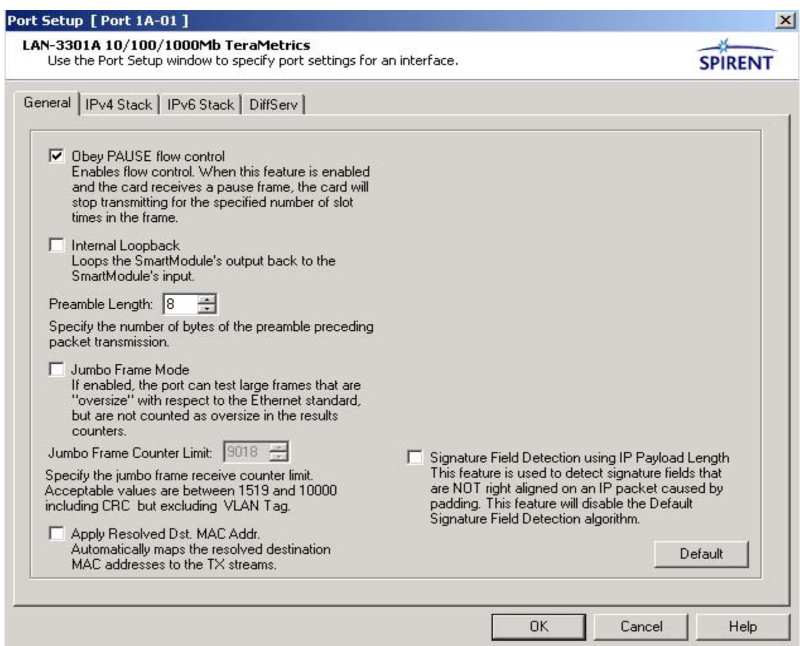


Figure 7-1. SmartBits 600x/6000x Port Setup- General Tab

Table 7-1. General Tab

Field	Description
Obey PAUSE flow control	When enabled, if the port receives a pause frame, it stops transmitting for the specified number of slots (pause quanta) in the frame. [Default is enabled (selected).]
Internal Loopback	Loops the SmartModule output back to the SmartModule input.
Preamble Length	The preamble parameter is used to specify the number of bytes of the preamble preceding packet transmission.
Jumbo Frame Mode	Jumbo frame mode is available on the LAN-3101A/B group of modules and all LAN TeraMetrics-based modules for the SmartBits 600x/6000x chassis. (Refer to the online Help for a detailed description of this option.)
Signature Field Detection using IP Payload Length	The 40-byte IP frame support is applicable to the following cards: LAN-33xxA, XLW-372xA, XFP-373xA, POS-3504As/AR, POS-3505As/AR, POS-3510A/As, POS-3511A/As, POS-3518As/AR, and POS-3519As/AR. (Refer to the online Help for a detailed description of this option.)
Apply Resolved Dst. MAC Addr.	There are many methods that can be used to map addresses to the test stream. (Refer to *"General Tab" on page 66* for a description of this field in the *User Preferences* window.)

c Select either the **IPv4 Stack** tab or **IPv6 Stack** tab, as appropriate for the test.

Table 7-2 on page 242 describes the fields in these dialog boxes for Layer 3 addresses and the handling of management frames.

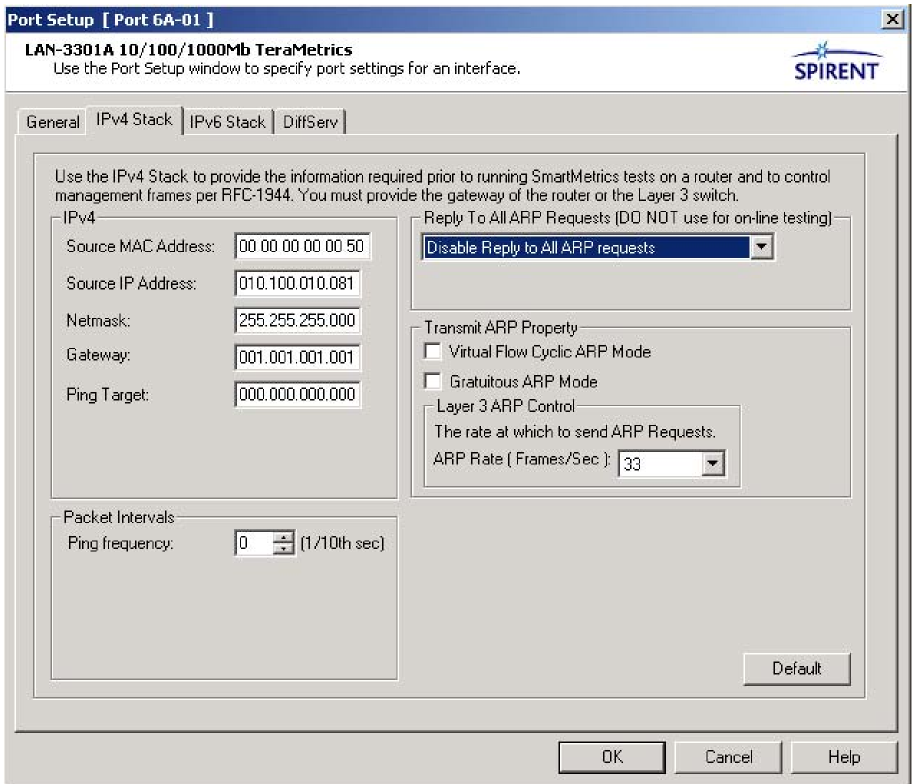


Figure 7-2. IPv4 Tab

Table 7-2. IPv4 Tab

Field	Description
Source MAC Address	A user-defined MAC address for the SmartBits module, used to respond to ARP requests from connected devices. These responses are only transmitted if the *Reply to All ARP requests using Port MAC* option is selected. (Note: The source MAC address is mirrored on the *IPv4* and *IPv6* tabs. The address can be changed at either location.)
Source IP Address	The IP address of the SmartBits card. This address should be different from the IP addresses of the Layer 3 streams.
Netmask	The netmask used with the gateway (router port).
Gateway	The IP address of the router port connected to the SmartBits port. A valid gateway IP address must exist either in this field or in the *Gateway* field in the *Streams Setup* dialog box.
Ping Target/Ping frequency SNMP Frequency RIP Frequency	SmartMetrics cards can issue ping, SNMP, and RIP packets that simulate typical background traffic. Use these fields to specify the intervals at which these packets are transmitted. The *Ping Target* field specifies the IP address to which the ping packet is sent.
Reply to all ARP requests (DO NOT use for on-line testing)	*Disable Reply to All ARP requests* option (default) This is the most common setting. The module does not reply to each ARP request it receives with Layer 3 setup or port setup MAC addresses. *Reply to All ARP requests using Port MAC* option The card replies with Layer 3 MAC addresses to each ARP request it receives without setting up any streams.
Transmit ARP Property Layer 3 ARP Control	Refer to *"Virtual Flow Cyclic ARPs and ARP Requests" on page 186* and *"Gratuitous ARP Mode" on page 196* for explanations of the transmit ARP properties. T*he Layer 3 ARP Control* pane contains a field to set the ARP rate in frames/second.

Address Resolution Protocol (ARP)

For data streams to be sent through a router, multilayer cards must know the MAC address of the router port, and the router must know the MAC addresses of the SmartMetrics cards. This is done by using Address Resolution Protocol (ARP) packet exchanges.

ARP maps an IP address to a MAC address. This IP address is the address of the router port connected to the SmartMetrics port, not the IP destination of a packet. The router port address is specified in the entry called *Default Gateway.* When this entry is set (not zero), the ARPs generated by the SmartMetrics port go to this address instead of the specified IP destination address.

The router also issues ARP requests to the SmartMetrics ports. These requests are replied to by either the local stack or the protocol stream if the target IP address in the ARP request packet matches the source IP address in the stream or stack. If a VFD has been set up for the destination IP address, the ARPs will fail. In this case, the alternative is to set a general ARP reply flag, which causes the SmartMetrics port to respond to all unsatisfied ARP requests using a MAC address generated from the port number.

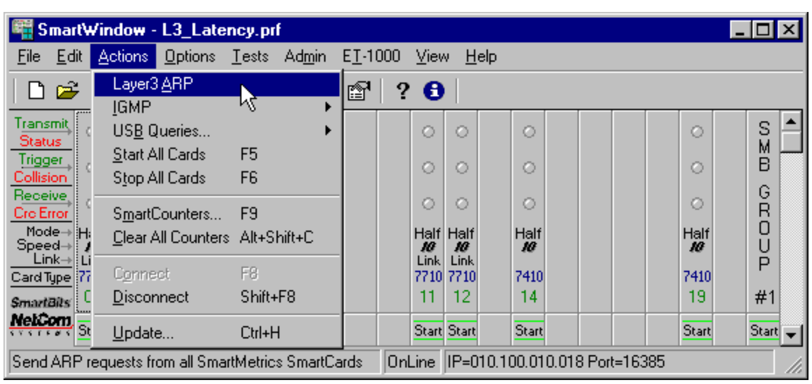
Sending Layer 3 ARP Requests

To ensure proper transmission of data streams through routers and Layer 3 switching products, it is normally necessary to send a Layer 3 ARP on behalf of the active streams. Use the *Actions* menu to send a Layer 3 ARP. (See *Step 1* below and the steps required to send Layer 3 ARPs on the SmartBits 200/2000 chassis.)

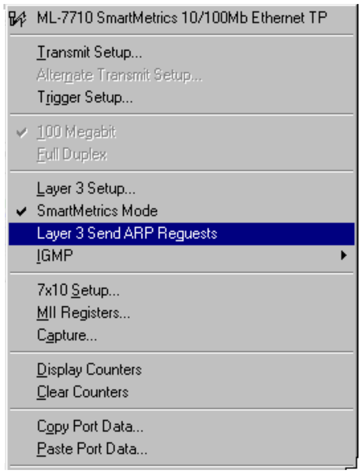
See *"Neighbor Discovery Protocol" on page 179* and *"Summary" on page 187* for the steps required to send solicitations and ARP requests on the SmartBits 600x/6000x chassis.

To send ARPs:

1 To send ARPs from all SmartMetrics cards, choose **Actions** > **Layer3 ARP**.
This setup should be performed each time the DUTs are connected, powered up, or reset.



2 To send ARP requests for a single card, click the card, then choose **Layer 3 Send ARP Requests.**



Preparing the Device Under Test (DUT)

Important: SNMP functionality, proprietary polling, and spanning tree frames generated by the DUT lower the measured performance of the DUT. It is recommended that all traffic generated by the DUT is turned off in order to obtain the actual performance of the switching fabric.

Preferences to Review

Three selections on the *Options* menu merit quick consideration.

Go to the SmartWindow main menu and choose **Options** > **Preferences**. (See also *"Preferences" on page 62* for additional information on this selection.)

The *Preferences* dialog box differs for the SmartBits 200/2000 and SmartBits 600x/6000x chassis families, as shown in *Figure 7-3 on page 245*.

- **Inter-ARP Gap**
  The default inter-ARP gap is set to 9.6 uSec, following the standard specification, and by default it cannot be changed for a SmartCard.
  However, SmartMetrics Ethernet SmartCards for the SmartBits 200/2000 allow you to change this gap. (These cards include the ML-7710/11.) To do this, select the *Allow time control of ARP requests* checkbox in the *SmartWindow Preferences* window. As an example, this might be necessary if a switch cannot process ARP requests at full-wire speed. Then reset the inter-ARP gap for each port as needed. (To do this, click the card and choose *Layer 3 Setup*.)

- **MII Register Control**
  You can automatically update the auto-negotiation settings for speeds and duplex mode on Ethernet cards, using the last saved configuration or a newly opened configuration file.

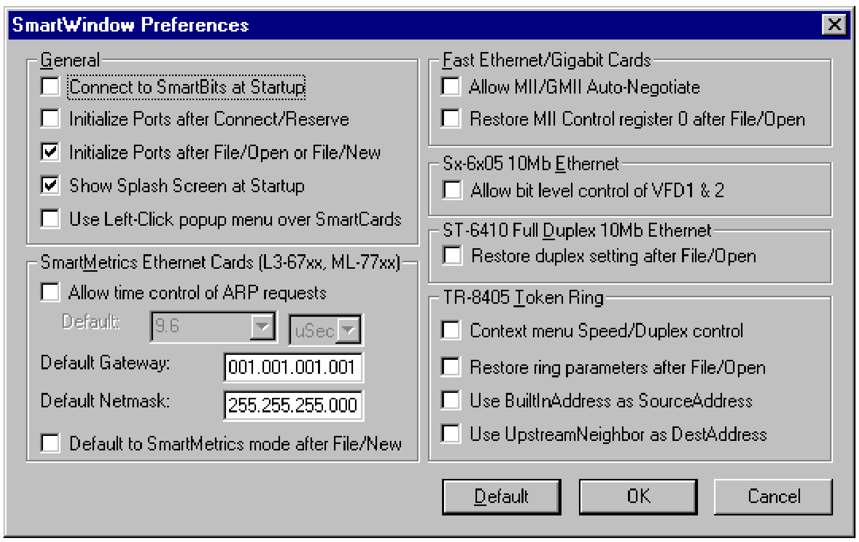
Select one of the following:

- SmartBits 600x/6000x: **Restore MII Register 0, 4, and 9 after File/Open or File/New**.
- SmartBits 200/2000: **Restore MII Control register 0 after File/Open**.

- **MII Auto Negotiation**
  To allow MII autonegotiation for Ethernet cards, select the **Allow MII Auto-Negotiate** checkbox (SmartBits 600x/6000x) or the **Allow MII/GMII Auto-Negotiate** checkbox (SmartBits 200/2000).

  To enable auto-negotiation selectively for any card, click the card image, select **MII Registers**, and click **Enable Auto-Negotiate**.

SmartBits 200/2000



SmartBits 600x/6000x

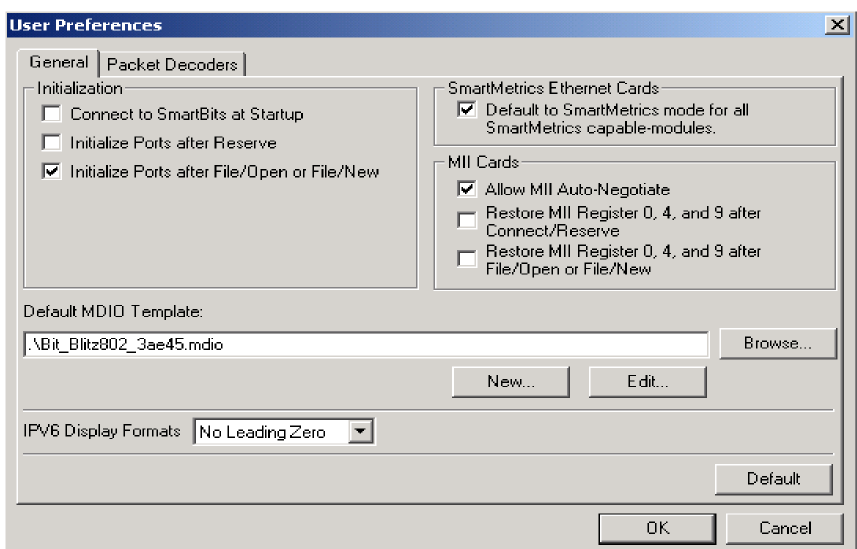


Figure 7-3. Preferences Dialogs

Test Using the LAN-3321A TeraMetrics Module

Refer to *"Required Steps for SmartMetrics (Layer 3) Testing" on page 238* for SmartMetrics setup and startup procedures. When these preliminary steps have been performed, the test can be set up.

The test example uses a LAN-3321ABase-TX Dual Media Ethernet TeraMetrics module. This and other Dual Media modules are capable of operating using either a copper interface (10/100/1000BASE-T) or fiber interface (1000BASE-X) for each port. A multiport module like the LAN-3321A (which has two ports) can operate with different port modes for each port. However, only one mode can be active on a port at any time.

The test setup is as follows:

- One LAN-3321A TeraMetrics module is installed in a SmartBits 6000C chassis.
- The SmartBits chassis is connected to a PC with SmartWindow via an Ethernet port.
- Two LAN-3321A ports are connected to two gateway ports on the Layer 3 switch/ router (DUT).

Additional cards that support this test:

- One LAN-3301A module or other TeraMetrics module can be substituted for the LAN-3321A module.
- Refer to *Figure 7-4* for an illustration of this test bed.

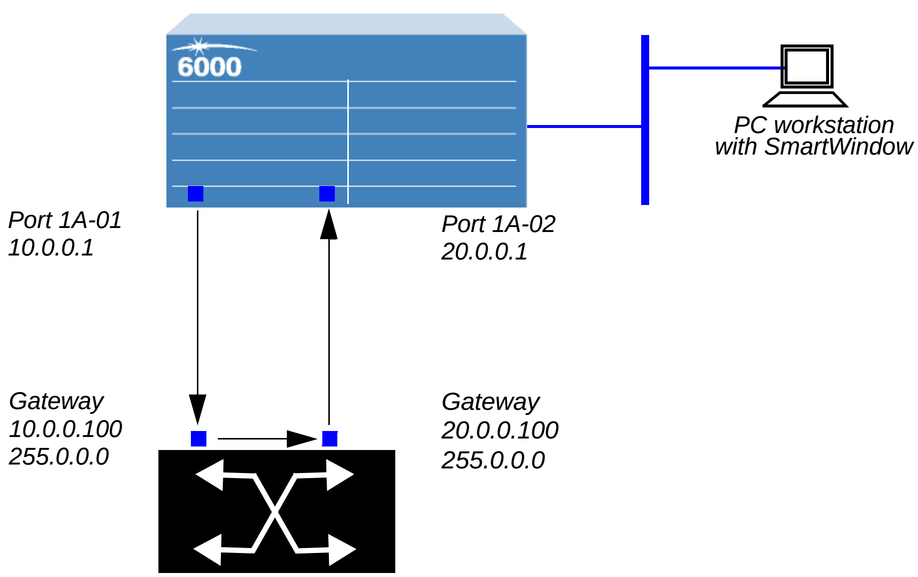


Figure 7-4. LAN-3321A Test Bed

Design of Test

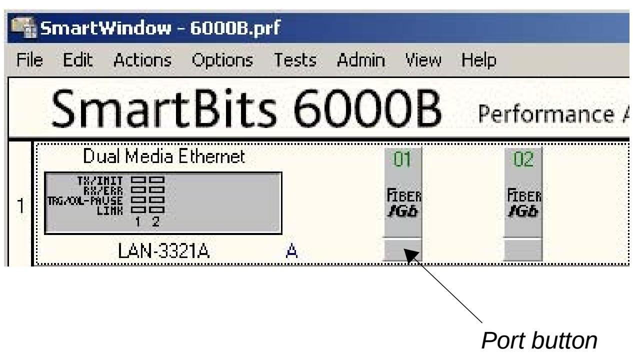
This test bed is designed for uni-directional traffic from port 1A-01 of the TeraMetrics module to the DUT. Return traffic is monitored and recorded by port 1A-02 of the TeraMetrics module. Other configurations include bi-directional traffic and/or the addition of other transmit/receive DUT ports and SmartBits module(s) ports.

Refer to *"Tests Using the XLW-3721A/XFP-3731A TeraMetrics Modules" on page 318* for an explanation of these and other test configurations for the XLW-3721A TeraMetrics module.

Note: The addressing structure used for this test is defined in the topology shown in *Figure 7-4 on page 246*. These values are shown in the sample configuration screens. The number of streams and how they are configured is not set. The sections in this chapter provide explanations and options of the different configurations that can be used in this test environment.

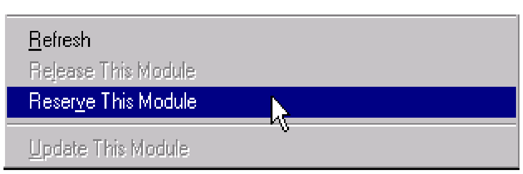
Global Default Settings

Launch the SmartWindow application, then use the following steps to check the default settings of each port and ensure that the settings are appropriate.

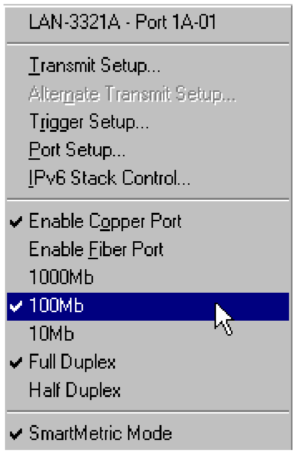


To check default settings:

1 Reserve the module to be configured. Click anywhere on the card image except the port button, and choose **Reserve This Module**.



2 Click the port button for port 1A-01 of the LAN-3321A. By default, the fiber interface is selected. For this example, use the copper interface, so select **Enable Copper Port** from the port menu.



***1** The card default speed is 1000Mbps. Select 100Mb.*

***2** SmartMetric mode is enabled by default.*

3 Once the copper mode has been enabled, the speed controls on the port menu become active. At the default port speed (1000Mb), the duplex controls are not applicable. Select **100Mb**. The duplex controls now become active.

Note: The *SmartMetric Mode* option is enabled by default.

Set up Port Addresses

The SmartBits chassis is connected to a Layer 3 switch or router (the DUT). Refer to *Figure 7-4 on page 246* for the topology used in this test bed.

Click port button **01** on the LAN-3321A and select **Port Setup**. Select the **IPv4 Stack** tab.

The *Port Setup* window (*Figure 7-5 on page 249*) configures the local stack. The window includes tabs for IPv4 and IPv6 address configuration, DiffServ setup, and general options such as *Pause* control (for Gigabit modules). Edit values in the window for the following purposes:

- To set the gateway IP address of the router port (DUT). This is required for Layer 3 switches.
- To change MAC and IP addresses so they do not duplicate stream addresses.
- To set the netmask for management frames. (This is optional and ignored by streams).
- To specify a ping IP address for pings and SNMP frames if needed (optional), as well as the frequency of ping, SNMP, or RIP packets (optional).
- To enable virtual flow cyclic ARPs. (See *“Virtual Flow Cyclic ARPs and ARP Requests” on page 186* in *Chapter 5, “Advanced Operational Theory”* for further information.)
- To enable gratuitous ARP mode. (See *“Gratuitous ARP Mode” on page 196* in *Chapter 5, “Advanced Operational Theory”* for further information.)

Configure Port Address

To configure port address:

1 Set the MAC and IP addresses and gateway address. Note the following characteristics of these addresses:

- The **Gateway** field value is the IP address of router port.
- The **Source MAC Address** field value is the port (not the individual stream).
- The **Source IP Address** field value must be in the same subnet as the router port/gateway.

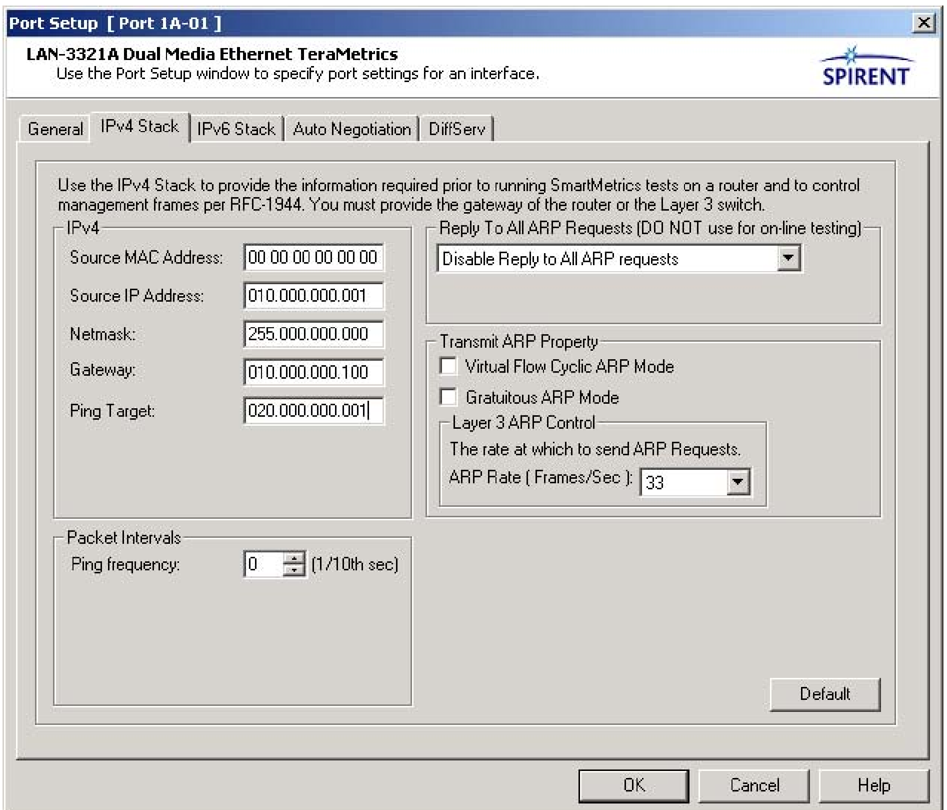


Figure 7-5. Port Setup Window

Important: The gateway IP address is the target address for ARP frames. If the gateway IP address is zero, the ARP frames target the destination IP addresses of the streams.

2 Click **OK** and return to the *Port* menu. (See *Figure 7-6*.)

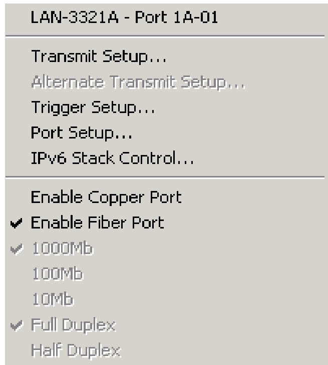


Figure 7-6. Port Menu

Test Port Addressing

Port addressing is tested using ARP requests and pings. Refer to the *Figure 7-7* for an illustration of the ping traffic over the test bed.

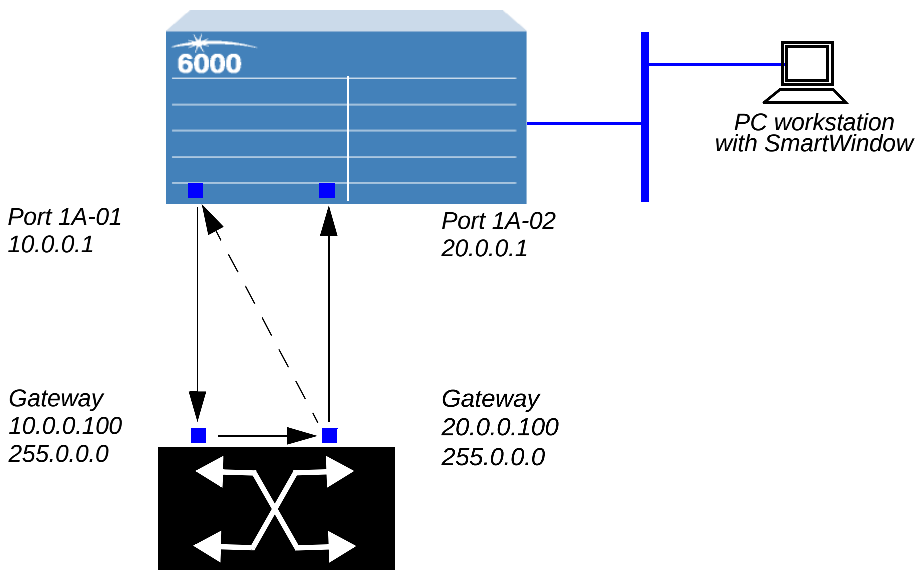


Figure 7-7. Ping Traffic Pattern

To test port addressing:

1. Click each port and choose **Layer 3 Send ARP Requests,** or choose **Actions** > **Layer 3 ARP** from the *SmartWindow* main menu to send ARP requests from all configured ports at one time.

2 Watch the SmartBits hardware or SmartWindow front panel LEDs. As each module transmits an ARP request, look for a brief green transmit and receive LED. If you do not see a momentary green receive LED light, the ARP response was not received.

For other streams and ARPs, try the ARP exchange times test to ensure that ARPs for all streams were received. (See *"Viewing ARP Response Times" on page 314*.)

Before transmitting traffic, it is helpful to ping the port IP addresses to confirm that the links to the DUT are working properly. Refer to *"Send Traffic and View Counters" on page 265* on how to configure the DUT.

To ping the port IP addresses:

1. Click the port button for port 1A-01 and select **Port Setup**.
2. Select the **IPv4 Stack** tab.
3. Enter the IP address for port 1A-02 as the **Ping Target** field value.
4. Set the **Ping Frequency** to 10.
5. Click **OK**.

Once ping is initiated, the ARP resolution (for ping target) must be completed before the Ping is sent. Using Smart Counters or Capture validates this process.

After performing steps 4 and 5 above, the pinging starts. After pinging is performed, return to the port setup of each card, and turn off pinging by setting the **Ping Frequency** to **0** to keep other results more clearly segregated.

If the link is not active, check that the correct speed is selected. (Default speed for the LAN-3321A is 1,000 Mbps.) For this example, **100Mb** was selected from the *Port* menu. (See *"Global Default Settings" on page 247*.)

Streams Setup Window

The *Streams Setup* window provides options for defining how the card schedules the streams that it transmits. Any option setup is performed before adding the streams, since these settings apply to the port overall. Return to the *Port* menu and select **Transmit Setup**. The *Streams Setup* menu appears. (See *Figure 7-8 on page 252*.)

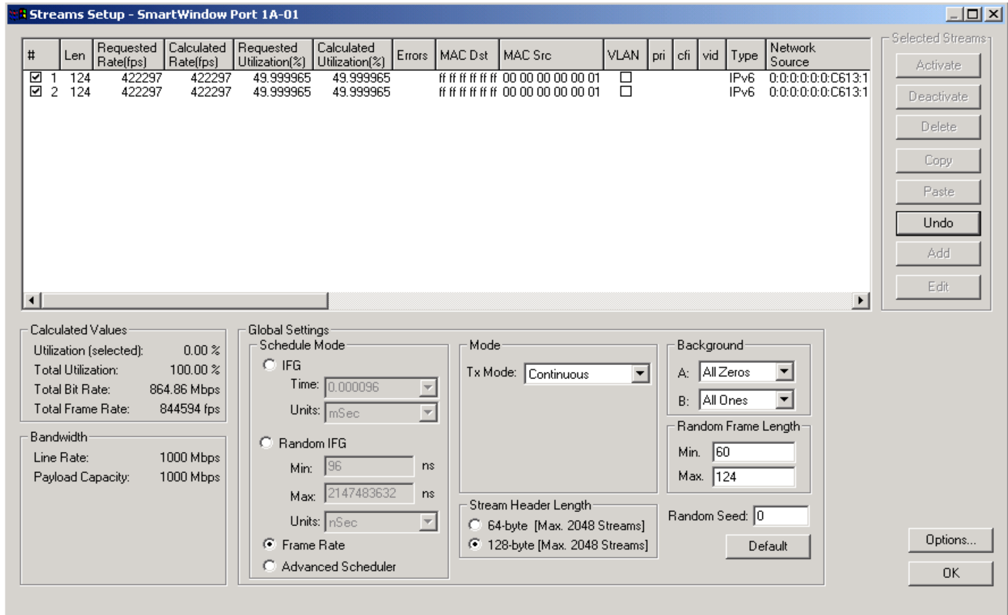


Figure 7-8. Sample Streams Setup Window

In the *Global Settings* pane, the *Schedule Mode* fields provide four options for scheduling:

- *IFG* — Interframe Gap: a fixed number of bit times between frames
- *Random IFG* — A varying number of bit times between frames
- *Frame Rate* — A defined frames-per-second rate of transmission for each stream
- *Advanced Schedule*r— The advanced scheduler does a better job of interleaving the streams when multiple streams are defined. The existing scheduler and advanced scheduler are both deterministic, meaning that each algorithm gives the same repeated results if the same configuration is used. The advanced scheduler increases the interleaving of the streams to avoid sending a large number of consecutive packets from a single stream. It signficantly reduces the jitter and out-of-place packets in the transmitted streams. It does so by spreading each stream through the sequence table according to its packet rate, rather than (as the current algorithm does) at the beginning or end of the sequence table.

  When this radio button is selected, the port schedules frames for transmission based on optimization that does not depend on Interframe Gaps (IFGs). Instead, the frames are ordered and transmitted according to a balanced mix that results in a smoother distribution of traffic between flows.

This capability requires the latest firmware and is supported on LAN-3306A, LAN-332xA, POS-3504As/AR, POS-3505As/AR, POS-3510A/As, POS-3511A/As, POS-3518As/AR, POS-3519As/AR, XLW-372xA, XFP-373xA, and FBC-360xA modules.

The selected scheduling mode applies to all streams generated by the port. Test traffic is sent in a round-robin fashion, with one frame from each stream generated in sequence.

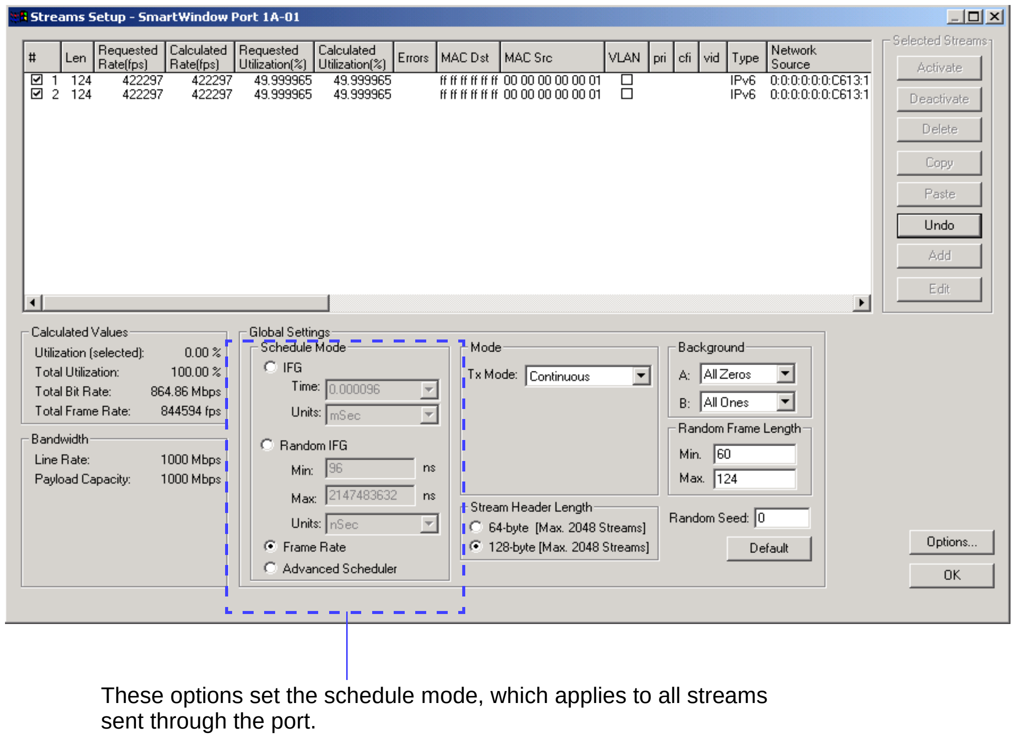


Figure 7-9. Schedule Mode Parameters in the Streams Setup Window

How Does Scheduling Work?

TeraMetrics cards include a software mechanism (the scheduler) that calculates how to allocate line bandwidth to the streams that have been created.

For all four scheduling options, the scheduler calculates a scheduling table that organizes all streams for transmission before any traffic is sent. The schedule table is static—it does not vary as test traffic is sent—even though two of the scheduling options (*Random IFG* and *Frame Rate*) appear to be dynamic in behavior (because they allow individual stream frame rates and random IFGs).

For the four modes, the test streams are organized as follows.

Gap-based Traffic

The two gap modes (*IFG* and *Random IFG*) actually belong in the same category. With each, the frame size and gap size (or range of gap sizes) are controlled but not the frame rate.

With *IFG* mode, the card inserts the specified gap (number of bit times) between frames. It then sends out test traffic (with the selected frame size) at the maximum line rate.

With *Random IFG* mode, a random number generator on the card produces gaps of varying sizes within the bounds defined using the *Min.* and *Max.* fields in the *Streams Setup* window. These gaps are inserted between frames. Then test traffic is sent with the selected frame size at the maximum line rate.

Rate-based Traffic

When *Frame Rate* or *Advanced Scheduler* is the selected mode, a different rate can be specified for each stream, but the IFG cannot be conrolled. Instead, the gaps are calculated and inserted by the card automatically.

With these modes, the scheduler always proposes full bandwidth for whatever stream(s) are to be added. However, it must use a portion of the bandwidth for the IFGs, thus the calculated utilization and calculated frame rates are always lower than what have been requested.

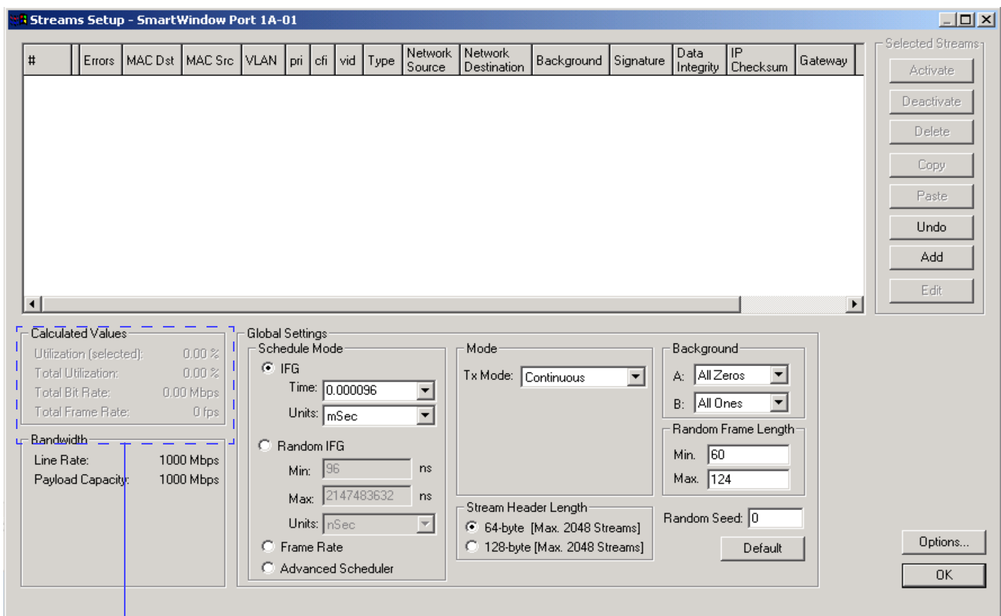
Frame rates can be specified that are lower than the maximum proposed. In this case, some of the total line capacity is unused by the actual test frames. In this case—when the frame rates specified for all streams do not use all the possible bandwidth—the “extra” bandwidth is divided among the streams and used as the IFGs.

Scheduling by Interframe Gap

When *IFG* or *Random IFG* is selected as the schedule mode, the card sends out test frames separated by the IFG that is specified. The frames of each stream are sent in round-robin order.

The default values for *IFG* set the minimum legal IFG for the transmission medium. This setup establishes full load on the transmission medium. For *Random IFG*, the gap can vary between the legal minimum and a maximum that can be specified.

When *IFG* or *Random IFG* is selected as the schedule mode, the *Streams Setup* dialog box appears as shown in *Figure 7-10*. Notice that the *Calculated Values* fields are greyed out; these fields do not apply to gap-based traffic, but only to traffic based on frame rate.



When schedule mode is set to IFG or random IFG, these fields are grayed out since they apply only the rate-based traffic.

Figure 7-10. Schedule Mode Parameters for Gap-based Traffic

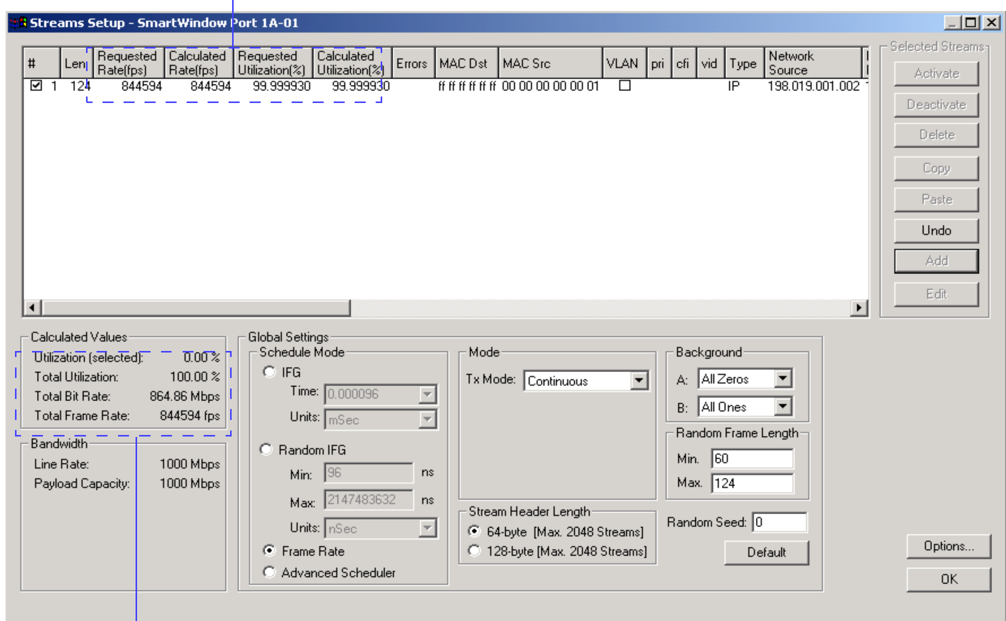
Scheduling by Frame Rate

When *Frame Rate* or *Advanced Scheduler* is selected as the schedule mode, the card or module calculates the frame rate for each stream based upon:

- Total bandwidth available
- Number of streams
- Requested rate for each stream.

See the *Streams Setup* window in *Figure 7-11*.

These fields appear when Frame Rate or Advanced Scheduler *is selected as the scheduling mode. They show the requested rate per stream and requested utilization, as well as the actual (calculated) frame rate and utilization that results from how the card has allocated the available bandwidth.*



When the Schedule Mode *is set to* Frame Rate or Advanced Scheduler, *these fields show the total calculated frame rates and percentages for all streams that have been added. As streams are created, SmartWindow calculates the individual and total frame rates for the card as well as IFGs.*

Figure 7-11. Schedule Mode Parameters for Rate-based Traffic

Specify the frame rate in the *Add Streams* window for the stream or streams that are created. (These options are disabled when *IFG* or *Random IFG* is selected.) As streams are created, the card calculates the stream order and the IFGs.

In the streams list, the *Calculated Rate* and *Calculated Utilization* fields adjust as streams are added or the settings for any stream are modified. Similarly, the *Calculated Values* pane at the bottom of the window adjusts to reflect the settings. *Figure 7-12* presents an example. Here, four rate-based streams have been added, and each has been allocated about 24% of the total available bandwidth.

In this example, four streams have been added, each with a requested rate of 210,672 frames per second.

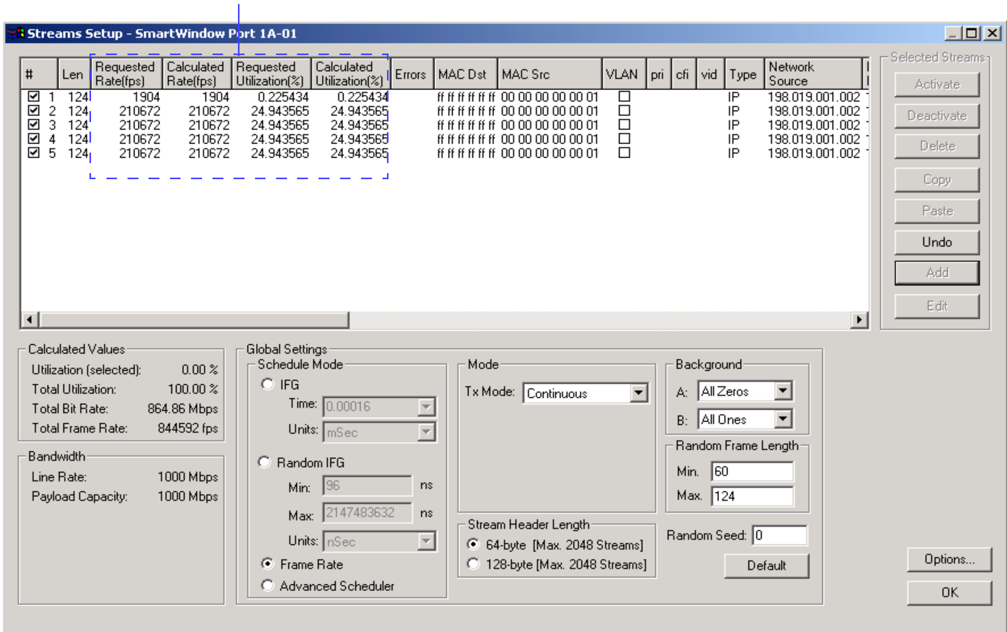


Figure 7-12. Bandwidth Allocation with Frame-based Test Traffic

Table 7-3 describes the values shown in the *Calculated Values* pane.

Table 7-3. Stream Utilization

Rate	Definition
Utilization (selected)	Total calculated bandwidth of all selected (highlighted) streams.
Total Utilization	Total calculated bandwidth of all streams.
Total Bit Rate	Total calculated capacity used by the aggregate of streams.
Total Frame Rate	Multiple of the number of frames times the total frames per second (fps) of each individual stream.

Adding a Stream

Adding and configuring streams for TeraMetrics modules is implemented in several ways. This section and *"Configuring a Stream" on page 260* describe a series of methods used for one IPv4 stream. (Refer to *"Tests Using the XLW-3721A/XFP-3731A TeraMetrics Modules" on page 318* and *"Test Using the LAN-3311A TeraMetrics Module" on page 374* for other configuration procedures of TeraMetrics modules.)

To add a stream:

1 Click the **Add** button in the *Selected Streams* pane of the *Streams Setup* window. The dialog box in *Figure 7-13* appears.

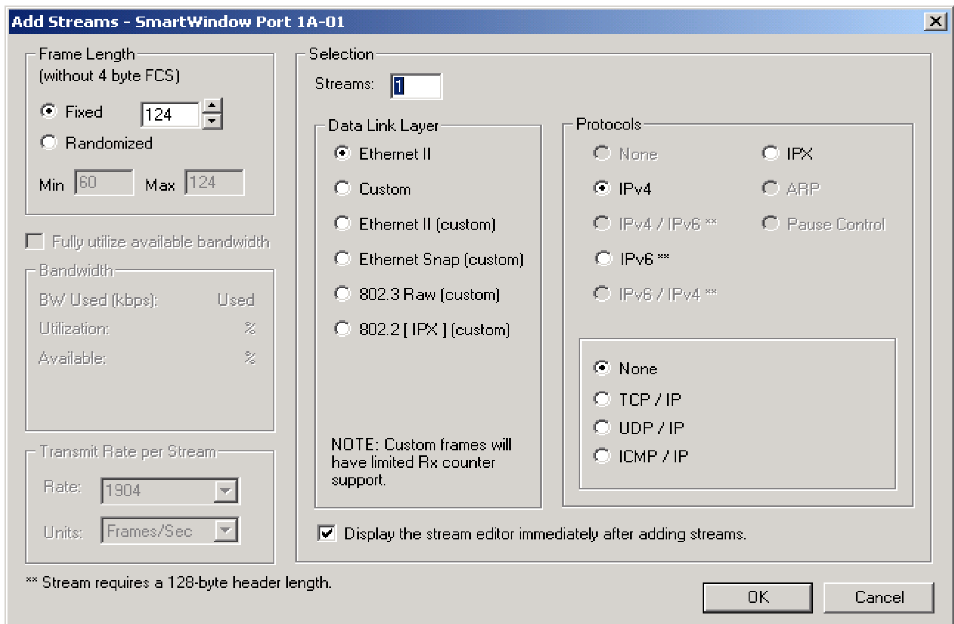


Figure 7-13. Add StreamsWindow

2 Move to the *Streams* field, located in the *Selection* pane, and add one stream.

Note: The *Add Streams* dialog box consists of panes, checkboxes, and one independent field. Refer to *Table 7-4* for the titles of these elements, along with a brief definition. (Refer to the online Help for a complete description of the *Add Streams* dialog box.)

Table 7-4. Add Streams Window Descriptions

Title	Type of Element	Description
Frame Length (without 4-byte FCS)	Pane	Used to select fixed or randomized frame lengths.
Fully utilize available bandwidth	Checkbox	Active for frame and advanced scheduler modes. Causes available bandwidth to be allocated to the stream(s).
Bandwidth	Pane	Active for frame and advanced scheduler modes. Displays BW used (Kbps), utilization, and available values for stream(s).
Transmit Rate per Stream	Pane	Active for frame and advanced scheduler modes. Units and rate set the transmit parameters of stream(s).
Streams	Field	Number of streams to be added.
Selection	Pane	Contains three panes used to define the protocol.
Display the stream editor immediately after adding streams.	Checkbox	Enables/disables the display of the screen editor.

Configuring a Stream

Refer to *Figure 7-14* for the sample test environment configuration.

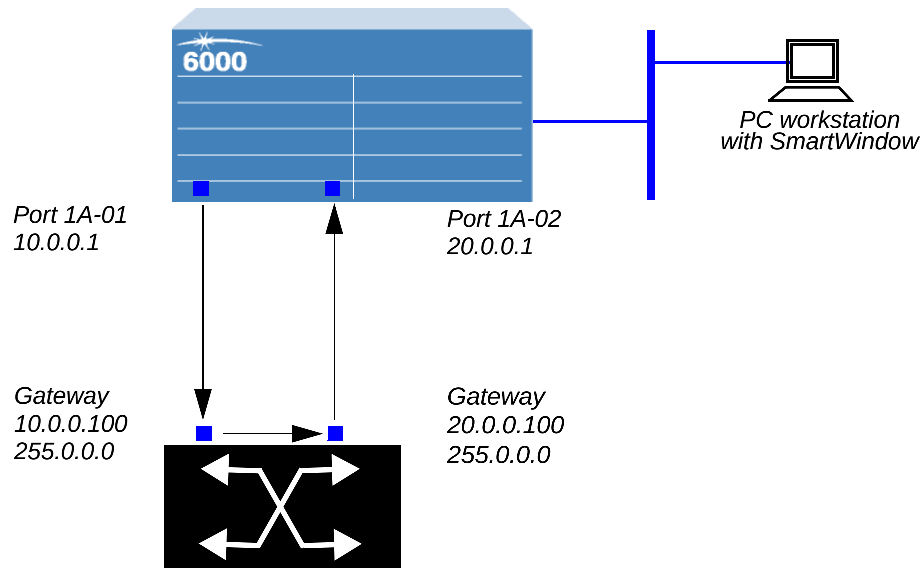


Figure 7-14. Stream IP Addresses by Port

Define the Stream Addresses

The Layer 2 and Layer 3 addresses are defined via the *Streams Setup* window and the *Add Streams/Selection* panes. The destination MAC address can also be defined via the *Preferences* window.

To use the streams setup method:

1. Access the **Streams Setup** window.
2. Highlight the address in the targeted stream.
3. Double-click directly on the value (MAC or IP addresses), and enter the new value.

To use the add streams method:

1. Access the **Add Streams** window.
2. Click the **Ethernet II** button in the *Data Link Layer* pane, the **IPv4** button in the *Protocols* pane, and **None** for Layer 4.
3. Select the **Display the stream editor immediately after adding streams** checkbox.
4. Click **OK**.

5 The *Transmit Setup* dialog box is displayed. It contains two panes that are used to configure different aspects of the stream. (Refer to *Figure 7-15 on page 261* for an illustration of this dialog box.)

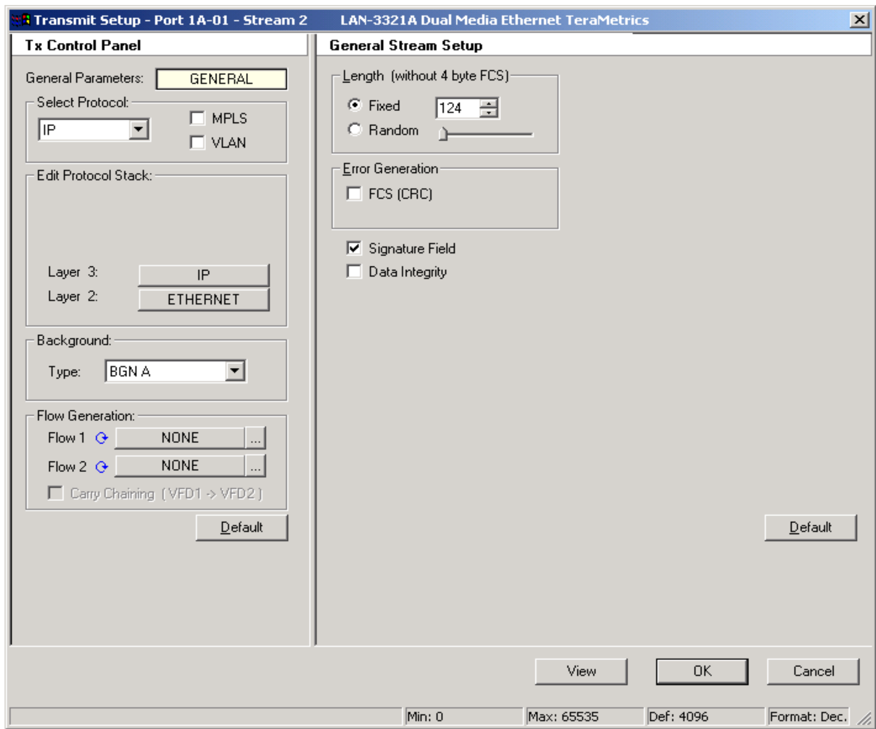


Figure 7-15. Transmit Setup Window: General Stream Setup

Note: Refer to the online Help for specific definitions of each pane.

6 In the *Edit Protocol Stack* pane, click the **Ethernet** button to display the *SETUP: Ethernet Protocol* pane. (See *Figure 7-16*.)

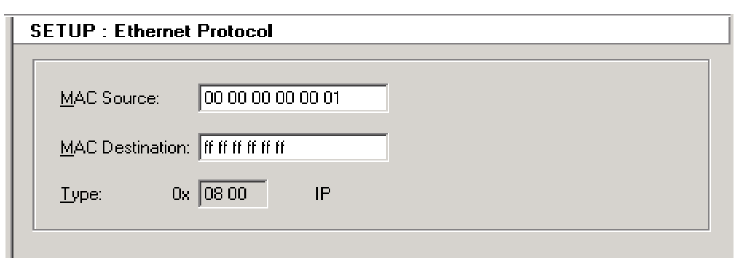


Figure 7-16. SETUP Window Pane

7 Insert the MAC source and destination addresses in these fields.

The MAC and IP addresses of streams must be unique to the streams and cannot be used for SmartBits or DUT ports. The source IP address of a stream and its SmartBits port should be on the same subnet as the associated router gateway. For Layer 3 routing tests, each pair of SmartBits and DUT ports should be on separate subnets, as suggested in *Figure 7-14 on page 260*.

8 The IP addresses are also inserted in the *SETUP* pane. Return to the *Tx Control Panel* dialog box, and click the **IP** button.

9 In the top portion of the *SETUP* pane are the IP address fields. Access the *IP Source* and *Destination* fields to change these addresses.

To use the user preferences method:

1 Access the **Add Streams** window, and confirm the IPv4 and MAC addresses.

2 Access the **User Preferences** window from *Actions* on the main toolbar. (See *Figure 7-17*.)

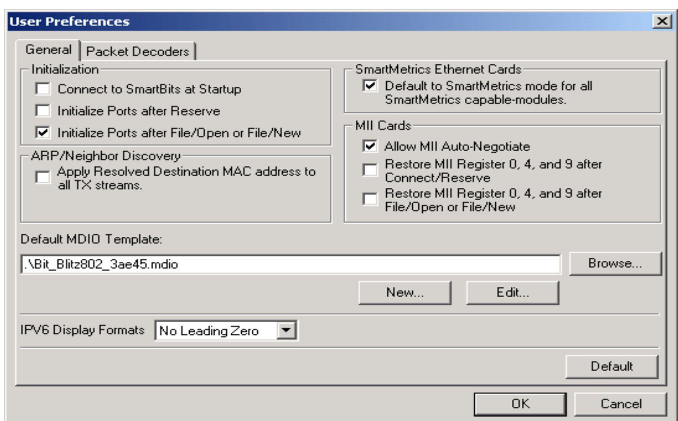


Figure 7-17. User Preferences Window

3 Select the **Apply Resolved Destination MAC address to all Tx streams** checkbox. After the ARP response is resolved, the stream MAC address is used for test traffic.

Select Different Protocols

Stream protocols are selected in one of two ways: use the *Add Streams* dialog box or the *Streams Protocol* pane. (Review the *"Streams Setup Window" on page 251* for a description of the add streams method.) The streams protocol method is described in the following procedure.

To use the streams protocol method:

1 In the *Tx Control Panel* dialog box, use the **Select Protocol** pull-down menu to see all available protocols. (See *Figure 7-18 on page 263*.)

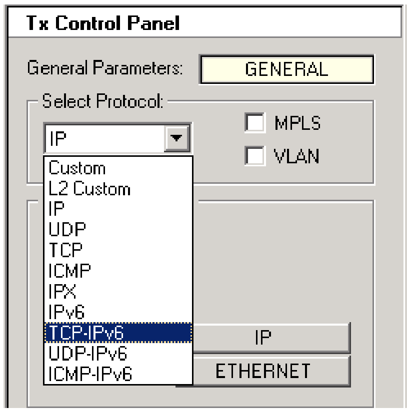


Figure 7-18. Stream Protocol

2 Select the **TCP/IPv6** protocol. This action changes the set of layers as well as the *SETUP* pane.

3 Press the **TCP/IPv6 Layer 4** button. Now configure this protocol using the templates in *SETUP*. (See *Figure 7-19*.)

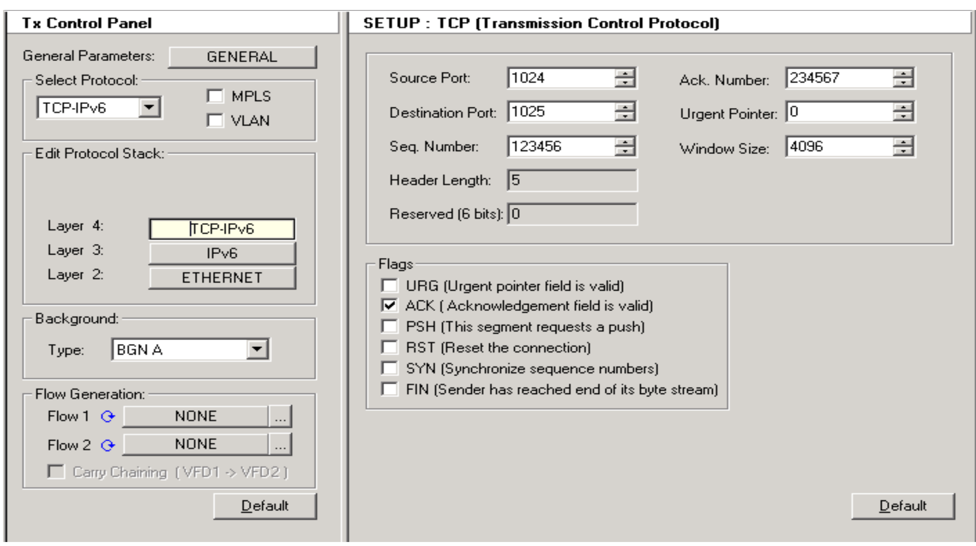


Figure 7-19. IPv6/TCP SETUP

Defining the Stream

Different *SETUP* windows are displayed for each set of Ethernet/protocol configuratons. Each of these SETUP windows has a custom set of templates that provide checkboxes and pull-down menus so parameters and requirements for the test streams can be configured.

To define the stream:

1. Return to the *Select Protocol* pull-down menu and select **IP**.
2. Click the **IP** button to see the templates used to set up the IPv4 stream.
3. Access the **SETUP:** window pane and select the **Type of Service (TOS)** tab.

   The Type of Service (TOS) fields have default values of 0. (For information on how to select TOS values for the test and other parts of this IP template, refer to the Smart-Window online Help.)
4. Click the **View** button on the *Transmit Setup* window. (See *Figure 7-20* for an illustration of the *Packet Editor* window.) Use this window to check the configuration of the stream.

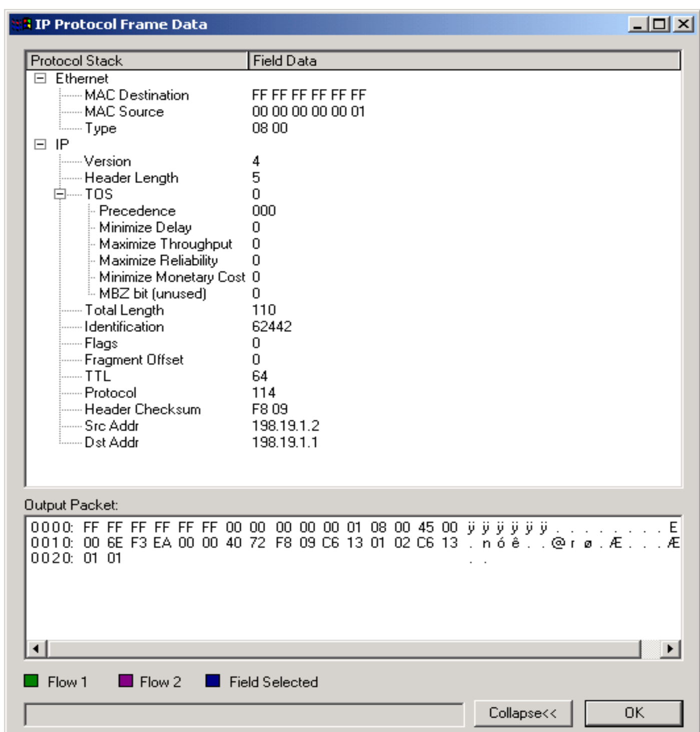


Figure 7-20. IP Protocol Frame Data Window

Note: For more information on templates for Layers 2, 3, and 4, refer to *“Configuring Transmit Streams on TeraMetrics Modules” on page 392*.

Send Traffic and View Counters

To configure the counters, transmit traffic, and view counters:

1. Read *"About SmartMetrics" on page 278* for an overview of SmartMetrics testing.
2. Perform the procedure contained in *"How to Run SmartMetrics Tests" on page 284* to run tests.

Testing Using ML-7710 SmartMetrics SmartCards

This section describes a setup procedure for the ML-7710 SmartMetrics SmartCard that is used in the SmartBits 200/2000 chassis family.

Refer to *"Required Steps for SmartMetrics (Layer 3) Testing" on page 238* for SmartMetrics setup and startup procedures. When these preliminary steps have been performed, you can set up the test.

The test setup is as follows:

- Two ML-7710 SmartCards are installed in a SmartBits 2000 chassis.
- The SmartBits chassis is connected to a PC with SmartWindow via an Ethernet port.
- The two ML-7710 ports of the SmartBits chassis are connected to two gateway ports on the Layer 3 switch/router (device under test).

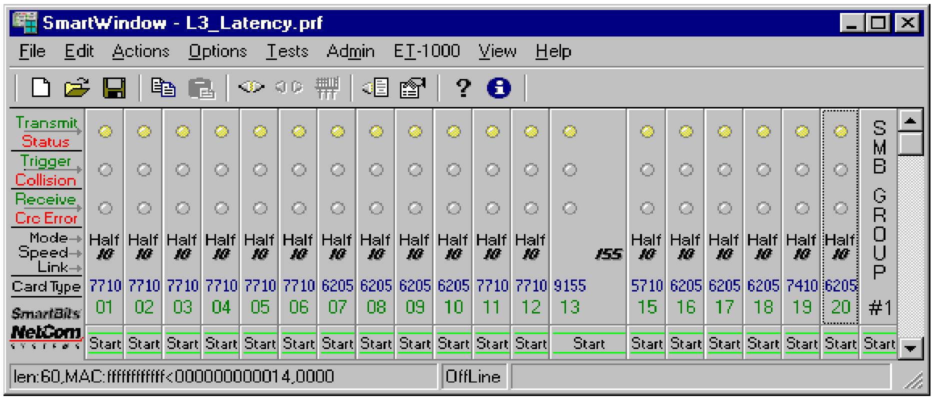
Note: This test setup uses two ML-7710 Smartcards. Additional SmartCards that support this test include the following:

- Two ML-5710/As can be substitued for the ML-7710s.
- Two LAN-3101A/B modules can be substitued for the ML-7710s.

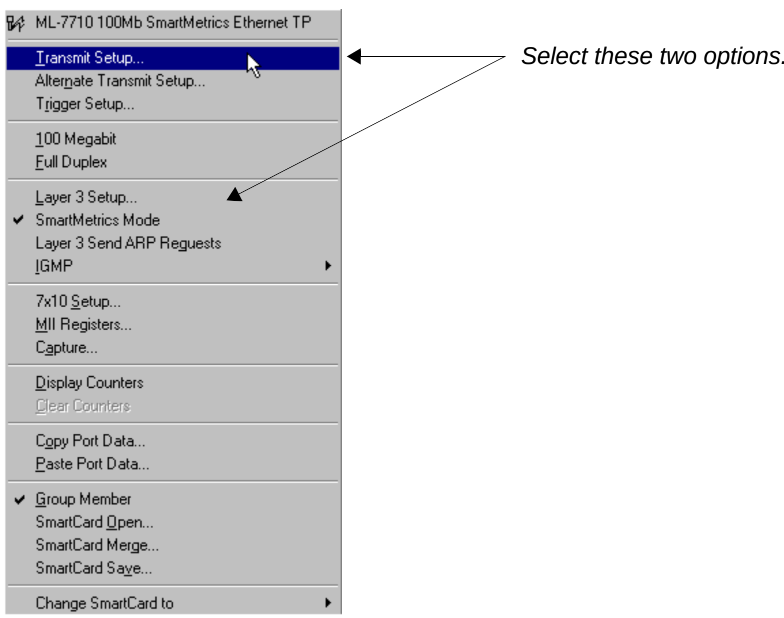
Review Global Default Settings

To check the default settings of each SmartCard:

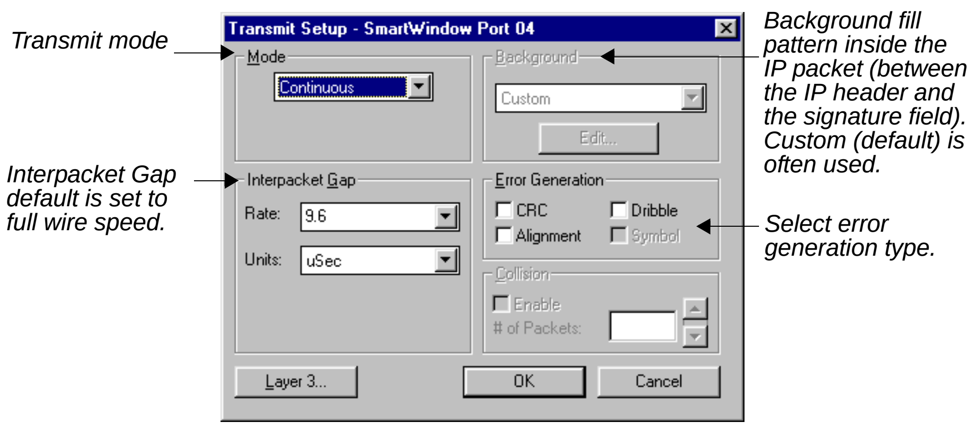
1 Open SmartWindow.



2 Click the ML-7710 SmartCard and choose the **SmartMetrics Mode** option. Then click the card again and select **Transmit Setup**.



3 In the *Virtual Transmit Engine (VTE) Setup* dialog box, select **This Port**. Use this dialog box to configure streams. Although many parameters can be modified, most fields are optional.



Set up One Layer 3 Stream per ML-7710 SmartCard

Use this SmartWindow procedure to configure one stream in each of the two ML-7710 SmartCards (e.g., ports 4 and 5 in a SmartBits 2000 chassis). The SmartBits chassis is connected to a Layer 3 switch or router.

Note: For the LAN-3101A/B modules, this procedure can be applied to two ports on one module.

It is helpful to set IP address assignments in patterns that are easy to remember and interconnect. Before setting up streams, configure the IP addresses of the SmartBits chassis and DUT ports. *Figure 7-21* illustrates a sample topology.

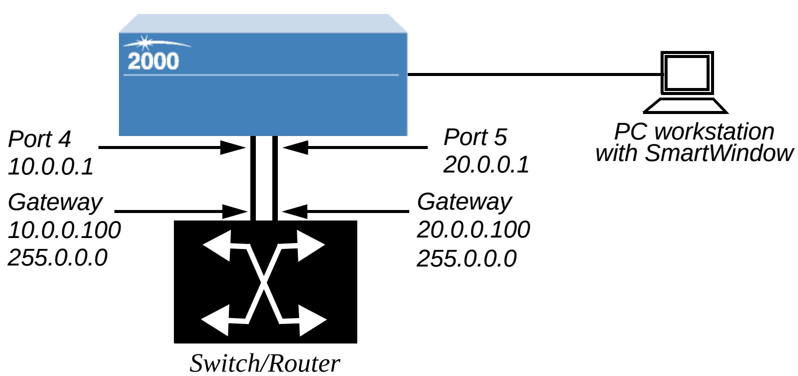


Figure 7-21. Two ML-7710 Cards Connected to Router Ports

To configure one stream in each of the two ML-7710 SmartCards:

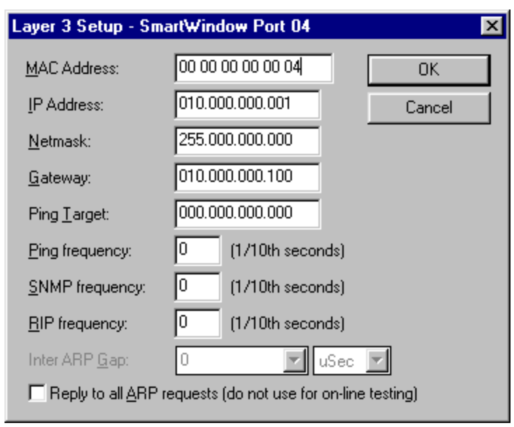
1. In SmartWindow, click the ML-7710 SmartCard in port 4, and choose **SmartMetrics Mode**.
2. Click the SmartCard again, then choose **Layer 3 Setup**.

   The **Layer 3 Setup** dialog box describes the local stack and is optional for most testing requirements. Edit values for the following purposes:

   - To set the gateway IP address of the router port (DUT). (This address is required for Layer 3 switches.)
   - To change MAC and IP addresses (if needed) so that these addresses do not duplicate stream addresses.
   - To set the netmask for management frames, if needed. (This action is optional and ignored by streams.)
   - To specify a ping IP address for pings and SNMP frames, if needed. (Optional)
   - To specify the frequency of ping, SNMP, or RIP packets. (Optional)

Port 4 Layer 3 setup

3. Set the MAC and IP addresses plus gateway address as shown below. The **Gateway** field value is the IP address of router port. The **MAC Address** field value reflects the card (not the individual stream). The **IP Address** field value must be in the same subnet as the router port/gateway. Once these addresses are entered, click **OK**.

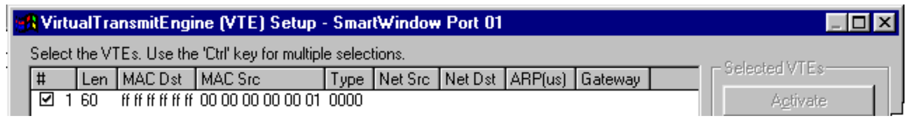


Warning: Do not select the **Reply to all ARP requests (do not use for on-line testing)** checkbox on a live network. This checkbox is useful only for unidirectional traffic to set up transmission of IP addresses.

Important: The gateway IP address is the target address for ARP frames. If the gateway IP address is zero, the ARP frames target the destination IP addresses of the streams.

Stream on port 4

4. Click the card and choose **Transmit Setup**. Highlight the default stream and click the **Delete** button. (The default stream will be replaced with more fully defined streams.)



5 Click the **Add VTEs** button to add a stream on port 4.

6 Choose **IP** from the **Protocol** pull-down menu, and click **OK**.

7 Highlight the stream, then choose **Edit Settings for** > **Selected VTEs**.

8 When the *Streams Setup* dialog box opens, click **Edit** to open the Protocol Editor. (Use *Figure 7-22 on page 269* as a guide when entering IP addresses in the Protocol Editor.)

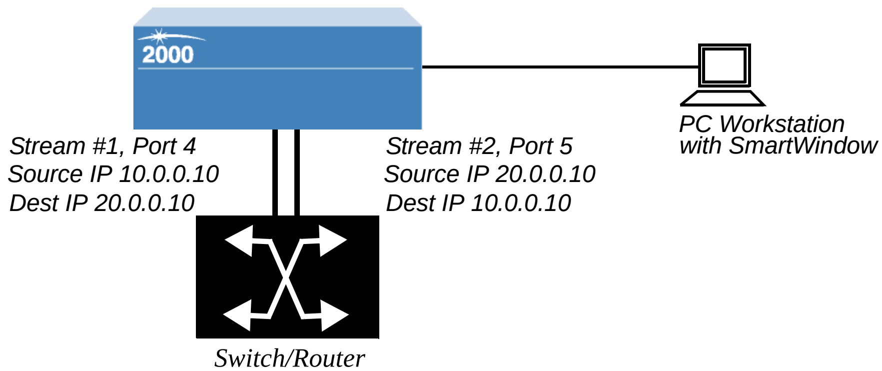
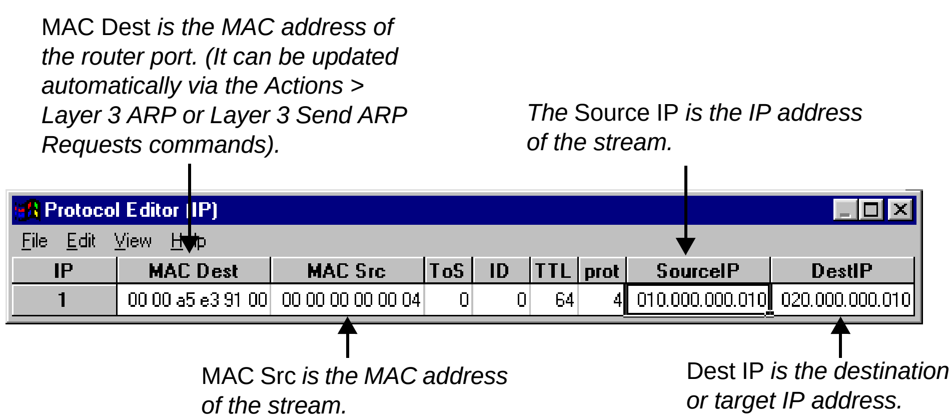


Figure 7-22. Stream IP Addresses by Port Association

9 In the Protocol Editor, choose **View** > **Invert Table**, then **View** > **Concise/Detail** to see more fields. Enter the appropriate addresses. (See *Figure 7-22*.)



Note: When an ARP response is received, the ARPs are handled internally; therefore, the MAC dest is not updated.

Important: The MAC and IP addresses of streams must be unique to the streams and cannot be used for SmartBits or DUT ports. The source IP address of a stream and of its SmartBits port should be on the same subnet as the associated router gateway. For Layer 3 routing tests, each pair of SmartBits and DUT ports should be on separate subnets, as shown in *Figure 7-22*.

10 Configure the port and stream for ML-7710 port 5. Click the port 5 SmartCard and choose **Layer 3 Setup**.

Port 5 Layer 3 setup

11 Set the MAC and IP addresses plus gateway address as shown in *Figure 7-23*. Remember that the MAC address and IP address of the card must be different from those of any of the streams that were set up.

Note: The Type of Service (TOS) field in the Protocol Editor defaults to 0. For information on how to select TOS values for the test, refer to the online Help.

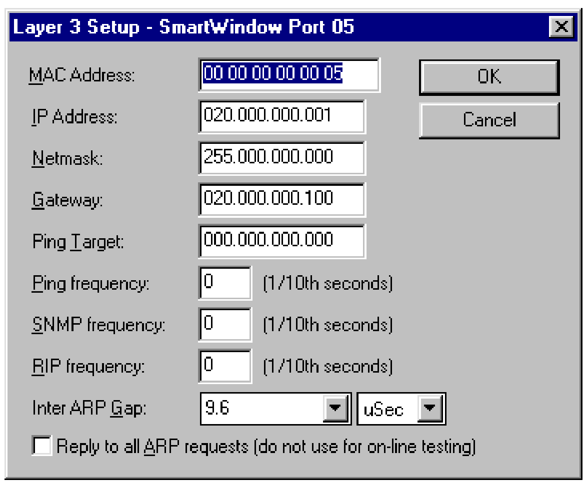


Figure 7-23. Layer 3 Setup

12 When the addresses have been entered, click **OK**.

Stream on port 5

13 Click the port 5 SmartCard and select **Transmit Setup**.

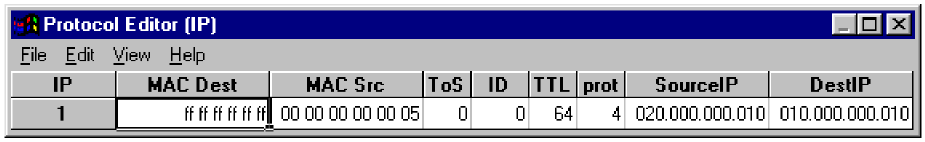
14 Perform *Step 4* through *Step 6* as before. Be sure to press **<Enter>** after each text entry to save it.

15 Click the **Close** button to exit the window.

Note: Note that source and destination IP addresses mirror the settings on port 4.

Learning MAC Addresses with Layer 3 ARP

As an alternate procedure for learning the MAC destination addresses, send Layer 3 ARPs from each card.



To learn MAC addresses with Layer 3 ARP:

1 Click each SmartCard and choose **Layer 3 Send ARP Requests** or choose **Actions** > **Layer 3 ARP** from the SmartWindow main menu to send ARP requests from all configured ports at one time.

2 Watch the SmartBits hardware or SmartWindow front panel LEDs. As each SmartCard transmits an ARP request, look for a brief green transmit and receive LED. If you do not see a momentary green receive LED light, the ARP response failed.

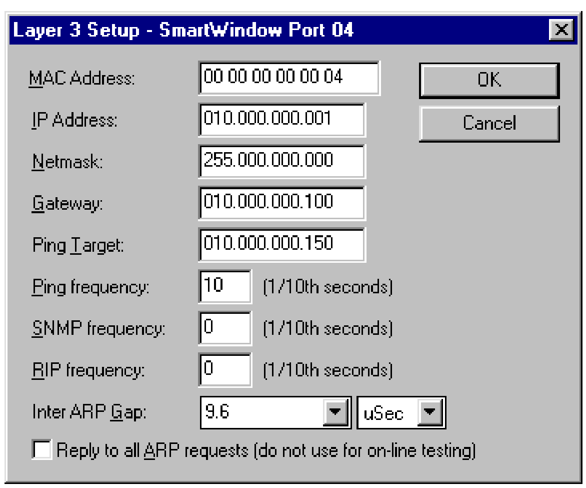
For other streams and ARPs, try the ARP exchange times test to ensure that ARPs for all streams were received. (See *"Viewing ARP Response Times" on page 314*.)

Ping Each SmartCard

Before transmitting traffic, it is worthwhile to ping the SmartCard IP addresses to confirm that the links to the DUT are working properly.

To ping each SmartCard:

1 Click the port 4 SmartCard, choose **Layer 3 Setup**, enter the **Ping Target** IP address for port 5, and set the **Ping Frequency** to **10**.



2 Click **OK**.

3 Click the port 5 SmartCard, select **Layer 3 Setup**, enter the **Ping Target** IP address for port 4, and set the **Ping Frequency** to **10**.

4 Click **OK**. (Pinging starts automatically as soon as the ping frequency is set to a non-zero value and the **OK** button is clicked).

5 After the pinging is performed, return to the **Layer 3 Setup** of each card, and turn off pinging by setting the **Ping Frequency** to 0. (This action keeps other results more clearly segregated.)

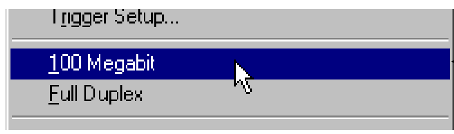
Check SmartCard Speed Setting

If the link is not active, check that the correct speed is selected. (The ML-7710 default is 10 Mbps; however, 100 Mbps might be required.)

To reset the SmartCard speed:

1 Click each card.

2 Select **100Mbps** from the drop-down menu of each SmartCard.



Choose 100 Megabit.

Send Traffic and View Counters

Now you are ready to transmit traffic and view counters. Proceed to *“About SmartMetrics” on page 278* for an overview of SmartMetrics testing. Then perform the procedure in *“How to Run SmartMetrics Tests” on page 284* to run tests.

Setting Multiple Streams per Card

This section describes how to create and use multiple streams on two cards, including counters and test results. It covers the following:

- Setting up 20 streams (transmit) on each port
- Creating a SmartBits group
- Transmitting traffic
- Viewing counters.

Note: This example uses ML-7710 SmartCards, but it applies equally to other SmartMetrics cards, as noted below.

The number of receive streams (i.e., rows displayed on the histogram) vary, depending on the type of module. (See *Table 7-5* for a listing of the maximum number of streams for each LAN module. See *"SmartMetrics Test Results" on page 306* for a explanation of the histogram and other tools used in understanding the test results.)

Table 7-5. Receive Streams for LAN Modules

Module	Maximum Number of Receive Streams
XFP-3730A/XFP-3731A[1]	32,000
XFP-3730A/XFP-3731A	16,000
LAN-332xA	16,000
LAN-31xxA	16,000
LAN-330xA	16,000

1 Requires latest firmware.

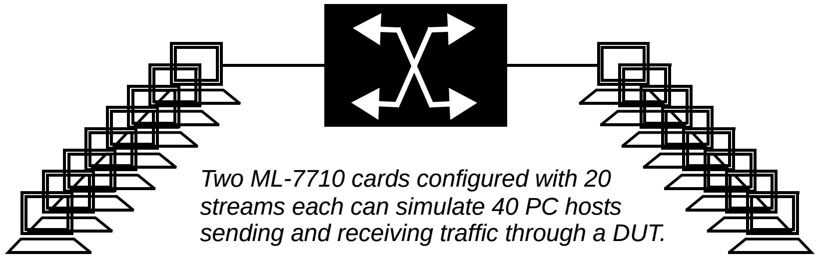
See *"Test Using the LAN-3321A TeraMetrics Module" on page 246* for the steps to set up streams on the new LAN-3301A TeraMetrics card. The following steps apply to that card as well, allowing only for differences in window and dialog box titles.

Note: This test setup uses two ML-7710s. Additional SmartCards that support this test include the following:

- Two ML-5710/As can be substituted for the ML-7710s.
- One or more LAN-3101A/B modules can be substituted for the ML-7710s.

Set up 20 streams per ML-7710 SmartCard.

The following procedure describes how to quickly set up 20 consecutive streams from each port, with varied IP and MAC addresses as well as with varied packet lengths (without FCS). If desired, you can also assign different protocols and add up to 1,000 streams to further simulate real-world networks.

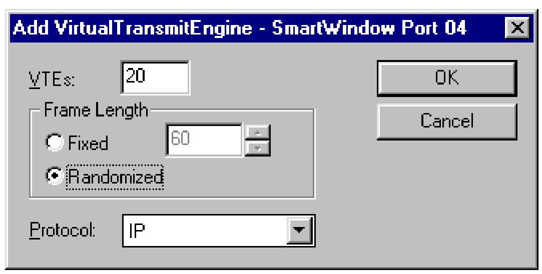


To set up multiple streams:

1. Click the first card or port and choose **Transmit Setup**.
2. Highlight the default stream and click the **Delete** button. It is helpful to delete the default stream and then configure all new streams.

Note: TeraMetrics modules (such as the LAN-3301A) have no default streams.

3. Click **Add VTEs** and enter **20** VTEs.



4. Click the **Randomized** button in the **Frame Length** pane (without FCS).

Note: It is recommended that you begin with fixed frame lengths to set initial testing benchmarks, then try randomized frame lengths for contrast. However, for this test, use the **Randomized** option.

5. Select **IP** in the **Protocol** drop-down menu.
6. Click **OK**. The Protocol Editor appears with default addresses for 20 streams.
7. Edit the first stream as follows:

   Source IP address:`10.0.0.4`

   Destination IP address (the Port 5 VTE stream):`20.0.0.5`
8. Highlight the entire **SourceIP** column, then right-click the top entry and select **Copy Down**. Right-click again and select **Fill Increment 0.0.0.x**.
9. Repeat *Step 8* for the **DestIP** column.

To change IP address defaults:

1. Edit stream 1 source and dest IP address.

2. Highlight Source IP *column, right-click, then* Copy Down > Fill Increment 0.0.0.x.

2. Highlight Dest IP *column, right-click, then* Copy Down > Fill Increment 0.0.0.x.

MAC destination addresses are filled by ARP exchange.

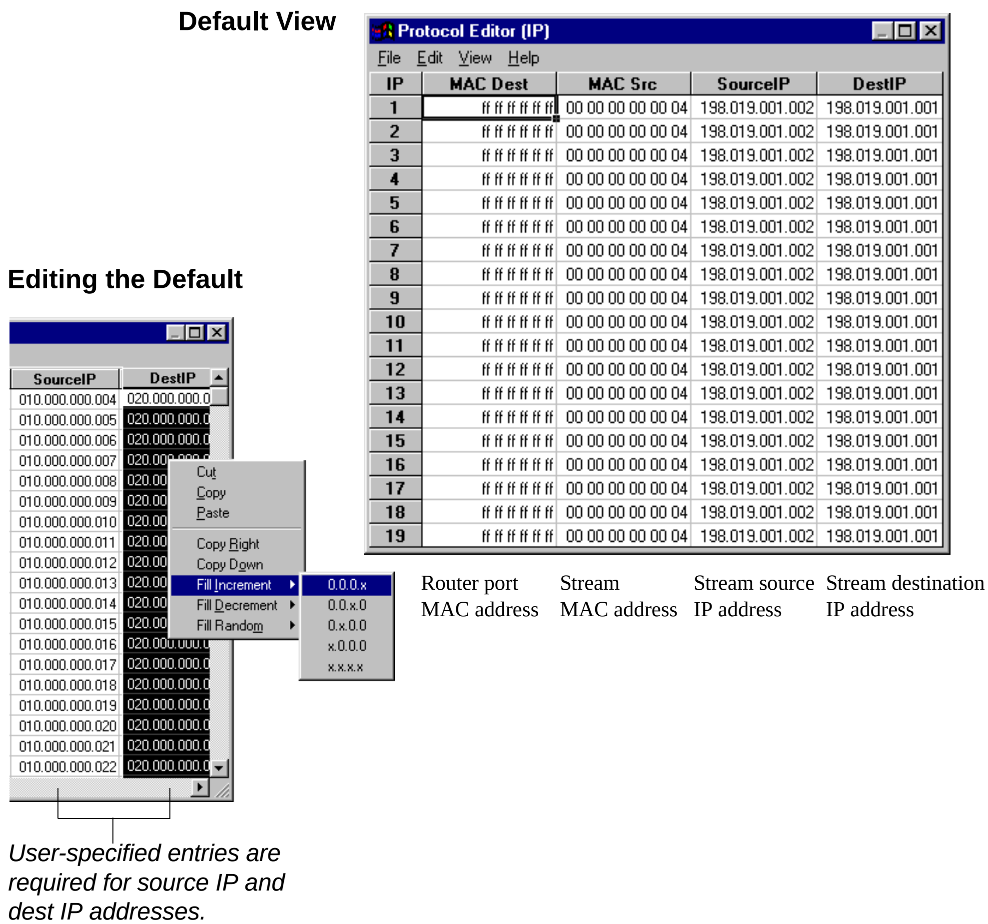


Figure 7-24. Editing Default IP Addresses

10 Click the **Close** button and save your settings.

11 View the 20 streams for port 5 in the **Transmit Setup** window (*Figure 7-25 on page 276*).

12 Click **OK**.

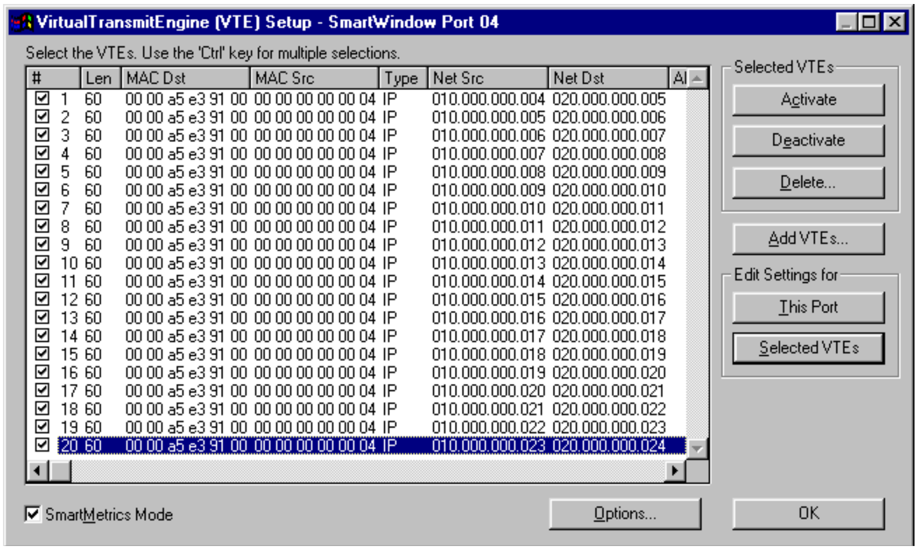


Figure 7-25. Multiple Streams in Transmit Setup Window

13 Repeat steps 1 through 7 above for port 5 using the following IP addresses. Use the port 4 addresses for destination IP addresses.

Port 5 stream IP addresses: `20.0.0.005` through `20.0.0.024`

Gateway for port 5: `20.0.0.100`

14 To configure the dest MAC addresses, choose **Actions** > **Layer 3 ARP** to send ARP requests to all configured ports.

To check that all ports have sent and received ARPs, perform the ARP exchange times test. (See *"Viewing ARP Response Times" on page 314*.)

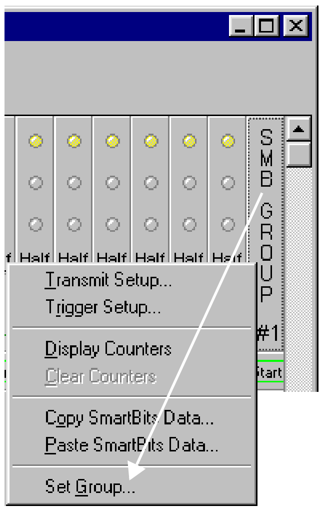
15 To confirm that the SmartBits links to the DUT are working properly, ping the port IP addresses as described in *"Ping Each SmartCard" on page 271*.

Using Group Start

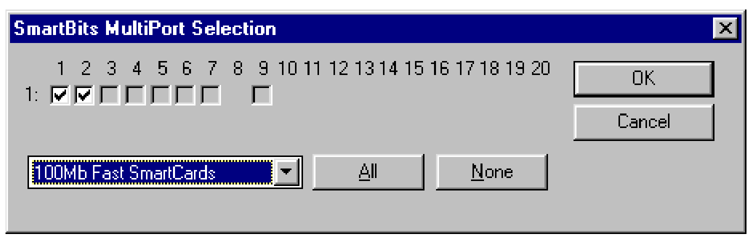
Creating an SMB group, transmit traffic, and view counters.

To start all transmissions of multiple SmartCards at the same time:

1. Right-click the **SMB Group** and choose **Set Group**.



2. Click the **None** button to clear all ports, then select port 1 and port 2 checkboxes to constitute the group. (All other ports are grayed out because the box in use is fitted for multiuser). Then click **OK**.



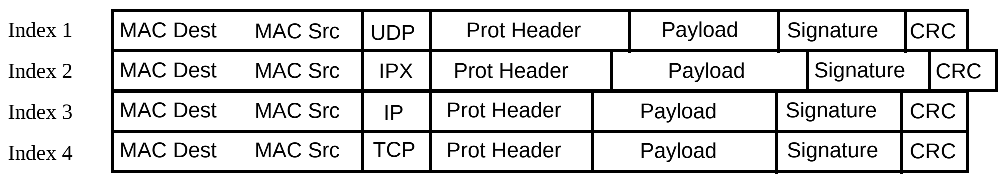
3. Choose **Actions > SmartCounters** to see results of multiple SmartCards on a single screen. Then choose **File > New Counter Window**. Highlight the port numbers whose counters need to be viewed (e.g., ports 1 and 2). Keep this window open.
4. Choose **View > Show** and select the checkboxes for rows and columns.
5. To define a custom indicator, select an empty cell to the right of the cells where data will be entered. Left-click inside this cell, then insert the math equation (pressing **F2** twice) using spreadsheet conventions.
6. Now click **Start** on the SMB group and watch SmartCounters.

About SmartMetrics

SmartMetrics refers to a method of generating test traffic that supports many unique streams definitions. SmartMetrics offers the following key test capabilities:

- Unique streams of traffic, generated from multiple frame blueprints
- Information tracking on a per-stream basis (as opposed to a per-port basis)
- A CRC check on the entire frame
- An embedded signature field in each frame, with timing and sequence information, that makes possible in-depth latency and sequence information
- An IP checksum for IP streams.
- Layer 3 testing.

Figure 7-26 illustrates four streams on a SmartMetrics card. As indicated, stream configurations can include multiple frame blueprints with different protocols and varying frame sizes (among other variables).



If enabled, the signature field overwrites 18 bytes of data at the end of the payload. It contains information such as the time stamp, steam ID, and frame sequence.

Figure 7-26. Four Streams (Frame Blueprints) on a SmartMetrics Card

When a card or module supports SmartMetric mode, it can generate frames that contain a signature field (*Figure 7-27*) with information about each frame. The receiving card uses this information to analyze network traffic behavior.

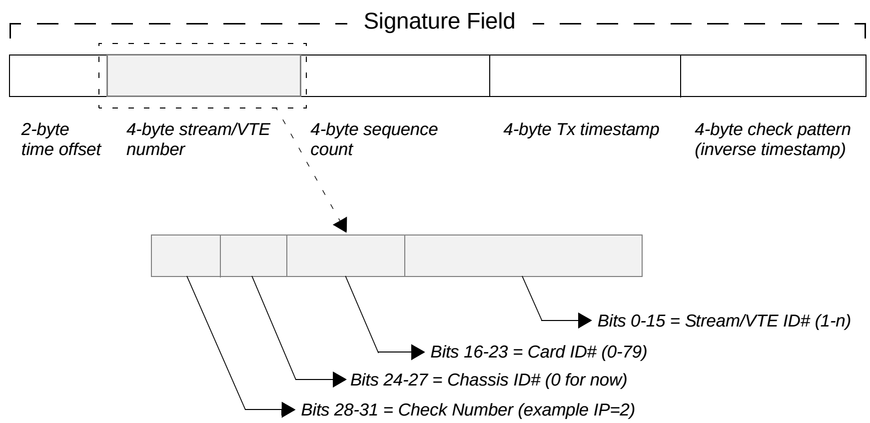


Figure 7-27. SmartMetrics Signature Field

SmartMetrics Test Requirements

Tx Requirements

The following must be configured for a card to transmit SmartMetrics streams:

- The card must be a SmartMetrics card. (Refer to *Table 7-6 on page 280*.)
- Streams must exist, be activated, and have a frame rate greater than 0.
- The signature field must be activated on all SmartMetrics cards. To activate the signature field:
  - **ML-5710/A, ML-6705, ML-6710, ML-7710, LAN-3101A/B**
    Edit the smartbit.ini file by making the following entry in the [Preferences] section:

    ```
    Layer3 Signature Control=1
    ```

    (Refer to *Table 5-9, "SmartBit.ini File: Important Commands and Settings," on page 142*.)

    This entry causes a checkbox to appear between Net Dst and ARP in the *Virtual Transmit Setup (VTE)* dialog box.
  - **POS Cards, LAN-3201B/C**
    Select the **Signature Field** checkbox in the **Transmit Setup** dialog box.
  - **LAN-33*xx*, LAN-37*xx*, XLW-372x modules**, **XFP-373xA**, and **FBC-3601A/3602A**
    Select the **Signature Field** checkbox in the **Tx Control Panel > General Stream Setup** dialog box. (To open the *Tx Control Panel* dialog box, select a stream, then click **Edit**.)

Rx Requirements

The following must be configured for a card to receive SmartMetrics streams:

- The card must be a SmartMetrics card. (Refer to *Table 7-6 on page 280* and *Table 7-7 on page 281*.)
- The card needs to be in SmartMetric mode.
- The card must support the requested test. (Refer to *Table 7-6 on page 280* and *Table 7-7 on page 281*.)
- The firmware must support the requested test. (Refer to *Table 7-6 on page 280* and *Table 7-7 on page 281*.)

Card Support for "Buckets" in Latency Measurements

The SmartMetrics and TeraMetrics-based modules support either 8 or 16 latency range settings ("buckets"), depending on module type. *Table 7-8* lists the ATM, Ethernet, Fibre Channel, and POS modules for the SmartBits 600x/6000x and shows the number of latency buckets provided by each module type.

Table 7-6. SmartMetrics Test Compatibility: Ethernet Cards

Test Type	ML-7710/7711 LAN-3101A/B LAN-3102A	LAN-330xA LAN-331xA LAN-332xA XLW-372xA XFP-373xA	LAN-3710AL/AE	ML-5710A	LAN-3201B/C[1]
Latency Per VTE	Yes[2]	Yes[2]	Yes	Yes	Yes
Latency Over Time	Yes	Yes	Yes	Yes	Yes
Latency Distribution	Yes	Yes	Yes	Yes	Yes
Raw Packet Tags	Yes	Yes	Yes	Yes	Yes
Frame Variation	Yes[2]	Yes[2]	Yes	Yes	Yes
Sequence Tracking	Yes	Yes	Yes	Yes	Yes
Sequence + Latency	Yes[2]	Yes[2]	Yes	Yes	Yes
ARP Exchange Times	Yes (except LAN-3101A)	Yes (except LAN-3300A)	Yes	Yes	No
(16)Latency Per VTE	Yes	Yes	Yes	Yes	No
(16)Latency Over Time	Yes	Yes	Yes	Yes	No
(16)Latency Distribution	Yes	Yes	Yes	Yes	No
(64)Latency Over Time	No	Yes	Yes	No	No
(64)Latency Distribution	No	Yes	Yes	No	No
(64)Sequence Tracking	No	Yes	Yes	No	No
(64)Sequence + Latency	No	Yes	Yes	No	No
RealTime Latency	No	Yes (except LAN-3300A, LAN-3301A, LAN-3302A, and LAN-331xA)	No	No	No

1 Requires SmartMetrics mode.
2 Requires current firmware.

Table 7-7. SmartMetrics Test Compatibility: WAN, POS, and FBC Cards

Test Type	WN-3405 WN-3415 WN-3420A WN-3441A WN-3442A WN-3445A	POS-3500A POS-3500B/Bs POS-3502A/As	POS-3505As/AR POS-3504As/AR POS-3510A/As POS-3511A/As POS-3518As/AR POS-3519A/AR	FBC-3601A FBC-3602A
Latency Per VTE	No	Yes	Yes	No
Latency Over Time	Yes	Yes	Yes	Yes
Latency Distribution	Yes	Yes	Yes	Yes
Raw Packet Tags	Yes	Yes	Yes	Yes
Frame Variation	No	No	No	No
Sequence Tracking	Yes	Yes	Yes	Yes
Sequence + Latency	Yes	Yes	Yes	Yes
ARP Exchange Times	Yes	No	No	No
(16)Latency Per VTE	Yes	No	No	No
(16)Latency Over Time	Yes	No	No	No
(16)Latency Distribution	Yes	No	No	No
(64)Latency Over Time	No	No	Yes	Yes
(64)Latency Distribution	No	No	Yes	Yes
(64)Sequence Tracking	No	No	Yes	Yes
(64)Sequence + Latency	No	No	Yes	Yes

Table 7-8. Number of Latency "Buckets" by Card Type

Module	Number of Latency Buckets
ATM	
ATM-345xA/As	16
Ethernet	
LAN-3100A	N/A
LAN-3101A/B	16
LAN-3102A	16
LAN-3111A/As	16
LAN-3150	N/A
LAN-3300A	16
LAN-3301A	16
LAN-3302A	16
Gigabit Ethernet	
LAN-3200A/As	N/A
LAN-3201A/B/C	8
LAN-3310A	16
LAN-3311A	16
LAN-3710AE	8
LAN-3710AL	8
LAN-3710AS	8
XLW-372xA	16
XFP-373xA	16
Ethernet Dual Media	
LAN-332xA	16

Table 7-8. Number of Latency “Buckets” by Card Type (continued)

Module	Number of Latency Buckets
Fibre Channel	
FBC-3601A	16
FBC-3602A	16
POS	
POS-3500A	8
POS-3500B/Bs	8
POS-3502A/As	8
POS-3504As/AR	16
POS-3505As/AR	16
POS-3510A/As	16
POS-3511A/As	16
POS-3518As/AR	16
POS-3519As/AR	16

How to Run SmartMetrics Tests

To run tests:

1 Ensure that both transmitting and receiving SmartCards are in SmartMetric mode. To do this:

- Right-click the card and choose **SmartMetrics Mode** — *or* —
- Select the **SmartMetrics Mode** checkbox on the *Virtual Transmit Engine (VTE) Setup* window. See *Figure 7-28*.

Note: The *Streams Setup* window has the same functions as the *Virtual Transmit Engine (VTE) Setup* window, but has a different layout and fields. It is available on other products such as the LAN-33xxA. Refer to *"Configure Streams on the Transmitting Card" on page 340* for an explanation of how to use this window to set up streams for a test.

2 Ensure that at least one stream (VTE) exists for the transmitting and receiving SmartCards and that the streams (VTEs) are activated.

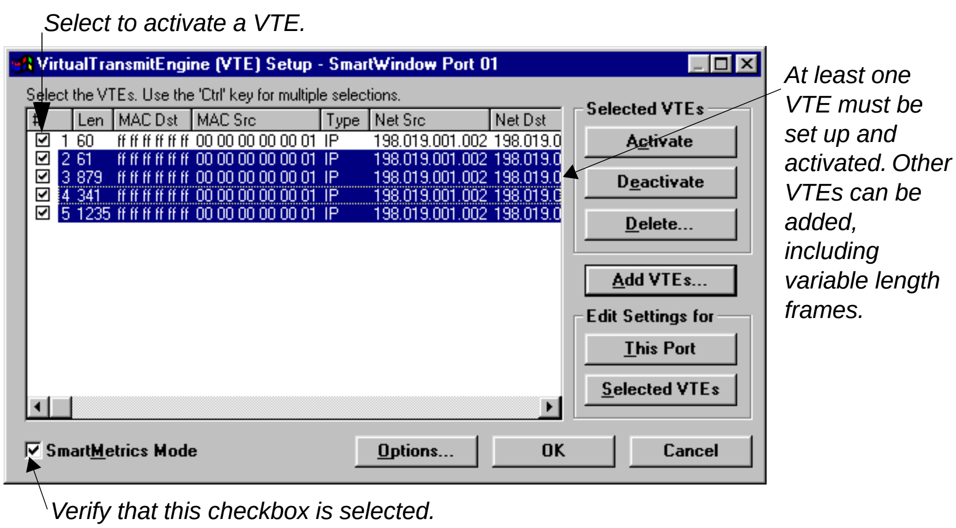
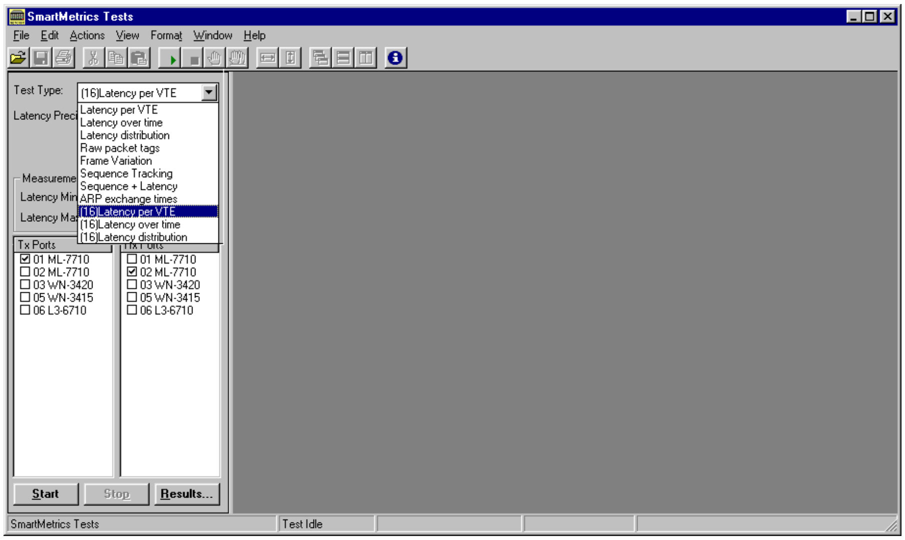


Figure 7-28. VTE Setup Window

3 Choose **Options** > **SmartMetrics Tests** from the main menu. The *SmartMetrics Tests* window is displayed.



4 Select the test to run from the **Test Type** drop-down menu.

About 16-bit, 32-bit, and 64-bit SmartMetrics

Some test names are prefixed by either **(16)** or **(64)**. The prefix indicates the number of bits available for counter results. The 16-bit SmartMetrics tests exist to provide legacy support for older SmartCards. The 64-bit SmartMetrics tests may be run on TeraMetrics modules—e.g., the LAN-33*xx* Ethernet modules or POS-3518AS/AR and POS-3519AS/AR modules (among others)—when Firmware 2.00 or later is installed.

See *Table 7-6 on page 280* for SmartMetrics test compatibility with Ethernet cards and modules. See *Table 7-7 on page 281* for compatibility with other card families.

5 Specify any parameters needed for the test, such as intervals (for Sequence + Latency test results.)

6 Select the transmitting and receiving ports.

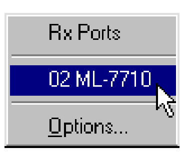
7 Click the **Start** button to start the test.

While the test is running, the port selection area and most toolbar buttons are greyed out. The status bar at the bottom of the window displays **Test Running**.

8 Click the **Stop** button to stop the test.
The status bar at the bottom of the window displays **Test Idle**.

9 To view test results, click the **Results** button.

The Results drop-down menu appears.



10 Select the card for which to view results.

11 To save test results to a file, select **File** > **Save** or **Save As**. (The default file format is Excel.)

Simultaneous Starting in SmartMetrics Tests

For SmartMetrics tests, a set of cards can start transmitting simultaneously, even when they are not grouped, by modifying the `smartbit.ini` file.

In the *Layer 3 Tests* section of the file, add the following lines:

```
Simultaneous Start = 1
```

Or, if this entry is already present, ensure that it is set to **1**. (The default is **0,** which disables simultaneous starting.)

Selecting and Deselecting Ports for SmartMetrics Tests

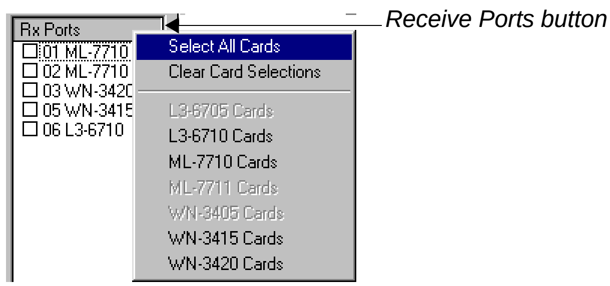
Select transmitting ports and receiving ports separately. You can select a single port, all ports at once, or all of the same type of SmartCard ports at once (if there is more than one).

To select ports individually:

1 Choose **Actions** > **SmartMetrics Tests** from the main menu.
2 Select the checkbox for the appropriate port.

To select all ports or a group of ports:

1 Choose **Actions** > **SmartMetrics Tests** from the main menu.
2 Click the **Tx Ports** or **Rx Ports** button.



3 Select one of the following:
- **Select All Cards** to select all ports.
- **Clear Card Selections** to clear all existing selections.
- The SmartCard type to select all of the same type of cards.

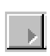
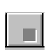
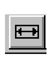
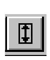
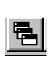
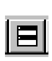
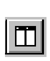
SmartMetrics Test Results Window Menus

File	Open an existing results file; save or print the active spreadsheet.
Edit	Manipulate highlighted information (e.g., copy and paste to another spreadsheet). Clear highlighted areas. Remove formatting that was set.
Actions	Select whether you want to view the toolbar and status bar.
View	Specify the spreadsheet display features, such as column headings, toolbar, or *Events Only* option. Specify mouse and keyboard actions.
Format	Define the appearance of the window, such as font and column dimensions.
Window	Specify how multiple spreadsheets should be displayed in the window.
Help	Identify the SmartMetrics test module.

Note: If the save function is used when the results for more than one port are displayed, the active spreadsheet is saved.

SmartMetrics Test Results Window Toolbar

The *SmartMetrics Tests* window displays a toolbar if the *Toolbar* option is selected on the *View* menu.

	Opens an existing results file.
	Saves the active results file.
	Prints the results file.
	Cuts the selected area to the clipboard.
	Copies selected area to the clipboard.
	Pastes selected area from the clipboard.
	Starts transmission.
	Stops transmission.
	Stops getting test results in the current active *Results* window.
	Stop getting test results in all *Results* windows.
	Adjusts column width to match contents.
	Adjusts row height.
	Arranges open files in cascade formation.
	Arranges open results files in tile formation, horizontally.
	Arranges open results files in tile formation, vertically.
	Displays **About** information for the current window.

How to Optimize 16-bit Latency Testing

Knowing the latency of a DUT before running a latency test may seem like a backwards approach to latency testing. However, the reason for latency tests is to verify the accuracy of your own latency estimates.

To optimize 16-bit latency testing:

1. Using your own latency estimates for a given DUT, run the Latency Distribution test as described in *"(16) Latency Distribution Test" on page 291*.
2. Review the results. Are the latency results distributed over a few buckets? If not:
   - Reset the precision to narrow the scale. For example, if the latency results fall within two or three buckets toward the center at the default precision of 25.6 μs, change the precision factor and run the test again.
   - Try using several frames of variable lengths (without FCS).
3. Run the other latency tests once you are satisfied with the granularity of the Latency Distribution test.

Refer to *"SmartMetrics 16-bit Tests" on page 290* for additional information on setting up 16-bit tests.

SmartMetrics 16-bit Tests

16-bit SmartMetrics tests may generate incorrect results when numbers exceed the upper limit of a given histogram precision range. When this occurs, the results displayed are meaningless and the test should be run again within prescribed guidelines for a given DUT.

SmartMetrics tests use a 32-bit latency counter (whenever possible) to gather and display statistical data. Some earlier cards only had 16-bit counter capability for gathering statistical data. (This is a firmware limitation.) However, for cards that do support 32-bit counters, only 16 bits out of 32 bits are retrieved and displayed for the 16-bit test results. The retrievable 16-bit portion depends on the precision setting. By default, the precision is set to 25.6, a range of 25.6 μs to 1,677,696 μs (1.6 sec).

Important: This limitation only applies to the 16-bit tests. All 32-bit tests (such as Raw Packet Tag test, Sequence Tracking test, etc.) use the entire 32-bit counter contents and no precision setting is required.

The following SmartMetrics tests are affected:

- (16) Latency per VTE
- (16) Latency Over Time
- (16) Latency Distribution.

As an example, suppose the **(**16) Latency per VTE test is run, transmitting a single burst of frames from the SmartBits port 1 through a DUT back to port 2 on the SmartBits. Each frame latency is estimated at 100 μs. A single burst is sent, but when the test finishes, the cumulative latency does not fall between 25.6 μs – 1.68 sec. The test results are incorrect and the burst size needs to be recalculated in frames or the latency range needs to be changed.

For greater granularity, the expected latency for one frame should fall somewhere close to the lower limit of the target precision setting in *Table 7-10 on page 294*.

Caution: When running 16-bit SmartMetrics tests at precision 6.5 msec, the maximum time of any 16-bit test is 429 sec.

(16) Latency Distribution Test

The following section describes how to optimize and run this 16-bit test. As explained in *"How to Optimize 16-bit Latency Testing" on page 289*, this test is used to:

- Narrow down latency estimates.
- Calculate the number of frames in a burst.
- Optimize the precision setting for other 16-bit latency tests.

To run the Latency Distribution test:

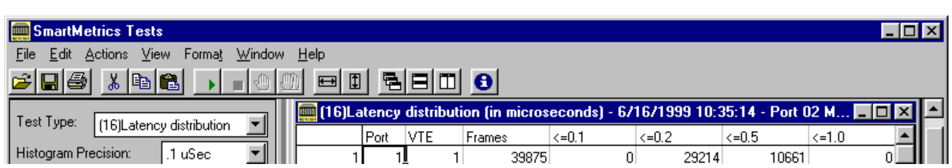
1. From the *SmartMetrics Tests* window, select **Latency Distribution** from the **Test Type** drop-down list.
2. Specify a precision in microseconds in the **Histogram Precision** field, or use the default. (See *"Using the Histogram Precision Settings" on page 293*.)
3. Select the ports to transmit VTEs of data in the test.
4. Select the ports to be monitored as data is received.
5. Click the **Start** button to start the tests for all of the ports involved in transmitting and receiving the data streams.
6. Run the test for a period of time. Then click the **Stop** button to terminate the test.
7. To view the results, click the **Results** button and select the appropriate port in the drop-down menu.

Adjusting the Precision Granularity

After running this test a few times, use the latency results to run other SmartMetrics tests with greater precision.

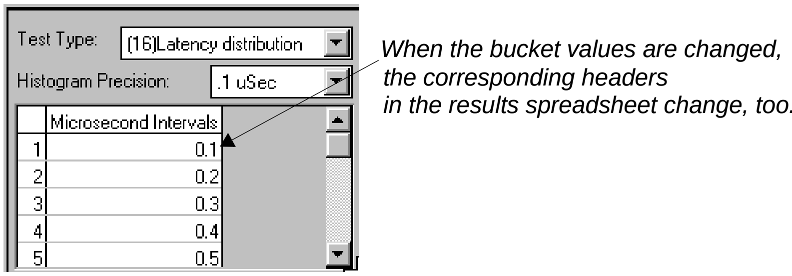
To adjust the precision granularity:

1. Run the test using the default precision.
2. View the results when the test is finished.
3. Adjust the precision. (For example, if the results fall between 25.6 and 51.2 µs, adjust the precision so that 51.2 µs falls at the upper limit of the range, i.e., select a precision of 1.6 µs.)
4. Run the test again.



5. Modify the buckets for greater granularity if the results fall within the lower end of the range.

You can modify the values in the configurable buckets scale. When the test is run again, this modifies the header values on the results spreadsheet.



The Latency Distribution test transmits a burst of packets, including variable length packets (without FCS, if required); monitors the received latency data; and distributes the results into spreadsheet "buckets" according to the 16 specified intervals. (See *Table 7-9*.)

Table 7-9. Bucket Default Values

Bucket	Default Value
1	25.6
2	51.2
3	128
4	256
5	512
6	1,280
7	2,560
8	5,120
9	12,800
10	25,600
11	51,200
12	128,000
13	256,000
14	512,000
15	1,280,000
16	1,677,696

Using the Histogram Precision Settings

The histogram precision setting of the buckets can be changed. For instance, if precision is set to the default 25.6 µs, then the upper limit of the test is 1,677,696 µs.

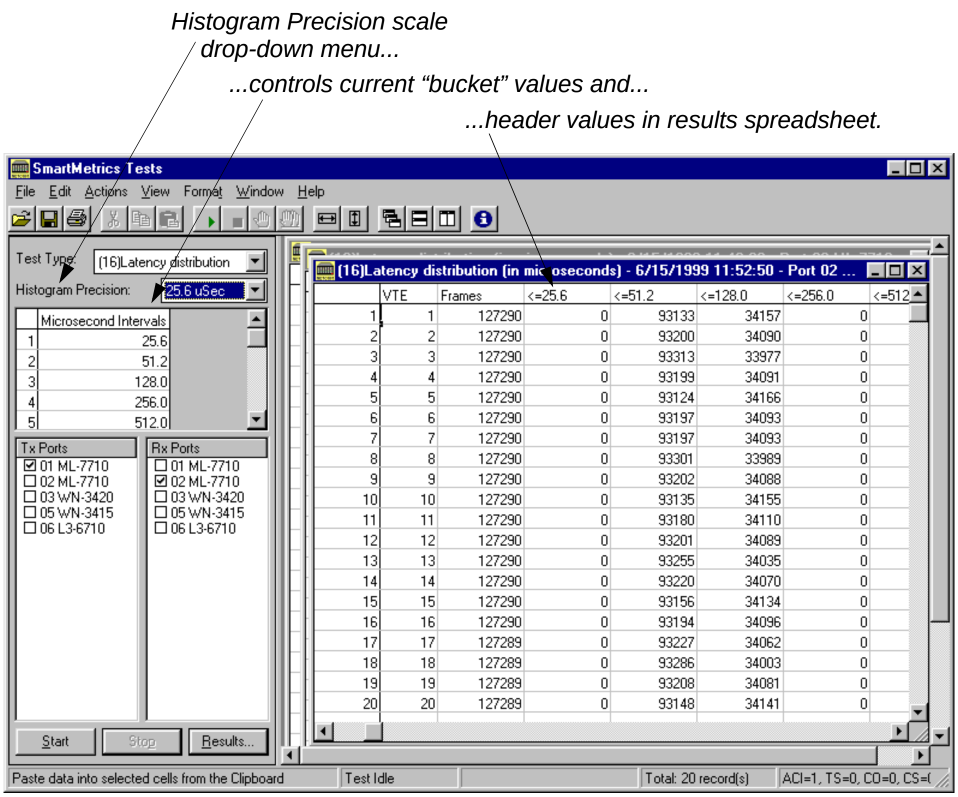


Figure 7-29. Latency Distribution Test Window

When the test is run, the buckets are used for holding the distributed latency results for the received packets in the burst. If the latency results exceed the upper limit of the selected range for any precision scale, the test is invalid. (See *Table 7-10 on page 294* for range limits.) Either run the test for a shorter period or set the granularity of the histogram precision scale to a new range.

Setting the Precision

Precision means finer granularity on the scale of measurement. As the scale increases, it shifts from µs to seconds. The increments of measurement become larger and granularity is lost.

Table 7-10. Latency Ranges by Histogram Precision Setting

Minimum Latency[1]	Maximum Latency
0.1µs	6.5536ms
0.2µs	13.1ms
0.4µs	26.2ms
0.8µs	52.4ms
1.6µs	104.8ms
3.2µs	209.7ms
6.4µs	419.4ms
12.8µs	.8389sec
25.6µs	1.68sec
51.2µs	3.36sec
102.4µs	6.71sec
204.8µs	13.4sec
409.6µs	26.8sec
819.2µs	53.7sec
1638.4µs	107.4sec
3276.8µs	214.7sec
6553.6µs	429.4sec

1 The lower limit is used to select the range in the histogram precision scale.

(16) Latency per VTE Test

The Latency per VTE test checks the latency for each active VTE of the transmitting port. Before running this test, refer to *"SmartMetrics 16-bit Tests" on page 290*.

SmartWindow monitors the received data and displays these results:

- **Port** – Transmitting port number
- **VTE** – Transmitting VTE stream number
- **Frames** – Total number of packets received
- **Minimum**, **Maximum**, **Average –** Minimum, maximum, and average latency (time in microseconds, between time sent and time received).

To run the Latency per VTE test:

1. Select **Latency per VTE** from the **Test Type** field drop-down list.
2. Specify a precision in microseconds in the **Latency Precision** field, or use the default.
3. Select the ports to transmit VTEs of data in the test.
4. Select the ports to receive data.
5. Run the test for a specified period of time. Then click the **Stop** button to terminate the test.
6. Click the **Results** button and select the appropriate port in the drop-down menu to view the results.
   The values show the latency of all received packets in the burst and are dependent on the precision setting.

(16) Latency Over Time Test

For this test, specify a time period (e.g., 1 msec increments). The test stores results in up to 4,000 data collectors. The test records all packets received with timestamp data and calculates the minimum or average latency for all currently active VTEs. The test also records data for discard eligible packets. Before running this test, refer to *"SmartMetrics 16-bit Tests" on page 290*.

SmartWindow monitors the received data and displays these results for all packets and as well as separate columns for discard eligible packets:

- **MilliSec** – The time interval over which the data was gathered
- **Frames** – Total number of packets received
- **Minimum**, **Average –** Minimum or average latency (time in microseconds, between time sent and time received).

To run the Latency Over Time test:

1. Select **Latency over time** from the **Test Type** field drop-down menu.
2. Specify the precision in microseconds in the **Latency Precision** field, or use the default.
3. Specify the latency (minimum or average).
4. Select the ports to transmit VTEs of data in the test.
5. Select the ports to be monitored as data is received.
6. Click the **Start** button to start the tests for all of the ports involved in transmitting and receiving the data streams.
7. Run the test for a period of time. Then click **Stop** to terminate the test.
8. Click the **Results** button and select the appropriate port in the drop-down menu to view the results.
   Example: If the test is set for a time interval of 5,000 msec and the test runs for 1 minute, the results spreadsheet contains 12 rows showing the number of packets plus minimum, maximum, and average latency during that time period.

Other SmartMetrics Tests

Refer to *"Required Steps for SmartMetrics (Layer 3) Testing" on page 238* to set up Smartmetrics tests and *"How to Run SmartMetrics Tests" on page 284* to run those tests.

Sequence Tracking Test

The Sequence Tracking test checks if any packets were dropped (not received) or received out of sequence for each active VTE.

SmartWindow monitors the received data and displays results for:

- **Port -** Transmitting port number
- **VTE -** Transmitting VTE stream number
- **Frames -**Total number of packets received
- **InSeq -** Number of packets received in sequence.

To run the Sequence Tracking test:

1. Select **Sequence Tracking** from the **Test Type** field drop-down list.
2. Select the ports to transmit VTEs of data in the test.
3. Select the ports to be monitored as data is received.
4. Click the **Start** button to start the tests for all of the ports involved in transmitting and receiving the data streams.
5. Run the test for a period of time. Then click the **Stop** button to terminate the test.
6. View the results by clicking the **Results** button.

Sequence + Latency Test

The Sequence + Latency test checks packet tags to verify that packets transmitted by other SmartMetrics SmartCards are received correctly, whether the packets are received in the correct sequence, and whether there are duplicate or missing packets. This test is a combination of the Sequence Tracking, Latency per VTE, and Latency Distribution tests.

The Sequence + Latency test is run per VTE stream. SmartWindow reports test results for each active VTE stream separately. For the duration of the test, the results show the minimum, maximum, and average latency in microseconds for each VTE stream received from each port transmitting to the receiving port.

Important: This test can be used with ML-7710 SmartCards that have Firmware Version 2.00 or higher.

SmartWindow monitors the received data and displays results for:

- **Port -** Transmitting port number
- **VTE -** Transmitting VTE stream number
- **Frames -**Total number of packets received
- **InSeq** - Number of packets received in sequence
- **Minimum**, **Maximum**, **Average –** Minimum, maximum, and average latency (time in microseconds, between time sent and time received)
- **16 Latency Intervals -** Latency distribution for default or user-specified times in microseconds.

Note: For this release, use a rate less than 133,000 per second. Set the rate in the *Interpacket Gap* pane of the *Transmit Setup* dialog box.

To run the Sequence + Latency test:

1. Select **Sequence + Latency** from the **Test Type** field drop-down list.
2. Enter a time in microseconds for an interval and press **Enter**, or use the default times that are displayed for the test. These times are used to create a histogram of packets received within the specified time intervals. Up to 16 counter ranges can be specified, incrementing each histogram counter for each packet received within the range of the counter. Each counter can be specified in bit times (e.g., 0.1 µsec).
3. Select which time intervals to use for the test. If specific intervals are not selected, each of the 16 intervals is used.
4. Select the ports to transmit VTEs of data in the test. (Only SmartMetrics SmartCards appear.)
5. Select the ports to be monitored as data is received.
6. Click the **Start** button to start the tests for all of the ports involved in transmitting and receiving the VTE data streams.
7. Run the test for a period of time. Then click the **Stop** button to terminate the test.
8. View the results by clicking the **Results** button.
9. Save the results to an Excel or Layer 3 Editor file, or copy and paste them to other applications.

Real Time Latency Test

The Real Time Latency test generates three measurable components in a real-time environment: average latency, total number of packets, and values for all 16 buckets. This test is available for these specific LAN modules:

- LAN-3306A

- LAN-332xA
- XLW-372xA
- XFP-373xA.

There are two methods to configure the parameters for the Real Time Latency test: access the *Tests* menu on the main toolbar, or access the *SmartCounters* window and directly select the ports.

To run the Real Time Latency test by accessing the Test menu:

1 Select **Tests** from the main toolbar and access the **Configure** dialog box. This action displays the *RealTimeLatency Configuration* window. (See *Figure 7-30*.)

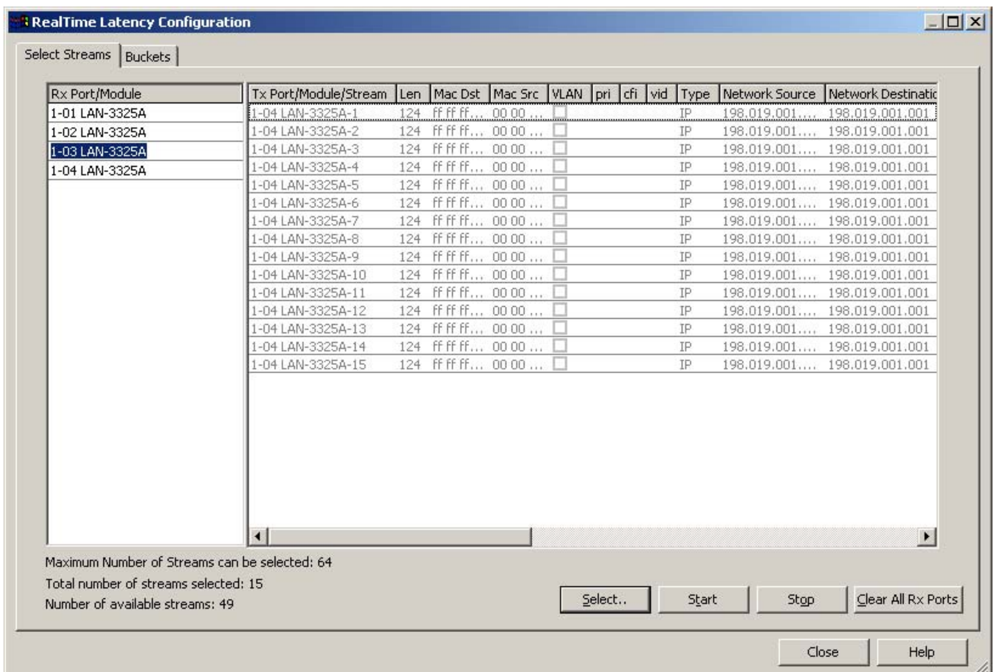


Figure 7-30. RealTime Latency Configuration Window

This window contains two tabs used to configure the streams and buckets for each set of latency tests.

2 On the *Select Streams* tab that shows a listing of the receive ports, click the **Select** button to add or delete a stream from each port.

3 Click the **Select** button to display a new window titled *Latency Stream Selector RxPort*.
The right pane of this window contains a series of checkboxes that can be used to select or clear each stream for the indicated port.
Selection shortcuts are available:

- Press the **<Shift>** key and right-click on the **#** column to select/clear groups of streams.
- Use the select/clear pop-up list to select/clear all selected streams.

The bottom left corner of the screen contains a cumulative total of the variables in this set of parameters.

Caution: While running the Real Time Latency test, selecting **Clear Counters** from the Rx port context menu (accessed by right-clicking the port icon in the main **SmartBits** window) will clear timestamps, causing invalid latency results.

Note: Unlike after-test measurements that are made with all counters halted on the receive port, real time measurements are made with the counters still running. Each counter is read in sequence and when all counters have been read, the results are returned to the user. This means that there can be small discrepancies in similar counters. Often, this is especially noticeable when comparing the total received frames counter with the sum of all frames received in the 16 latency buckets; these two counts can be off by one or off by two simply because the counters are not read at the same instant.

4 Select the **Buckets** tab after configuring the receive ports to review the size of the buckets used to capture the latency counts. (See *Figure 7-31*.)

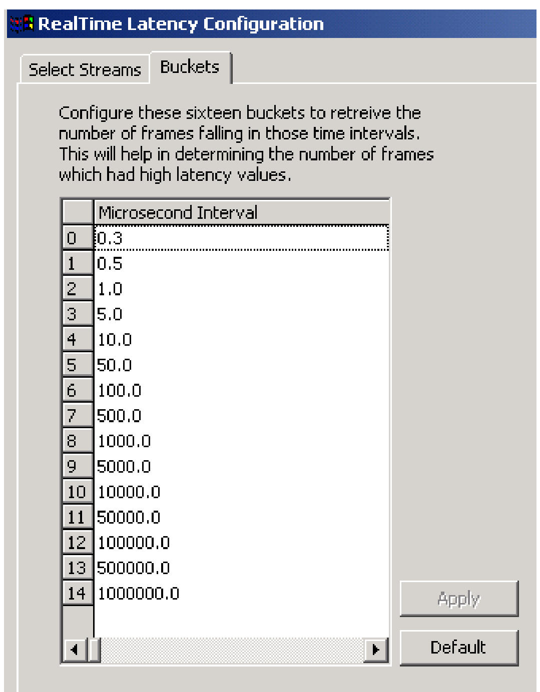


Figure 7-31. RealTime Latency Buckets tab

5 On this tab, 15 buckets are displayed (0-14). Each of these 15 buckets can be sized to capture specific groups of values. In the counter display, there are 16 buckets since the the last bucket contains those values more than 1,000,000 milliseconds filtered in the

15th bucket. *Table 7-10 on page 294* shows the minimum and maximum time intervals for the 15 buckets.

6 Click the **Apply** button to enable the latency time intervals that apply to all receive ports.

After the latency test(s) have been implemented, view the results via the Smart-Counter window. (Refer to *"Configuring Transmit Streams on TeraMetrics Modules" on page 392* and *"Real Time Latency Counters" on page 435* for additional information on how to configure SmartCounters to display real time latency counters.) See *Figure 7-32* for a display of the counter data found in the SmartCounter *Stream Statistics* window.

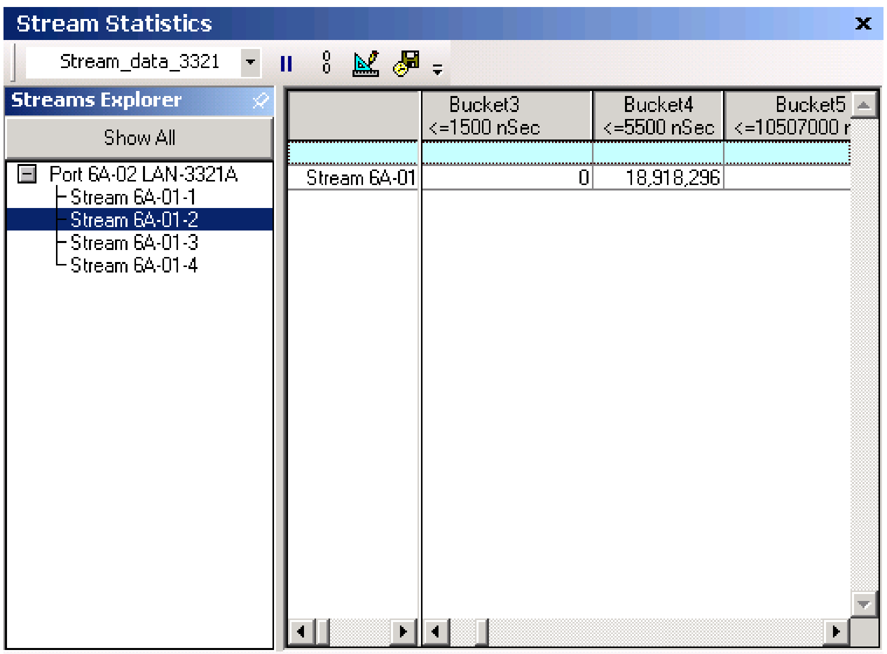


Figure 7-32. Real Time Latency Counters

Important: If a receive port has been configured for the Real Time Latency test and you attempt to delete a stream(s), a warning message appears. The message states that when proceeding with this action, the updated stream(s) can be viewed in the SmartCounters window, but the configuration is not uploaded to the module unless the Real Time Latency test is restarted.

The new receive port configuration is saved in a **.prf** file format. When this file is opened and you connect, the port entry is deleted if the configuration is not found. (This action also occurs on the transmit side.)

Capturing counter values is dependent upon the configuration of the receive port. If this port is configured for a Real Time Latency test, then a warning message appears that indicates the capturing process will stop the test on this port. This action occurs because you cannot simultaneously perform a capture and implement the Real Time Latency test.

To run the Real Time Latency test by accessing the SmartCounters window:

1 Access the *Port* menu and select **Display Counters** to display the *SmartCounters* window. Within this window, there are several windows, depending upon how SmartCounters is configured and what modules are running on the SmartBits 600x/6000x chassis.

2 Locate the menu bar in the *Results Framework* window. Select **Actions** to see *Tx Start* and *Tx Stop*. (See *Figure 7-33* for an illustration of the *Results Framework*, *Port Statistics*, and *Stream Statistics* windows.)

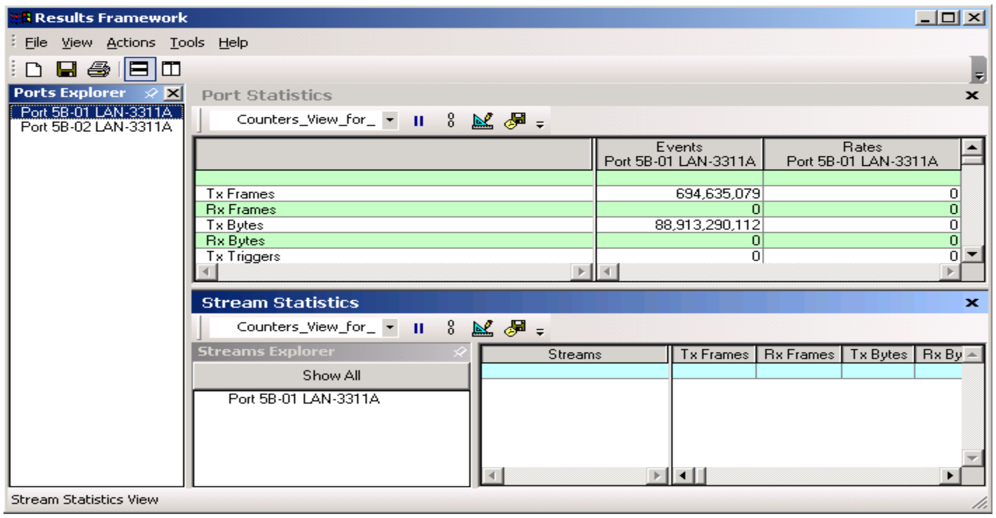


Figure 7-33. SmartCounter Windows

3 Review the *Stream Statistics* window after/during the test, since all real time latency counts are displayed within each of the time intervals. (See *Figure 7-32 on page 301*.)

Note: Used for latency counts, the 16 time intervals (buckets) are configured by using the real time latency configuration procedure described in the previous section or using the *Histogram Precision* field within *SmartMetrics Test* dialog box (which is accessed from main menu). [Refer to *"(16) Latency Distribution Test" on page 291*.] When using the latter method, it is necessary to select the *"(64)Sequence + Latency"* test type to ensure that the maximum latency counter values can be obtained. The bucket sizes (time intervals) remain the same as used for conventional latency data.

Raw Packet Tags Test

In Layer 3, VTE streams contain a 16-byte packet tag field in each transmitted packet. This tag is inserted at the end of the packet and consists of packet sequence number, source VTE stream, destination VTE stream, and timestamp. This function is used to determine transit latency and, in conjunction with the protocol VFD, to facilitate mesh tests of components such as routers.

In the Raw Packet Tags test, packets are stored and sent directly to SmartWindow without any calculations or filtering performed on the VTE stream tags received. The test can store up to 4,000 packet tags. The results spreadsheet for the test displays one line of information for every tagged packet of each VTE.

Note: The Raw Packets test retrieves and displays a maximum of 16,300 packets.

SmartWindow monitors the received data and displays these results for each packet of each VTE:

- **Port** – The port on which the packet was received.
- **VTE** – The number of the VTE identifying the VTE source of the stream.
- **Sequence** – The packet sequence number, which is incremented for each packet transmitted. Sequence numbers are maintained independently for each destination VTE stream. The numbers are reset to zero whenever the card is started.
- **TxTime** – The timestamp indicating when the packet was transmitted. It is the timestamp of transmit time for a packet to 100 ns resolution. (This timestamp is added by the transmit hardware and represents the actual time the packet exited the card rather than the time the packet was prepared for transmission.) It is an absolute number representing the clock tick at the time of transmission. It is relative to **Rx Time**.
- **RxTime** – The timestamp of when the packet was received. It is an absolute number representing the clock tick at the time of receipt. It is relative to **Tx Time**.
- **Delta –** The amount of change between **Tx Time** and **Rx Time**.

To run the Raw Packet Tags test:

1. Select **Raw packet tags** from the **Test Type** field drop-down list.
2. Select the ports to transmit VTEs of data in the test.
3. Select the ports to be monitored as data is received.
4. Click the **Start** button to start the tests for all of the ports involved in transmitting and receiving the data streams.
5. Run the test for a period of time. Then click the **Stop** button to terminate the test.
6. View the results by clicking the **Results** button.
   The raw data is shown in the spreadsheet and can be copied or saved for detailed processing elsewhere.

ARP Exchange Times Test

This is a test of Address Resolution Protocol (ARP) response. For each VTE stream that uses IP or UDP, the card transmits an ARP request. The timestamp of the request and its response is stored per stream. Information is stored for each active stream.

Note: Currently this test is not supported on the LAN-3300A/LAN-3301A module.

For each VTE (stream), SmartWindow displays these results:

- **DestMAC** – The MAC address of the connected Device Under Test (DUT).
- **ReplyTime** – The time in microseconds before an ARP response is received.

To run the ARP Exchange Times test:

1. Select **ARP Exchange Times** from the **Test Type** field drop-down list.
2. Select the ports to transmit VTEs of data in the test.
3. Select the ports to be monitored as data is received.
4. Click the **Start** button to start the tests for all of the ports involved in transmitting and receiving the data streams.
5. Run the test for a period of time. Then click the **Stop** button to terminate the test.
6. View the results by clicking the **Results** button.

Frame Variation Test

Packets that were transmitted at regularly spaced intervals can be delayed once they enter the network and arrive at varying intervals, due to factors such as jitter or device buffering.

This test measures variations in how soon one packet follows another in a VTE stream. For example, it measures the time interval between packets 1 and 2, then between packets 2 and 3, etc., as the packets arrive at the DUT. This test plots the number of packets that arrive within each of the 16 user-specified time intervals.

SmartWindow monitors the received data and displays these results for each packet of each VTE:

- **Port** – The port on which the packet was received.
- **VTE** – The number of the VTE identifying the VTE source of the stream.
- **Frames** – Total number of packets received.
- **16 Intervals –** Time interval default or user-specified times in microseconds by which to track packet arrival times.

To run the Frame Variation test:

1. Select **Frame Variation** from the **Test Type** field drop-down list.
2. Enter a time in microseconds for an interval and press the **Enter** key, or use the default times that are displayed for the test. These times are used to create a histogram of packets received within the specified time intervals.

   You can specify up to 16 counter ranges, incrementing each histogram counter for each packet received within the range of the counter. Each counter can be specified in bit times (e.g., 0.1 µsec).
3. Select which time intervals to use for the test. If no intervals are selected, each of the 16 is used.
4. Select the ports to transmit VTEs of data in the test. (Only SmartMetrics SmartCards appear.)
5. Select the ports to be monitored as data is received.
6. Click the **Start** button to start the tests for all of the ports involved in transmitting and receiving the VTE data streams.
7. Run the test for a period of time. Then click the **Stop** button to terminate the test.
8. View the results by clicking the **Results** button.

SmartMetrics Test Results

The SmartMetrics tests emulate live network traffic. They provide information about the relationships and timing of frames so the functionality and performance of a device under load can be evaluated. They dynamically track data per stream and change in latency. Since the results are presented in spreadsheet format, totals for a single SmartCard can be obtained. The stream-based SmartMetrics test results include:

- Sequence tracking
- Sequence + Latency (both 16- and 32-bit tests; does not apply to ML-7710 SmartCard)
- (16) Latency per VTE
- (16) Latency distribution
- (16) Latency over time
- ARP exchange times
- Raw packet tags
- Frame variation.

The (16) preceding some test options refers to the number of bits available for counter results. Tests not marked with (16) contain 32-bit counters. Before running the 16-bit counter tests, refer to *"SmartMetrics 16-bit Tests" on page 290*.

Latency in SmartMetrics Test Results

All of the SmartMetrics latency tests measure the difference between transmit and arrival time. Specifically, this is the difference between the time at which a tagged byte leaves the transmitting port and the time at which that byte arrives at the receiving port. However, each test result differs in how it measures latency—per VTE, over time, or by distribution. The Sequence + Latency tests combine three tests: sequence tracking, latency per VTE, and latency distribution.

Cut Through and Store and Forward Devices

Latency test results are typically used to measure the performance of "cut through" devices. Measurement of latency through one or more "store and forward" switches can be calculated by adding the time to transfer any remaining bytes out of the transmitting port.

Cut through devices begin retransmission after receiving packet headers. This increases performance over store and forward devices. Latency of these devices is described above.

Store and forward devices receive a complete packet on the input port before beginning transmission on the output port. For these devices, the latency is defined as the difference between the time the last byte leaves the transmitting device and the time at which the first byte arrives at the destination device.

The results are presented to cover both possibilities. A result of NO is shown in the store and forward column if the system is able to detect the type of DUT as a cut-through switch.

Interpreting SmartMetrics Test Results

SmartWindow places test results for a receiving port into a spreadsheet that can be viewed from within the *SmartMetrics Tests* window. Use the *SmartMetrics Test* window toolbar buttons or the menu options to modify the spreadsheet format and selectively display information as you can with traditional spreadsheet applications.

Timestamps - Tests that use latency histograms (Sequence + Latency and Latency Over Time) utilize a timestamp of when the packet was transmitted. The timestamp is the transmit time for a packet to a 100 ns resolution. The transmit hardware adds this time stamp. It represents the actual time the packet exited the card rather than the time the packet was prepared for transmission. It is an absolute number representing the clock tick at the time of transmission.

Management Frames – Management frames (RIP and SNMP) can be added to any SmartMetrics tests (per RFC 1944) from the *Port Setup* window. Management frames are relatively low rate streams containing authentic packets that are designed to inject management and routing control traffic into a test stream.

Note: If results are displayed for more than one port at a time, when a file is saved, only the active spreadsheet is saved to the file.

Viewing SmartMetrics Test Results (Histograms)

To view results for a single destination SmartCard:

1. Click the **Results** button, or select **Actions > Get Results** from the menu.
2. Select the port for which to view results.
   A spreadsheet containing the results appears in the right pane of the window.
3. Specify any required formatting or window elements using the toolbar or menu bar options.

To view results for more than one port, repeat these steps. Spreadsheets for subsequent ports that are selected display in the window according to which command is in effect on the toolbar.

To change the order in which the results are retrieved:

1. Click the **Results** button, then choose **Options** from the pop-up menu.
2. From the **SmartMetrics Test Options** dialog box, select the port to reorder the test results.

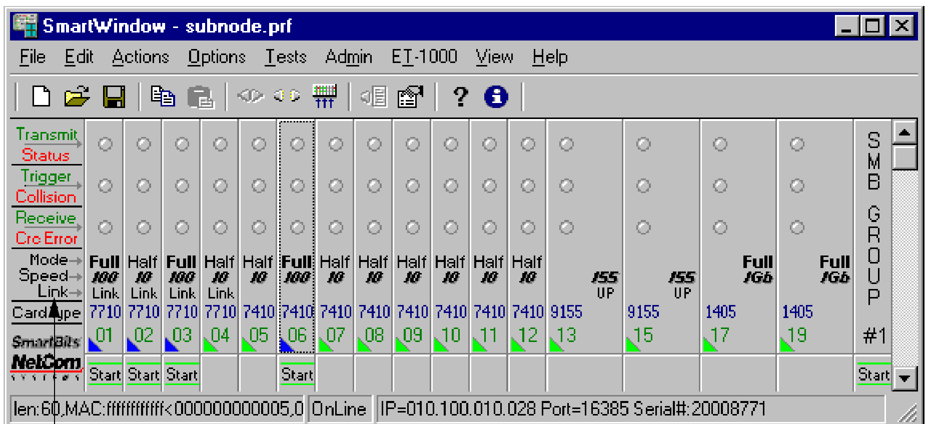
Detailed Tracking and Statistical Results

This section contains a sample configuration procedure for the latency and sequence tracking tests used to inspect the raw packet results via data capture. Information regarding performance of Latency and Sequence Tracking tests, inspection of raw packets, plus use of triggers and capture is included.

The Latency and Sequence Tracking tests provide valuable statistical data for performance analysis of the Layer 3 switch/router.

To perform Latency and Sequence Tracking tests:

1 Confirm that all links are active.



Link displayed on the SmartCard indicates an active link to the DUT.

In this example, the following parameters are set up using 20 streams for ports 1 and 2:

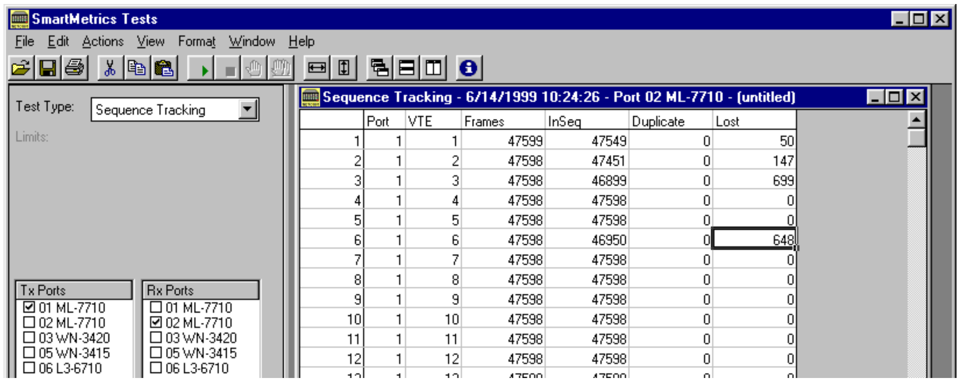
- Transmit setup: continuous mode, 9.6 µsec interpacket gap for 100% utilization
- Frame length (without FCS) for all streams: 60

2 Choose **Actions > Layer 3 Send ARP Requests**.

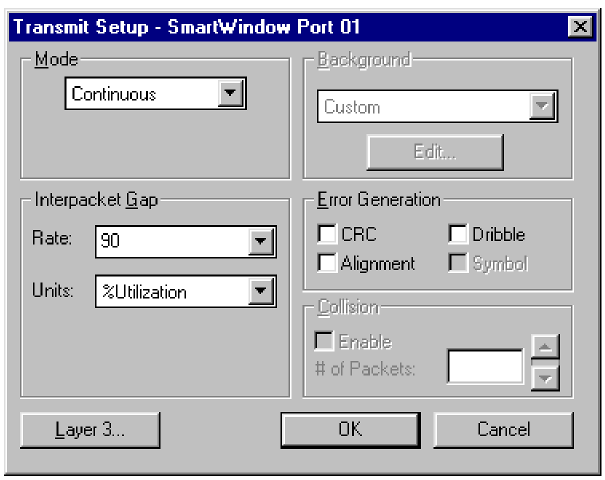
3 To run SmartMetrics tests on traffic from port 1 to port 2, choose **Options > Smart-Metrics Tests**.

Sequence tracking

4 Choose **Test Type > Sequence Tracking**, select checkboxes for Tx port 01 and Rx port 02, then click the **Start** button at the bottom of the window. After several seconds, click the **Stop** button. Then click the **Results** button and select the receive card (port 02).



5 To set a lighter load and determine the rate at which there is little or no packet loss, right-click port 1, select **Transmit Setup**, and click the **This Port** button.

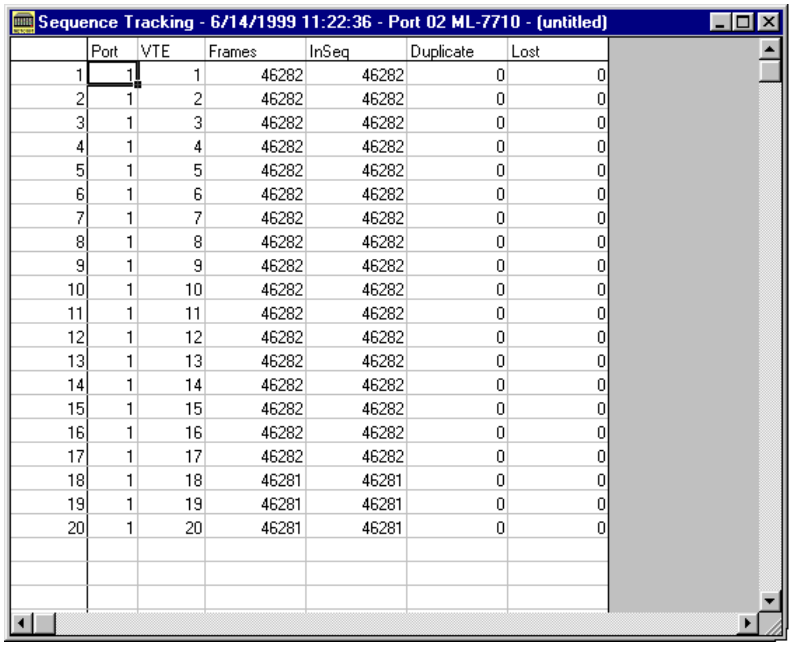


6 In the *Interpacket Gap* pane, select **% Utilization** in the *Units* field, then enter **90** in the *Rate* field. Click **OK**.

7 Click **OK** again to close the *Transmit Setup* window.

8 Run the **Sequence Tracking** test again.

After a few more test runs, the 80% load produced the following sequence tracking. You may wish to repeat this test a number of times over a period of time to track the consistency of the router and potential interruptions during the same and different loads, with increased or decreased number of streams, and with varied frame lengths (without FCS, either fixed or random).



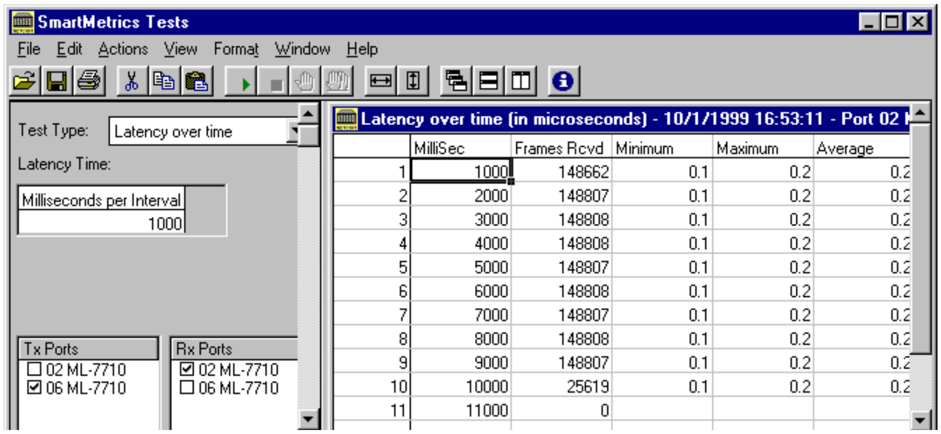
	Port	VTE	Frames	InSeq	Duplicate	Lost
1	1	1	46282	46282	0	0
2	1	2	46282	46282	0	0
3	1	3	46282	46282	0	0
4	1	4	46282	46282	0	0
5	1	5	46282	46282	0	0
6	1	6	46282	46282	0	0
7	1	7	46282	46282	0	0
8	1	8	46282	46282	0	0
9	1	9	46282	46282	0	0
10	1	10	46282	46282	0	0
11	1	11	46282	46282	0	0
12	1	12	46282	46282	0	0
13	1	13	46282	46282	0	0
14	1	14	46282	46282	0	0
15	1	15	46282	46282	0	0
16	1	16	46282	46282	0	0
17	1	17	46282	46282	0	0
18	1	18	46281	46281	0	0
19	1	19	46281	46281	0	0
20	1	20	46281	46281	0	0

The remaining tests are run at the 80% utilization rate with the same switch.

Latency Tests

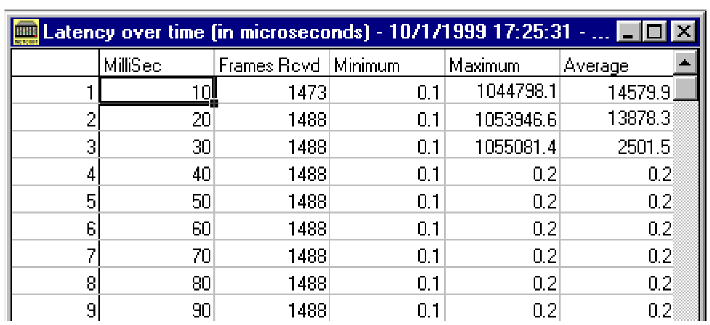
To run these tests:

1 Choose **Test Type> Latency over Time**. Click the **Start** button, run the test for a few seconds, then click the **Stop** button. Click the **Results** button and select receive port 02.



	MilliSec	Frames Rcvd	Minimum	Maximum	Average
1	1000	148662	0.1	0.2	0.2
2	2000	148807	0.1	0.2	0.2
3	3000	148808	0.1	0.2	0.2
4	4000	148808	0.1	0.2	0.2
5	5000	148807	0.1	0.2	0.2
6	6000	148808	0.1	0.2	0.2
7	7000	148807	0.1	0.2	0.2
8	8000	148808	0.1	0.2	0.2
9	9000	148807	0.1	0.2	0.2
10	10000	25619	0.1	0.2	0.2
11	11000	0			

An ideal switch would slightly increase latency for a short time; latency would remain constant for most of the test, then decrease as the ML-7710 stops transmitting. An increasing latency from start to finish indicates that the switch cannot handle the load for long sustained periods. As the latency increases, the switch buffers more frames. A spike in the latency indicates a problem with buffer scheduling and warrants more investigation.[1]

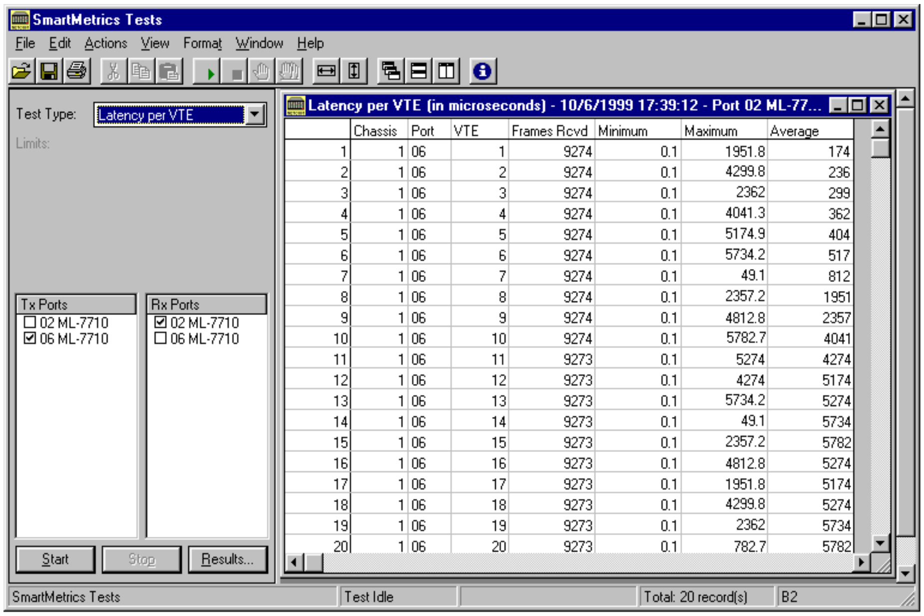


	MilliSec	Frames Rcvd	Minimum	Maximum	Average
1	10	1473	0.1	1044798.1	14579.9
2	20	1488	0.1	1053946.6	13878.3
3	30	1488	0.1	1055081.4	2501.5
4	40	1488	0.1	0.2	0.2
5	50	1488	0.1	0.2	0.2
6	60	1488	0.1	0.2	0.2
7	70	1488	0.1	0.2	0.2
8	80	1488	0.1	0.2	0.2
9	90	1488	0.1	0.2	0.2

1. After approximately 1 second, the latency drops to a reasonable level. A possible cause of this change is the use of a fast path mechanism.

Latency per VTE

2 Choose **Test Type > Latency per VTE**. Click the **Start** button, run the test for a few seconds, then click the **Stop** button. Click the **Results** button and select receive port 02. Spikes in the latency are apparent.



The 20 streams are summarized with the minimum, maximum, and average for each stream. The latency range is relatively wide.

Latency distribution

3 Choose **Test Type > Latency Distribution**. Click the **Start** button, run the test for a few seconds, then click the **Stop** button. Click the **Results** button and select receive port 02. The latency has dropped dramatically, so the 13.4 to 14.2 msec value shows consistently under the 20 msec time interval.

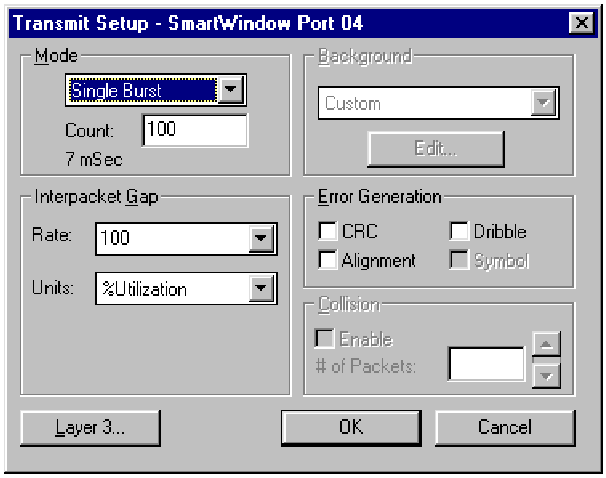
Note: To look closely at the content of the last 131,000 packets received, use the **Test Type Raw Packet Tags** test.

Inspecting raw packets.

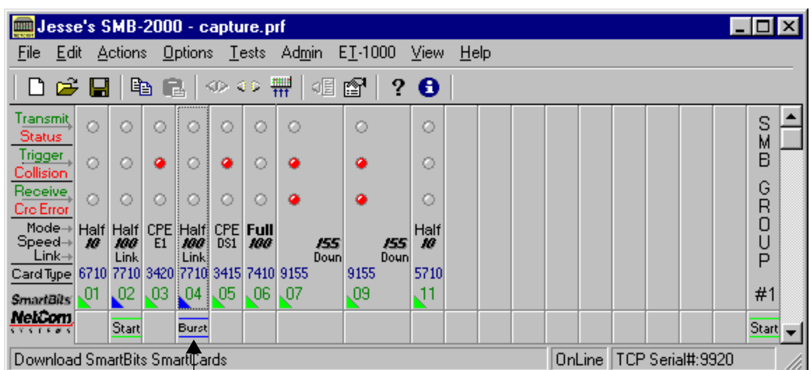
4 To use full-wire rate in single burst mode, click the port 4 SmartCard, choose **Transmit Setup**, and click the **This Port** button.

5 Set mode to **Single Burst,** and select **%Utilization** in the **Units** field and **100** in the **Rate** field of the *Interpacket Gap* pane, which will create a 10-second burst at full wire rate.

6 Click **OK**.



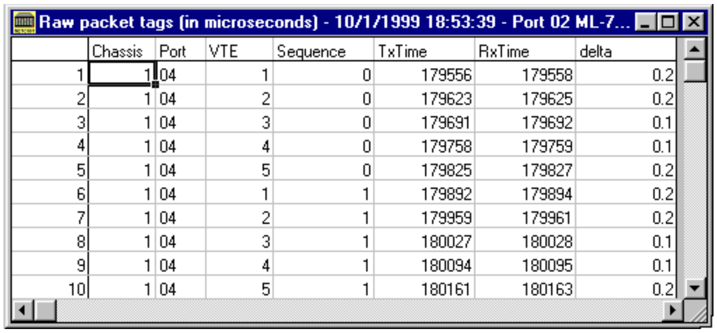
Note: The two active ML-7710 SmartCards show the live link status and burst mode.



Burst mode sends 100 frames from port 6 to port 2.

7 Choose **Options** > **Layer 3 Tests,** and then choose **Test Type**> **Raw Packet Tags**.

8 Click the **Start, Stop,** and **Results** buttons to view raw packets in detail. Notice how the test cycles continuously through the five streams set up on port 4.


Raw packet tags (in microseconds) - 10/1/1999 18:53:39 - Port 02 ML-7...

	Chassis	Port	VTE	Sequence	TxTime	RxTime	delta
1	1	04	1	0	179556	179558	0.2
2	1	04	2	0	179623	179625	0.2
3	1	04	3	0	179691	179692	0.1
4	1	04	4	0	179758	179759	0.1
5	1	04	5	0	179825	179827	0.2
6	1	04	1	1	179892	179894	0.2
7	1	04	2	1	179959	179961	0.2
8	1	04	3	1	180027	180028	0.1
9	1	04	4	1	180094	180095	0.1
10	1	04	5	1	180161	180163	0.2

Viewing ARP Response Times

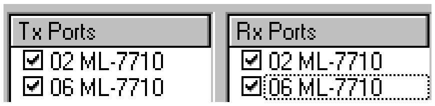
It can be helpful to look at ARP response times that may vary with traffic load, time of day, and the characteristics of each switch. The ARP response times also confirm that all ports are sending and receiving ARPs properly.

To perform an ARP exchange and view the ARP response times:

1 Choose **Options** > **SmartMetrics Tests**.

2 Choose **Test Type** > **ARP exchange times**.

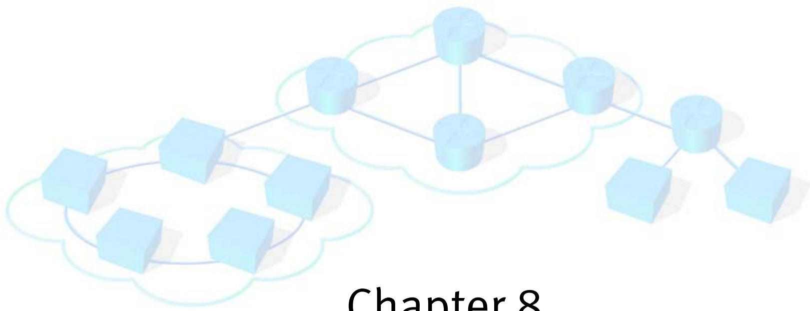
3 Click ports 2 and 6 for **Tx Ports** and **Rx Ports**. Each port sends ARPs to the DUT and receives a response time for each stream.



4 Click the **Start** button. After a few seconds, click the **Stop** button.

5 Click the **Results** button, and select port 2 results. Then click port 6 results.

A separate *Results* window appears for each port.



Chapter 8

Testing Gigabit Routers

SmartBits Gigabit cards and modules plus SmartWindow provide the tools for effective testing and evaluation of Gigabit switches and routers, including the emerging 10 Gbps Ethernet devices.

See *"Additional Feature for the LAN-3710AL/AE/AS" on page 445* for capabilities and options not covered by the setup examples.

In this chapter...

Testing Gigabit Routers with SmartMetrics

Use SmartWindow plus SmartBits Gigabit cards and modules to test Layer 2 and Layer 3 functionality and performance under extremely heavy load conditions. When a Gigabit card provides SmartMetrics results (e.g., the LAN-3310A or LAN-3311A modules), it becomes possible to assess full Gigabit router performance, qualifying the capabilities of both core and edge routers.

With SmartMetrics modules, tests and results include:

- Per-flow frame loss
- Latency
- Latency and sequence
- Latency distribution tracking.

This chapter describes three SmartMetrics Gigabit and 10 Gigabit tests:

- *"Tests Using the XLW-3721A/XFP-3731A TeraMetrics Modules" on page 318*.
- *"Test Using the LAN-3311A TeraMetrics Module" on page 374*.
- *"Test Using the LAN-3201B/C SmartMetrics Module" on page 380*.

It also covers XAUI testing and a traditional-mode test with the LAN-3710AL/AE/AS 10 Gbps module. Refer to:

- *"XAUI Testing" on page 342*.
- *"Test Using the LAN-3710AL/AE/AS 10GbE Module" on page 355*.

Figure 8-1 on page 317 illustrates a sample SmartMetrics test setup. A SmartBits 6000x chassis is equipped with LAN-3311A TeraMetrics modules used to send test traffic through a Gigabit router. Traffic is received by a port on a LAN-3201B/C module in the same chassis.

Note: The data (network addresses and other parameters) illustrated in *Figure 8-1 on page 317* is used in some of the descriptions in this chapter. However, in other sections, the descriptions use a different set of data to emphasize specific network configuration principles.

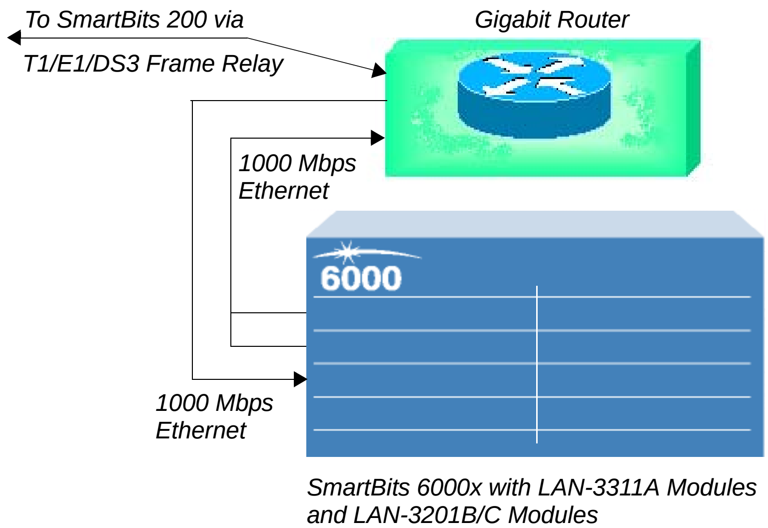


Figure 8-1. Gigabit Router Test Topology

Tests Using the XLW-3721A/XFP-3731A TeraMetrics Modules

This section provides an example of test setup for the XLW-3721A TeraMetrics module. The XFP-3731A TeraMetrics has the same functionality in most applications. Differences between these two modules are noted in the functional descriptions of each feature. One notable difference is that XFP-373xA modules do not support XAUI testing.

Refer to *"Testing Gigabit Routers with SmartMetrics" on page 316* for an overview of testing with Gigabit modules. This section covers the following topics:

- *"Information on Transceivers and XENPAK/XFP Profiles" on page 320*.
- *"Port Menu" on page 320*.
- *"Layer 3 Setup: IPv4 Stack and IPv6 Stack" on page 339*.
- *"Configure Streams on the Transmitting Card" on page 340*.
- *"Set up the DUT" on page 341*.
- *"Send Traffic and View Counters" on page 341*.

For additional information on the configuration process, see the following topics:

- *"Configuring Transmit Streams on TeraMetrics Modules" on page 392*.
- *"Configuring SmartCounters" on page 415*.

Note: This test setup uses the XLW-3721A or XFP-3731A. Additional cards and modules that support this test include the XLW-3720A XENPAK MSA and XFP-3730A XFP MSA SmartMetrics modules.

About the XLW-3721A and XFP-3731A TeraMetrics Modules

The XLW-3721A/XFP-3731A TeraMetrics modules are MSA-based units for the SmartBits 600x/6000x chassis. The XLW is a XENPAK-based module and the XFP is a XFP-based module. The XLW product series supports numerous Optical Interfaces (OI) that are hot-swappable and configurable through a window-based GUI. It also supports the 10GBase-CX4 transceiver. The CX4 unit uses a XAUI copper interface and is described in the online Help and the *CX4 Installation Instructions* (P/N 340-1301-001).

Table 8-1 lists the module interfaces with associated descriptions. *Table 8-2 on page 319* lists the available interfaces for the XLW-372xA and XFP-373xA modules.

Table 8-1. Types of Transceivers

Transceiver	Media	Interface
10GBase-CX4	XAUI Copper	Ethernet
10GBase-LX4	X Fibre over 4 lane, 1310nm	Ethernet
10GBase-SR	R Fibre over 850nm	Ethernet

Table 8-1. Types of Transceivers (continued)

Transceiver	Media	Interface
10GBase-LR	R Fibre over 1310 nm	Ethernet
10GBase-ER	R Fibre over 1550nm	Ethernet
10GBase-SW	R Fibre over 850nm	Ethernet/compatible with SONET
10GBase-LW	R Fibre over 1310 nm	Ethernet/compatible with SONET
10GBase-EW	R Fibre over 1550nm	Ethernet/compatible with SONET

Table 8-2. XENPAK and XFP Transceivers

Module	Base	Transceiver
XLW-372xA	XAUI Extender	ACC-3602A
	10GBase-LX4	Supported- not available
	10GBase-CX4	ACC-3604A
	10GBase-SR	ACC-6024A
	10GBase-LR	ACC-6022A
	10GBase-ER	ACC-6023A
	10GBase-LW	ACC-6028A
XFP-373xA	10GBase-SR/SW	ACC-6030A
	10GBase-LR/LW	ACC-6031A
	10GBase-ER/EW	ACC-6032A

The LX4 and CX4 use four channels for transmission. The SR/LR/ER and LW series use one channel.

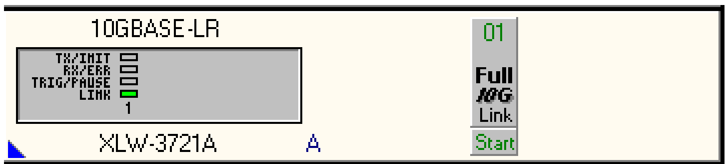
Both XLW-372xA and XFP-373xA modules support a mode of operation where LAN Ethernet is compatible with SONET. This feature (called WAN mode) enables you to switch between two transmission modes: 10GBase-LW and 10GBase-LR. The XFP has this capability with any of the transceivers, while the XLW requires the ACC-6028A. The switching operation between these two interfaces for the XLW and XFP units is described in *"Port Menu" on page 320*.

Information on Transceivers and XENPAK/XFP Profiles

The SmartWindow interface identifies the installed Optical Assembly (OA) or 10GBase-CX4 transceiver for XLW-372xA modules when the module is reserved for your use.

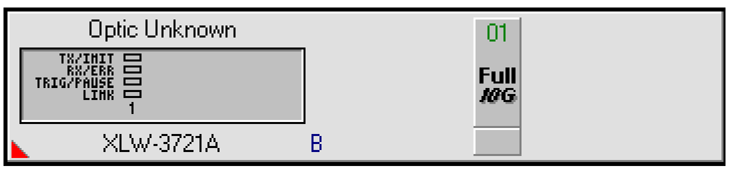
Module reserved

When SmartWindow is connected to the SmartBits chassis and a XLW-372xA module has been reserved, SmartWindow presents the module image as shown below. This example shows an OA type identified above the LED panel of a XLW-3721A module.



Module not reserved

If the module has not been reserved (even if SmartWindow is connected to the chassis), the OA (or CX4) cannot be identified and SmartWindow simply shows “Optic Unknown”.



Port Menu

The *Port* menu displays two types of fields for the XLW and XFP modules. The first type are those that are identical and include *Port Setup*, *Counters*, and other fields used in conventional test procedures. The second set of fields are those that are unique to the hardware/protocol of these modules. In these cases, there are specific fields associated with the XLW-372xA (with ACC-6028) modules and other unique fields available only with the XFP-373xA modules.

Within these subsets of fields are functions that are used for swapping between protocols, viewing profile data, and initiating tests. This section describes how these fields are displayed and used. See *Table 8-3 on page 321* for an overview of the similar and dissimilar fields used with the XLW and XFP modules plus those windows that are displayed.

Table 8-3. XLW and XFP Port Menu Fields

Module	Top Level/Next Level(s)	Window Displayed
XLW	XENPAK Profile	XENPAK Profile Information
	WAN Line Status	Port Status
	XENPAK Alarm Status	XENPAK Link Alarm Status
	Port Setup/SONET/SDH tab	SONET/SDH
	Port Setup/Link Alarms tab	Link Alarms
	Port Setup/General tab/ Loopback	Loopback windowpane and other
XFP	XFP Profile	XFP Profile Information
	WAN Line Status	Port Status
	Port Setup/SONET/SDH tab	SONET/SDH
	Port Setup/Link Fault Signaling tab	Link Fault Signaling
	Port Setup/General tab/ Loopback	Loopback windowpane (different fields than displayed for XLW) and other

XENPAK and XFP Profiles

This field displays LAN information for XLW and XFP modules, including detailed information about the physical characteristics of each type of module. The *XENPAK Profile Information* dialog box lists parameters for the XLW modules while the *XFP Profile Information* dialog box lists parameters for XFP modules. (Refer to *Figure 8-2 on page 322* and *Figure 8-3 on page 322*.)

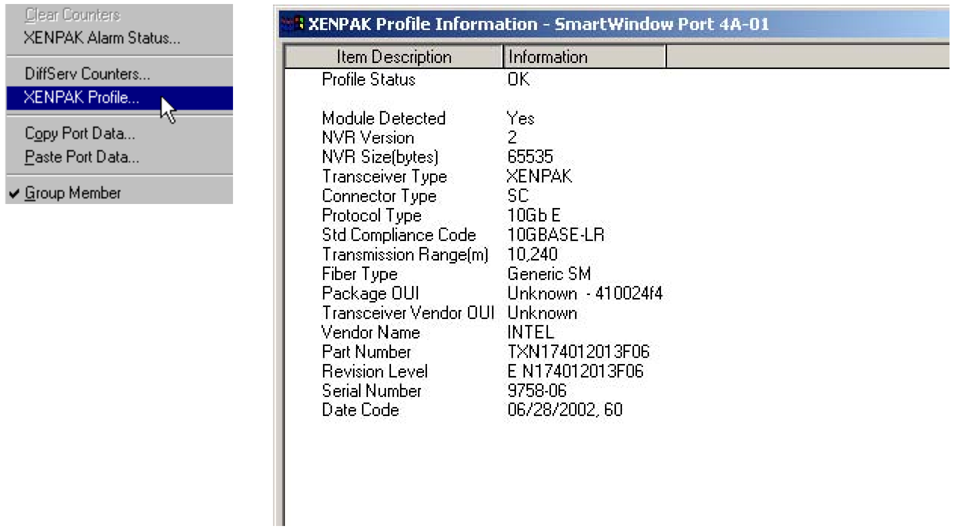


Figure 8-2. XENPAK Profile Window

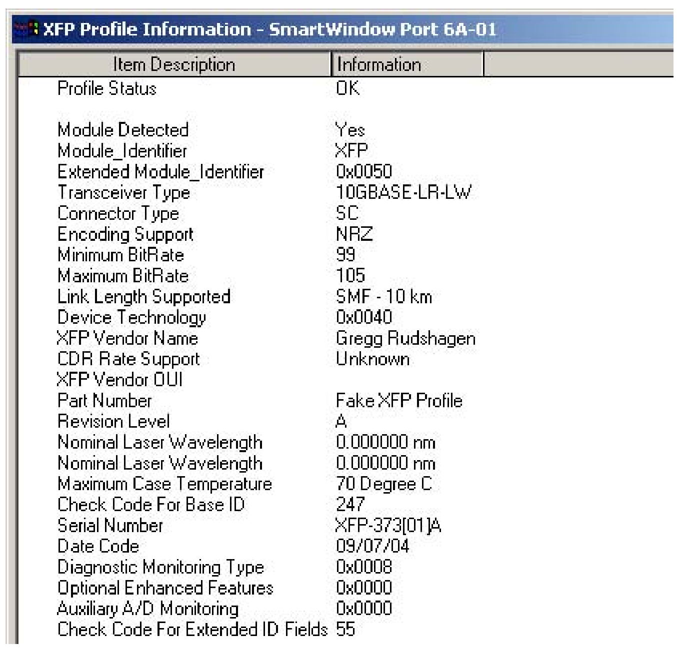


Figure 8-3. XFP Profile Window

Swapping Between Modes

Table 8-2 on page 319 lists the modes (interfaces) for the XLW-372xA and XFP-373xA 10 Gigabit modules. Each module can switch between the following two modes only:

- 10GBase-LR (Ethernet)
- 10GBase-LW (Ethernet/SONET compatible).

This configuration/capability is inherent in the XFP-373xA and available with the XLW-372xA when the ACC-6028A interface is used.

Note: In this document, the Ethernet interface is referred to as LAN and the Ethernet/SONET compatible interface is called WAN.

Switching is implemented from one of two locations: the *Actions* menu on the main toolbar (*Figure 8-4*) or the *Port* menu (*Figure 8-5 on page 324*).

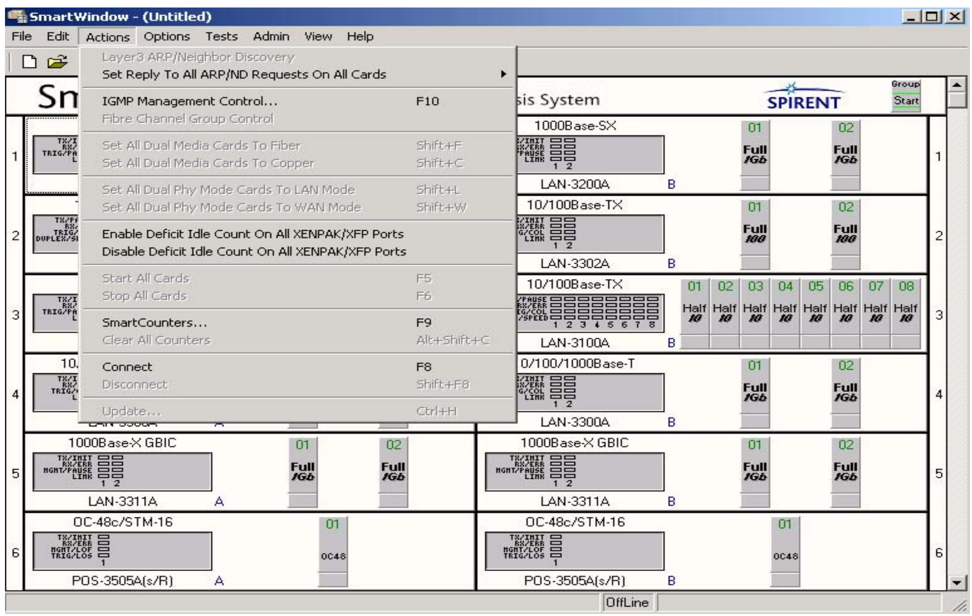


Figure 8-4. Actions Menu

Figure 8-5. LAN/WAN Swapping: Port Menu

When one of these parameters is selected, the changes are implemented immediately (including the new virtual image on the main screen as well as the configuration parameters). For example, if the *Set All Dual Phy Mode Cards to LAN Mode* (on the *Action* menu) is selected, the virtual display shows *10GBASE-LW* positioned above the virtual front panel. The switching of modes can be completed before or after configuring other parameters for this module. Also, *Action* menu mode switching applies to all reserved modules.

Note: See *"Editing Frames" on page 157* for more information on how to set-up the *LAN* mode.

WAN Line Status

The *WAN Line Status* parameter, located in the middle of the *Port* menu, is unique to the XLW-372xA (with ACC-6028A) and the XFW-373xA modules. When selected a window is displayed that shows the status of WAN alarms, such as the alarm indication signal. (Refer to *Figure 8-6* for an illustration of this window and the online Help for a description of each type of alarm.)

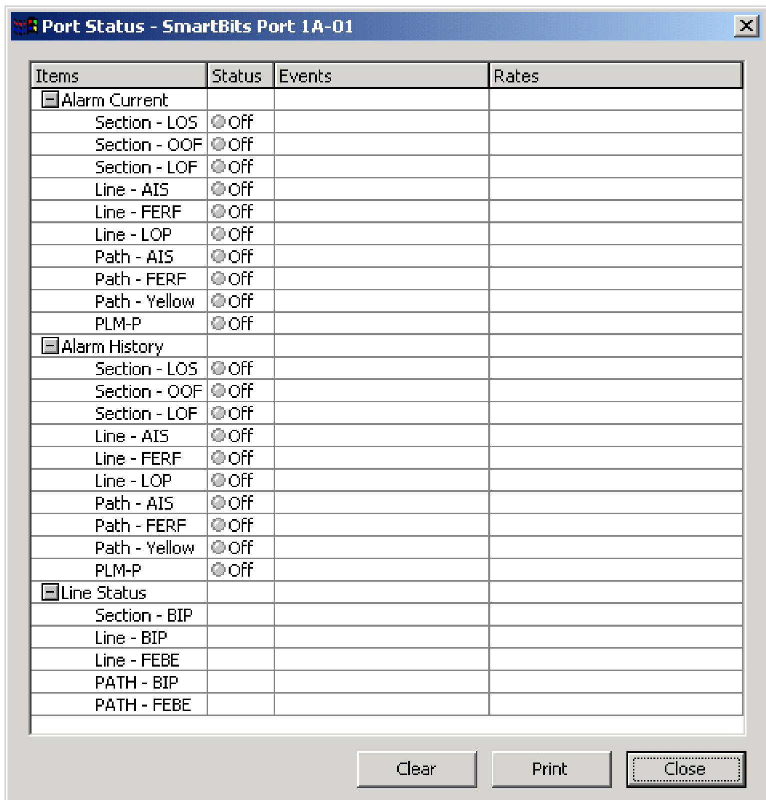


Figure 8-6. WAN Line Status

XENPAK Alarm Status

This window is accessed through the *Port* menu or by clicking the **Show Link Alarm Status** button that is located on the *Port Setup/Link Alarms* tab. The *XENPAK Link Alarm Status* window shows the current status of all three NVR registers: LASI alarms, Tx alarms, and Rx alarms. (Refer to *Figure 8-7 on page 326*.)

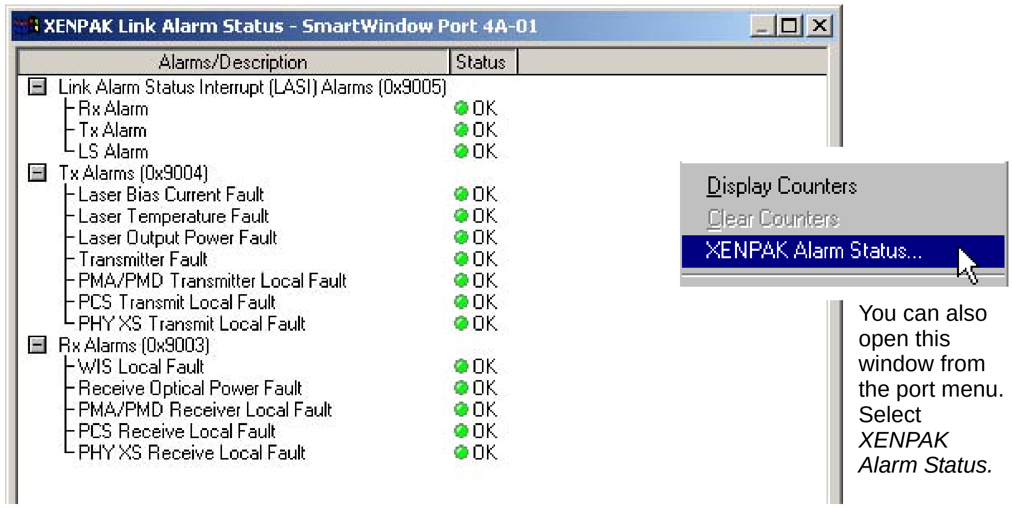


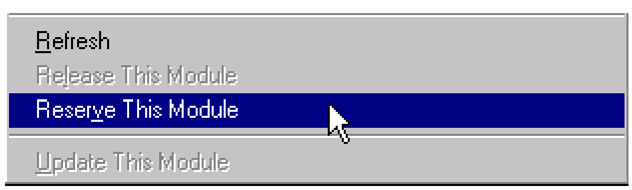
Figure 8-7. XENPAK Link Alarm Status Window

Accessing Port Setup

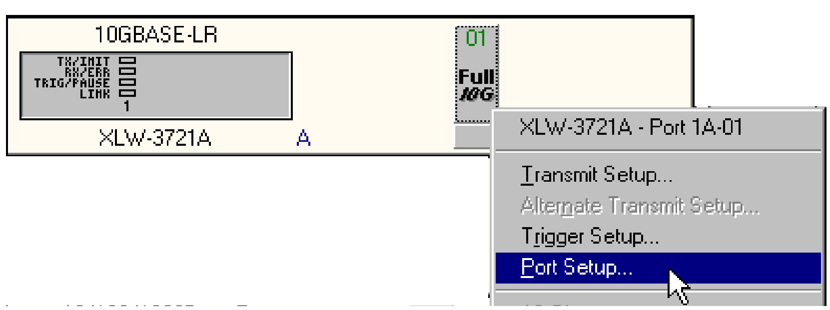
Set up the line parameters, and connect to the SmartBits 600x/6000x chassis. Then perform the following procedure.

To access port setup:

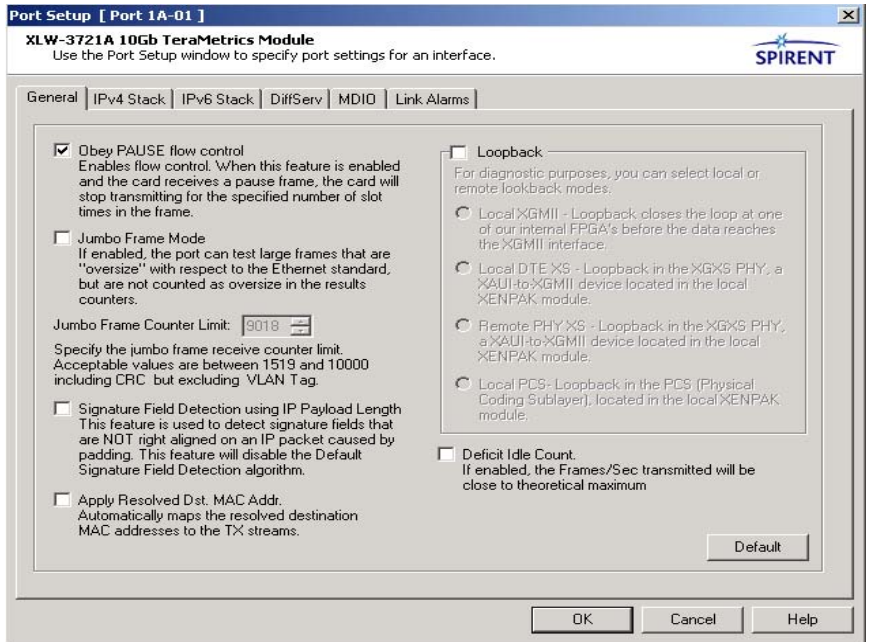
1 Reserve the module to be configured. Click anywhere on the module image except the **Start** button, and choose **Reserve This Module**.



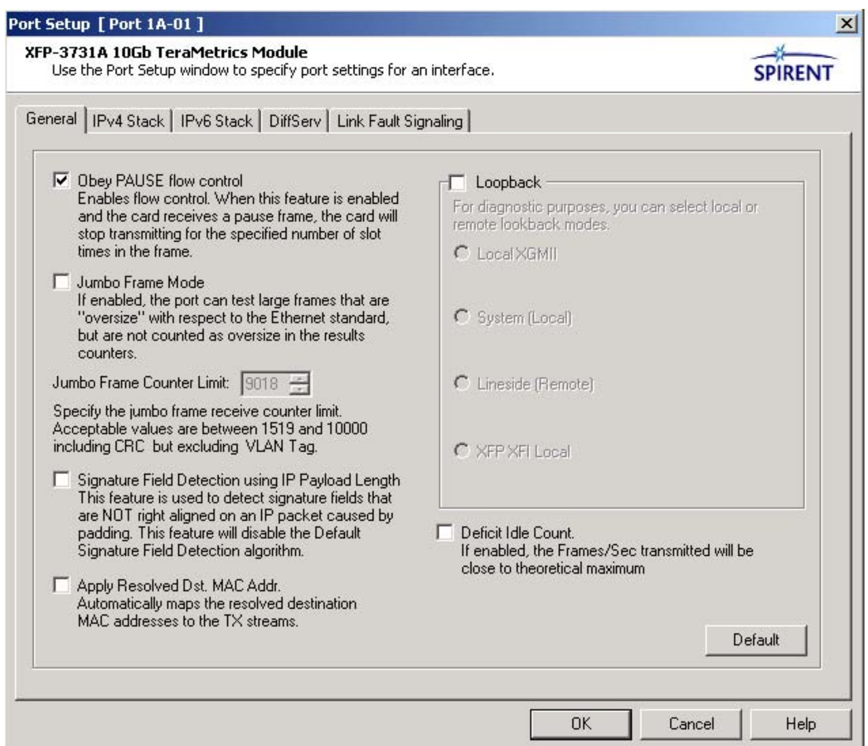
2 Click the port button to open the port menu.



3 Select **Port Setup**. *Figure 8-8 on page 327* shows the *Port Setup* windows for XLW and XFP modules.



XLW



XFP

Figure 8-8. Port Setup-General Tab

Notes:

- The number and type of tabs are different for each module.
- The loopback functions are different for each module. These are described in the *"General Tab"*section.
- The number of *Port Setup* tabs for the LAN mode is different than the number of tabs for the WAN mode. (See *Table 8-4*.)

Table 8-4. Port Setup Tabs for LAN and WAN Modes

Tabs	LAN mode	WAN mode
General	Yes	Yes
SONET/SDH	No	Yes
IPv4 Stack	Yes	Yes
IPv6 Stack	Yes	Yes
DiffServ	Yes	Yes
MDIO	Yes	Yes

General Tab

These options include flow control, jumbo frames, and internal loopback. Click the *Default* button to reset all options to default values.

- **Obey Pause Flow Control**: Permits the port to respond to pause frames received from the DUT. (This option is enabled by default.)
- **Jumbo Frame Mode**: Allows the port to test large frames, with respect to the Ethernet definition of frames. These frames are called "oversize." When this checkbox is selected, the port can send and receive jumbo frames. (See *"Jumbo Frames" on page 184* in *Chapter 5, "Advanced Operational Theory"* for a detailed explanation.)
- **Signature Field Detection using IP Payload Length** (without FCS): Refer to *Table 7-1 on page 240* for a description of this field.
- **Apply Resolved Dst MAC Address**: Refer to *Table 7-1 on page 240* for a description of this field.
- **Loopback:** Refer to *"Loopback" on page 329* for an explanation of how to use the loopback function.

- **Deficit Idle Count**: This checkbox enables the use of deficit idle count to more closely match the requested throughput to the actual transmitted throughput. The difference between the requested and actual throughput is maximized when you want to transmit a large number of small frames that do not end exactly on a 4-byte boundary. In these cases, using deficit idle count can help close or eliminate the difference. (Refer to the 802.3ae document section 46.3.1.4 titled "Start control character alignment" for the technical details about how deficit idle count facilitates a closer match between desired throughput and the actual transmitted throughput. Refer to *"Defining the Schedule Mode" on page 393* for more information on how and when IFG is used.)

Loopback

The loopback tests vary between the XLW-372xA and XFP-373xA modules. The XLW-372xA module tests use the XAUI interface while the XFP-373xA modules use the PMA and PMS interfaces.

XLW-372xA Loopback

The XLW-372xA modules have internal loopback modes at one of four points in the XENPAK/XAUI interface. (Refer to *Figure 8-9 on page 330*.)

- **Local XGMII** – Loopback closes the loop at one of the internal FPGAs in the XLW-372xA module before data reaches the XGMII interface.
- **Local DTE XS** – Loopback in the XGXS DTE, an XGMII-to-XAUI interface chip located in the XLW-372xA module.
- **Remote PHY XS** – Loopback in the XGXS PHY, a XAUI-to-XGMII device located in the XENPAK optical module assembly.
- **Local PCS** – Loopback in the Physical Coding Sublayer (PCS), located in the XENPAK optical module assembly.

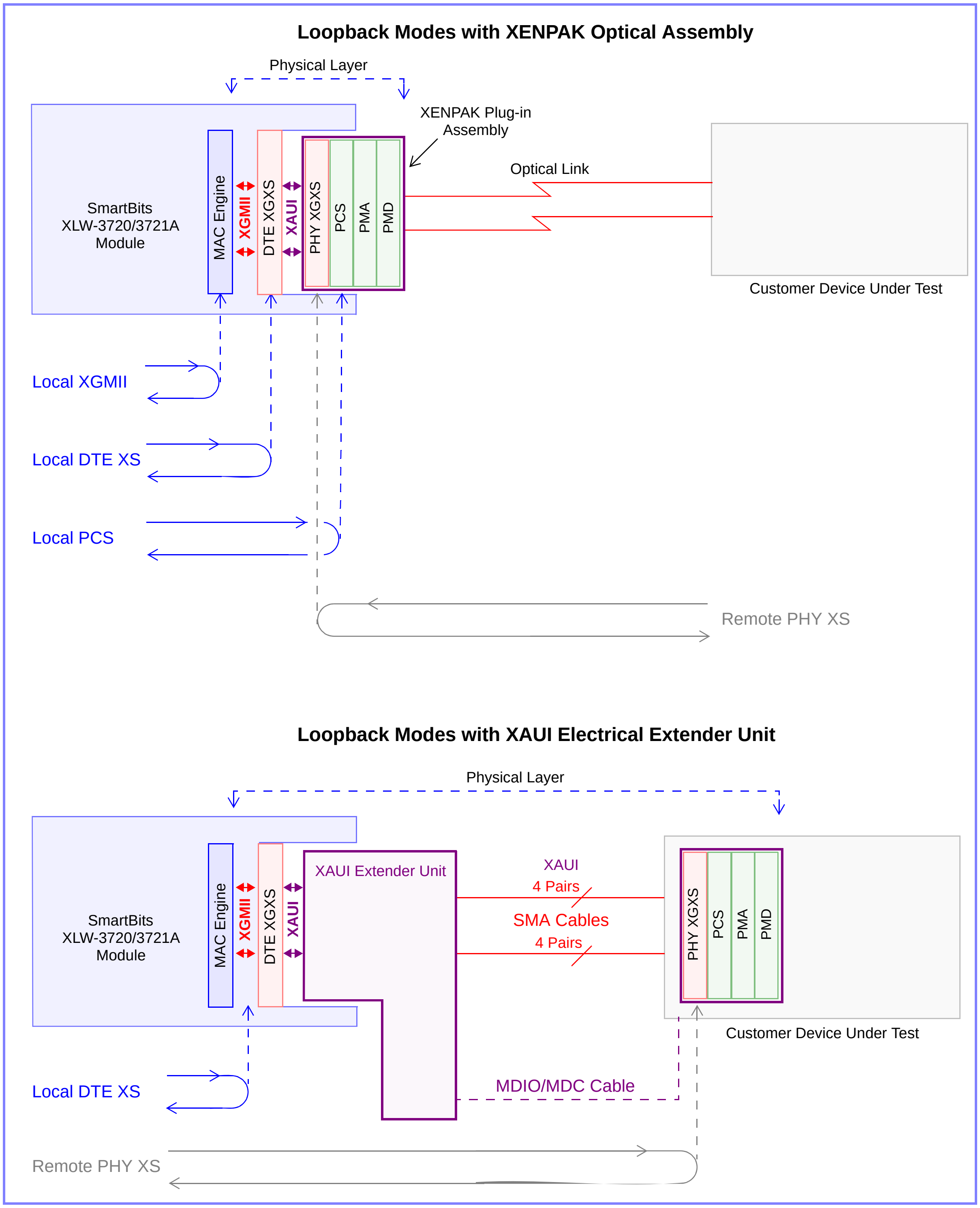


Figure 8-9. XLW Loopback Modes

XFP-373xA Loopback

The XFP-373xA modules have four loopback modes:

- Local XGMII
- System (Local)
- Lineside (Remote)
- XFP XFI Local.

A brief description of these modes is given in *Table 8-5*. (Refer to *Figure 8-10 on page 332* for an illustration of these loopback modes.)

Table 8-5. XFP Loopbacks

Name	Description
Local XGMII	Packets loopback locally from PCS.
System (Local)	Packets loopback locally from PMA.
Lineside (Remote)	Packets loopback remotely from PMA.
XFP XFI Local	Packets loopback locally from PMD.

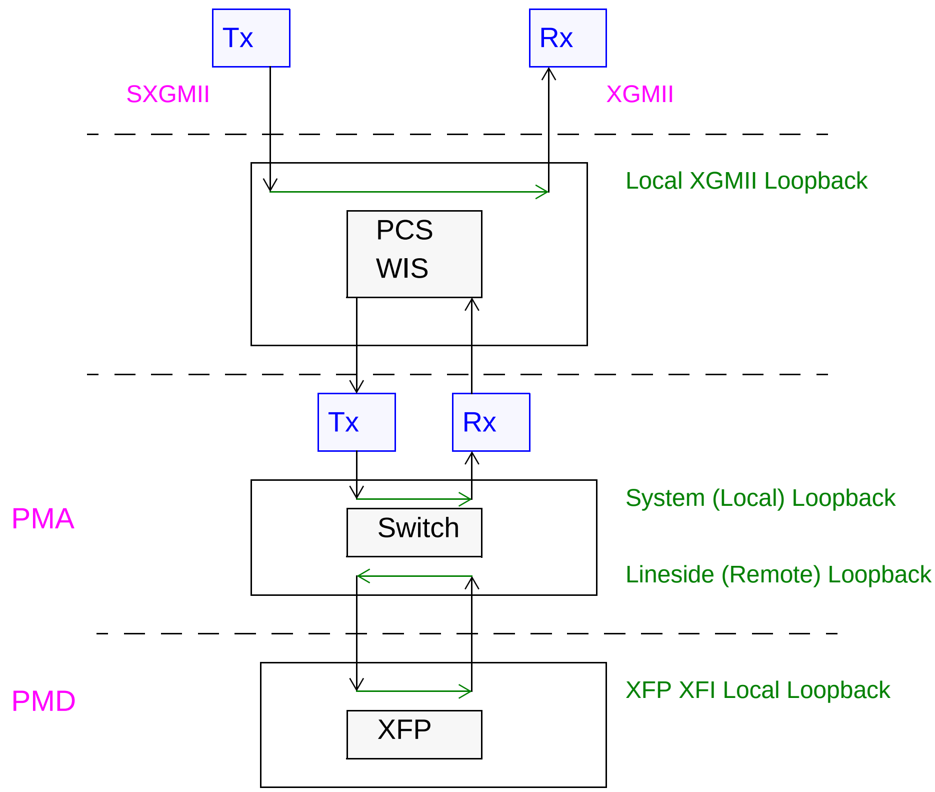


Figure 8-10. XFP Loopback Modes

SONET/SDH Tab

This tab is only displayed for the WAN mode on the XFP-373xA and the XLW-372xA with the ACC-6028A transceiver module installed.

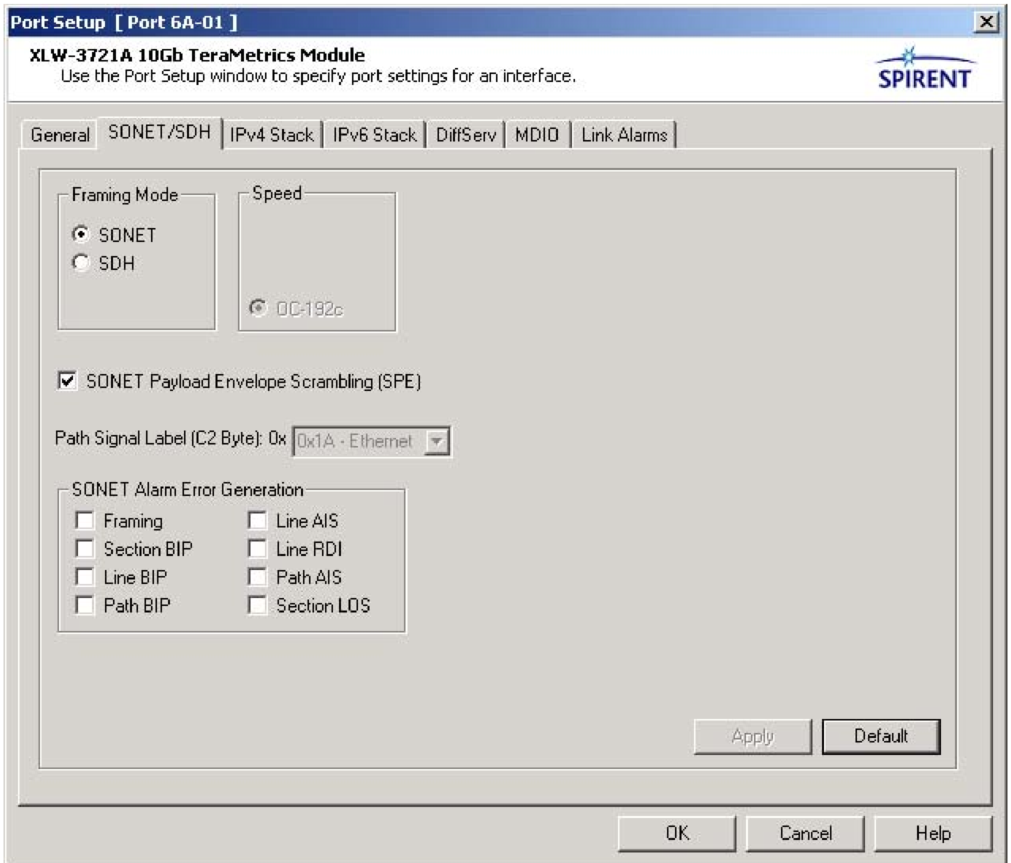


Figure 8-11. SONET/SDH Tab

Framing Mode/Speed

There are two types of framing modes: SONET and SDH. Set these parameters to conform with your test requirements and installation characteristics. [For speed, the XLW-372xA (with ACC-6028A)/XFP-373xA always runs at the OC-192c rate.]

SONET Payload Envelope Scrambling (SPE)

The *SONET Payload Envelope Scrambling* option enables an $x^{43}+1$ self-synchronizing scrambler. Most SONET/SDH equipment enables payload scrambling by default, because it ensures an adequate number of 0/1 transitions for clock recovery purposes.

When this option is selected, the module scrambles the entire SONET payload envelope. If no PPP frames are being transmitted, it scrambles the idle pattern.

Path Signal Label (C2 Byte) 0x

The *Path Signal Label C2 Byte* identifies the contents of the SONET/SDH Synchronous Payload Envelope (SPE). The default value 0x1A (decimal 36) indicates Ethernet and should be used for SONET/SDH tests.

SONET Alarm Error Generation

Optionally, SONET alarm error generation can be enabled. Select the appropriate checkboxes in order to choose which errors should be generated by the card. (Refer to the online Help for a complete description of each alarm.)

Apply Function

At the bottom of the *SONET/SDH* tab is the *Apply* button. Press this button to generate a SONET alarm without closing this window. This feature gives you the capability to send alarms repeatedly without re-configuring the alarm parameters or having to re-open this window. (In contrast, click the **OK** button to send the alarm and close the window.)

This button is disabled when the chassis is offline.

IPv4 Stack and IPv6 Stack Tabs

These tabs on the *Port Setup* window configure the local IP stack. Set values on these tabs for the following purposes:

- To set the gateway IP address of the router port (DUT). (This operation is required for Layer 3 switches.)
- To change MAC and IP addresses so that they do not duplicate stream addresses.
- To set the netmask for management frames. (Optional; this operation is ignored by streams.)
- To specify a ping IP address for pings and SNMP frames if needed (optional), as well as the frequency of ping, SNMP, or RIP packets. (Optional)
- To enable virtual flow cyclic ARPs. (See *"Virtual Flow Cyclic ARPs and ARP Requests" on page 186* in *Chapter 5, "Advanced Operational Theory"* for further information.)
- To enable gratuitous ARP mode. (See *"Gratuitous ARP Mode" on page 196* in *Chapter 5, "Advanced Operational Theory"* for further information.)

Refer to *"Layer 3 Setup: IPv4 Stack and IPv6 Stack" on page 339* for the steps to select values for the fields and options on these tabs.

DiffServ Tab

The *DiffServ* tab is used to set up DiffServ counters. This option is used on a receiving SmartBits port. It measures, in test results, the number of received frames that contain TOS values. It also provides a tally of specific TOS values.

See *"DiffServ Counters" on page 437* for the steps to set up this option.

MDIO Tab

The *MDIO* tab can be used when an XAUI extender unit with MDIO interface is attached to the port.

Note: The XAUI extender unit only functions on the XLW-372xA gigabit modules.

The unit enables you to specify an MDIO template file for the port. (Refer to *"XAUI Testing" on page 342* for additional information on testing using the XAUI unit.)

The *File* window identifies the currently assigned template file. Initially, this is the same as the default file for all ports, which is set in the *Options* > *Preferences* dialog box (accessed from the SmartWindow main menu). Specify a unique MDIO template for each port interfaces, if required. (Refer to *Figure 8-12*.)

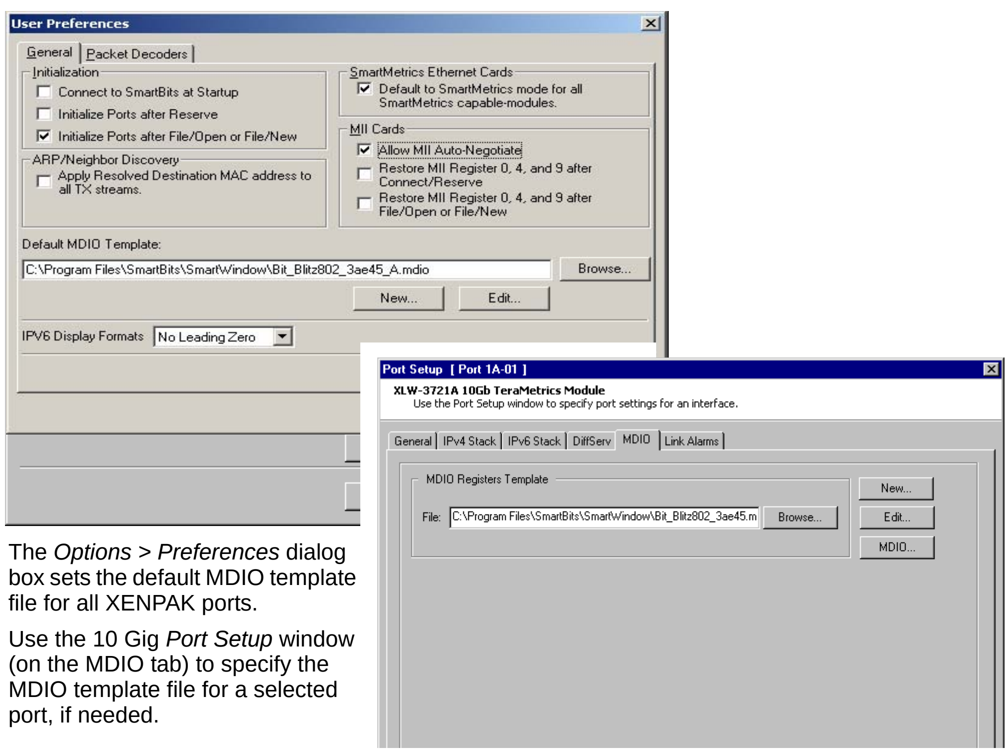


Figure 8-12. MDIO Template Selection

Predefined template files

SmartWindow includes predefined MDIO template files that are located in the installation directory. (Click **Browse** to open the folder and view the files.) The following is a list of these files:

- ieee802_3ae45.mido

  Based on IEEE Std.802.3ae, with the first five devices defined. No vendor specifics; no extensions.
- jdsu802_3ae45.mdio

  JDSU IEEE Std.802.3ae. Includes the vendor's specifics and extensions.
- BitBlitz802_3ae45.mdio

  BitBlitz IEEE Std.802.3ae. Includes the vendor's specifics and extensions.
- agilent802_3ae45.mdio

  Agilent IEEE Std.802.3ae. Includes the vendor's specifics and extensions.
- intel802_3ae45.mdio

  Intel's IEEE Std.802.3ae. Includes the vendor's specifics and extensions.

Creating a new file or editing a defined file.

Other options on the *MDIO* tab enable you to edit a selected template file or create a completely new file. In these cases, use the MDIO Template Editor to set the desired values for devices and registers.

An *MDIO Status* window provides detailed information on MDIO settings for the port.

Link Alarms Tab

The *Link Alarms* tab displays configuration parameters (i.e., bit values for non-volatile registers) for the LAN mode. It also has a link to the *XENPAK Link Alarm Status* window. (This tab is only displayed on the XLW modules.)

- **Link Alarm Status Interrupt (LASI) Control Register (0x9002)**

  This is a LASI control register that allows global masking of the RX_ALARM, TX_ALARM, and LS_ALARM inputs. Select the appropriate checkboxes to enable individual alarms.
- **Tx Alarm Control Register (0x9001)**

  The Tx alarm control register can be programmed to assert when specific transmit path fault condition(s) are present, based on the indications of the Tx alarm status register (0x9004). (The contents of the Tx alarm control register are ANDed with the contents of the Tx alarm status register before applying an OR function that generates the TX_ALARM signal.) Select the appropriate checkboxes to enable individual faults.
- **Rx Alarm Control Register (0x9000)**

  The Rx alarm control register can be programmed to assert when specific receive path fault condition(s) are present, based on the indications of the Rx alarm status register (0x9003). (The contents of the Rx alarm control register are ANDed with the contents of the Rx alarm status register before applying an OR function that generates the RX_ALARM signal.) Select the appropriate checkboxes to enable individual faults.

Link Fault Signaling Tab

Use the *Link Fault Signaling* tab with XFP-373xA modules to insert fault link conditions into the test stream. This capability can be accessed from the *Port* menu or from the *Link Fault Signaling* tab (*Figure 8-13*).

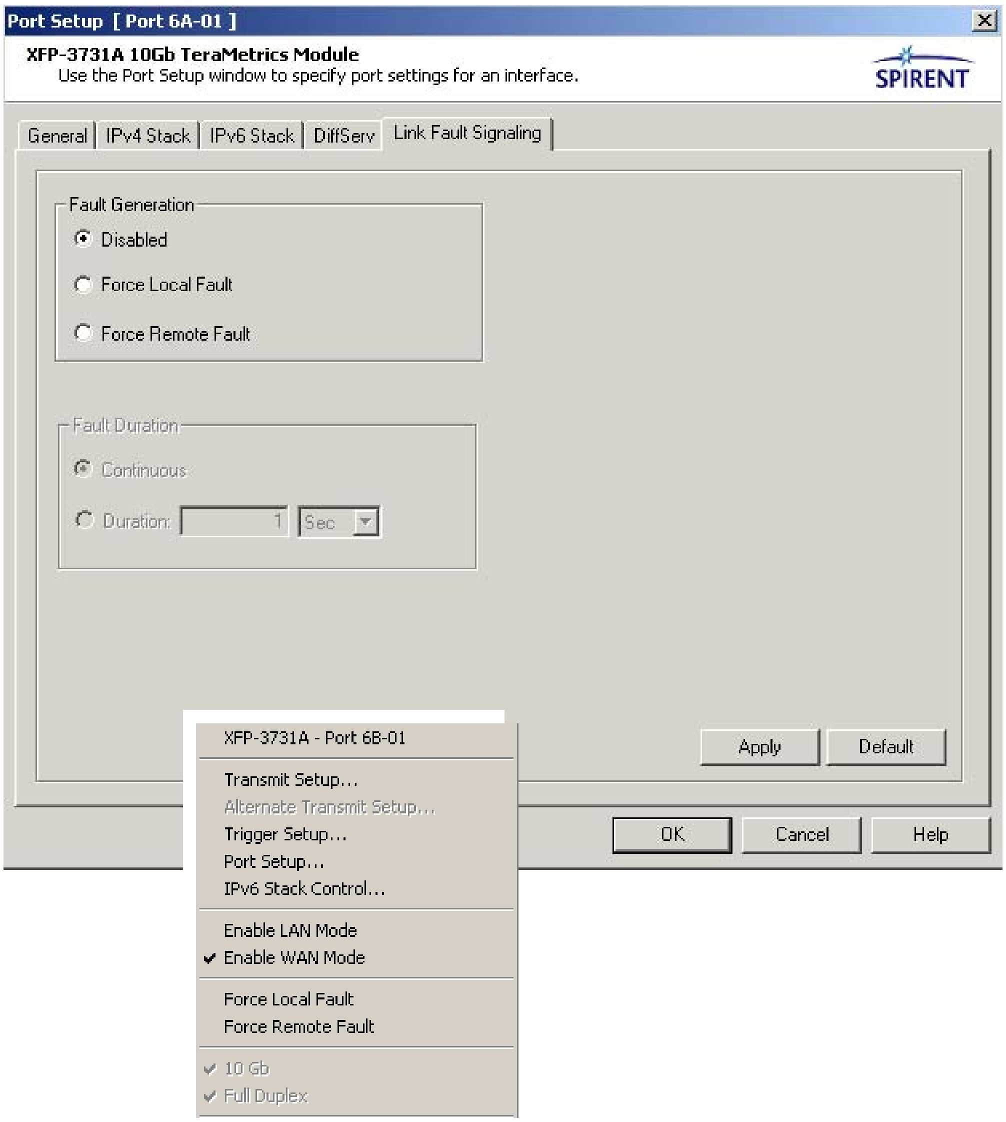


Figure 8-13. Link Signaling Tab

The forced error conditions that are inserted into the test stream are shown visually on the virtual chassis panel. (Refer to *"Connected to SmartBits 600x/6000x" on page 53* for a description of these displays.)

The SmartWindow link fault signaling capability enables you to induce two types of faults: local (LF) and remote (RF). The location of where these faults occur (display) depends on the parameters of the test. The following examples describe local and remote fault generated tests.

Local Fault Generated Test (with SmartBits Connected to DUT)

1. SmartBits generates a forced local fault.
2. SmartBits displays local fault error.
3. DUT displays (presents) remote fault error condition.

Remote Fault Generated Test (with SmartBits connected to DUT)

1. SmartBits generates a forced remote fault error.
2. SmartBits displays no error condition (unless there is an error due to other reasons).
3. DUT displays (presents) remote fault error condition.

There are two panes and two buttons located on the *Link Fault Signaling* tab: the *Fault Generation* pane, the *Fault Duration* pane, the *Apply* button, and the *Default* button. (The default condition is no forced faults; clicking the **Default** button manually enables this condition.) Forced fault configurations are applied when the **Apply** or **OK** button is clicked. (Refer to *Table 8-6* and *Table 8-7*.)

Table 8-6. Fault Generation Pane

Button	Description
Disabled	Clears testing sequence to default condition.
Force Local Fault	Generates a local fault by SmartWindow. (Refer to examples for description of “local”.)
Force Remote Fault	Generates a remote fault by SmartWindow. (Refer to examples for description of “remote”.)

Table 8-7. Fault Duration Pane

Button	Description
Continuous	Enables continuous fault test mode. SmartWindow continuously generates local or remote faults.
Duration	Enables duration fault test mode. SmartWindow generates local or remote faults for durations measured in minutes, seconds, or microseconds.

Note: Link fault signaling is available exclusively on the XFP-373xA modules.

Layer 3 Setup: IPv4 Stack and IPv6 Stack

Use the *IPv4* or *IPv6* tabs of the *Port Setup* window (selected from the port menu) to set port-level IP addresses.

Note: The following example illustrates the use of IPv6 addresses.

To set the IPv6 address format:

1 Select **Options** > **Preferences** from the main menu.

2 Select **Compact** in the *IPv6 Display Formats* field.

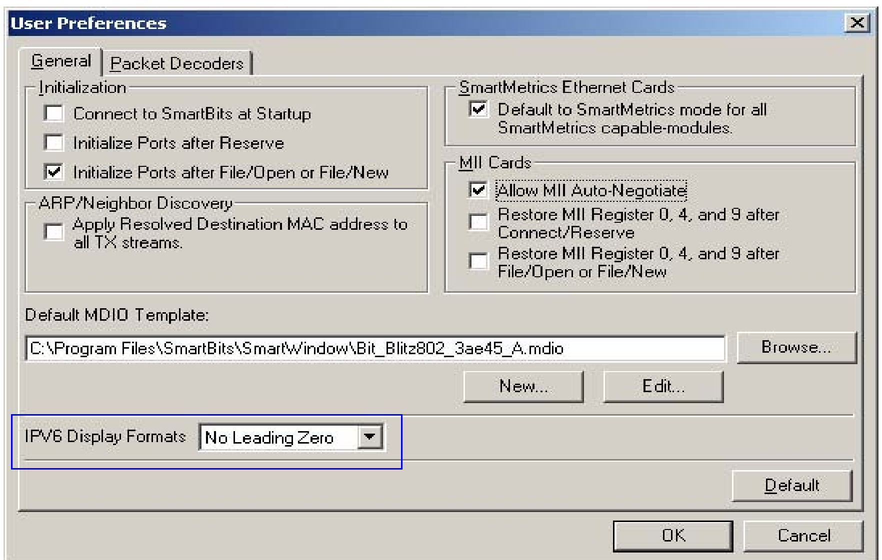


Figure 8-14. Setting the IPv6 Display Format

To set the IPv6 addresses:

1 Click the port button for port 1A-01. Ensure that *SmartMetric Mode* is enabled, which is the default.

2 Click the port button again and choose **Port Setup**. The *Layer 3 Setup* dialog box opens (*Figure 8-15 on page 340*).

3 Select the **IPv6 Stack** tab.

4 Refer to *Figure 8-16 on page 340* for the IP address information for port 1A-01 in this example. (A gateway IP address might need to be added, depending on the test configuration.)

5 When all addresses have been entered, click **OK** to close the window.

IPv6 address format is Compact. *(See Step 2 on page 339* and *"Selecting an Address Display Format" on page 171.*)

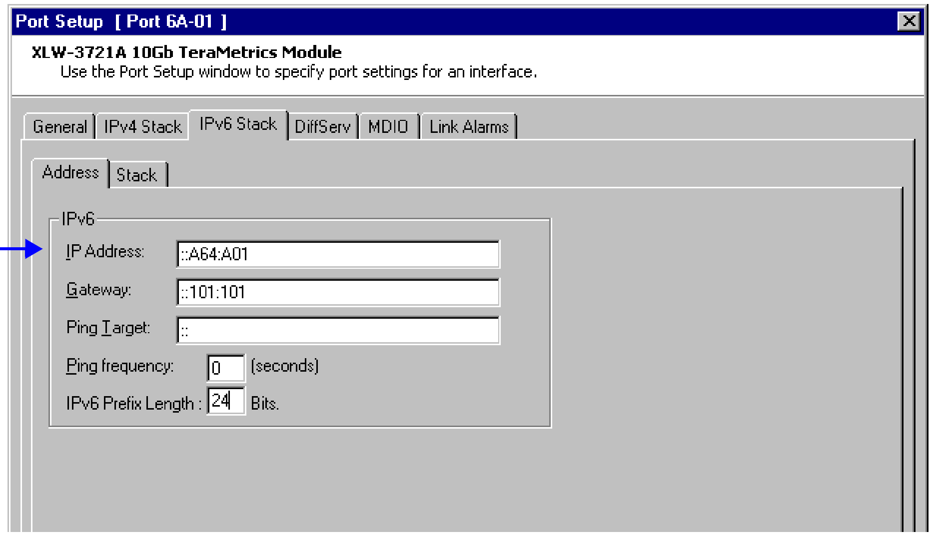


Figure 8-15. Layer 3 Setup Dialog

Figure 8-16 shows the IP addresses in SmartWindow Layer 3 setup fields. (These are default values.)

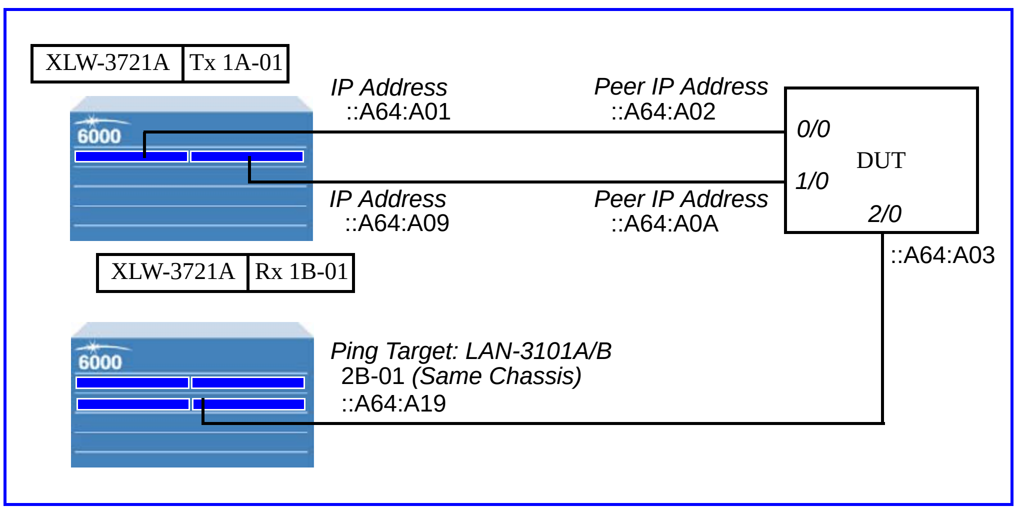


Figure 8-16. "Card Topology" IP Address Configuration

Configure Streams on the Transmitting Card

Up to 512 IPv6 or IPv4 streams can be configured on an XLW-3721A port. In general, however, only enough streams are set up to meet the requirements of the test. (See *Table 5-13 on page 170* for a listing of the maximum number of streams allowable for each type of module.)

Refer to *"Configuring Transmit Streams on TeraMetrics Modules" on page 392* for a description of the configuration process.

Set up the DUT

Refer to *"Configuring the DUT" on page 413* for a description of how to set up the DUT.

Send Traffic and View Counters

Now you can transmit traffic and view counters. Proceed to *"Running SmartCounters" on page 435* for the necessary steps.

XAUI Testing

This section describes how to use the *XAUI Testing* option in SmartWindow, that is accessed from the XLW-3720A/3721A port menu. This section includes the following topics:

- *"Overview of XAUI and MDIO"*
- *"SmartBits XAUI Extender Unit" on page 345*
- *"Typical XAUI Test Bench" on page 346*
- *"Setting up and Running XAUI Tests" on page 347*.

Overview of XAUI and MDIO

Note: Refer to *IEEE Draft P802.3ae* for complete information on the topics outlined in this section. The following paragraphs introduce key concepts but are not meant to be a comprehensive presentation of all related details.

The *10 Gigabit Attachment Unit Interface (XAUI)* is a standard developed by the IEEE 802.3ae 10 Gigabit Ethernet Task Force. Technical details are presented in clauses 47 and 48 of the IEEE 802.3ae 10Gb Ethernet standard. Also important are clauses 22 and 45, which define the Management Data Input/Output Interface (MDIO). The MDIO is similar in concept to the MII for Gigabit interfaces, but it provides important extensions in the number of devices and registers for configuration, status, and control.

Relationship to the OSI Model and Physical Layer

Figure 8-17 on page 343 illustrates the role of XAUI in the Ethernet physical layer, with reference to the OSI model and the 10 Gigabit Media Independent Interface (XGMII).

Between the MAC and PHY layers, the XGMII provides full-duplex operation at 10Gbps. Each direction is independent and contains a 32-bit data path plus clock and control signals. In total the interface is 74 bits wide.

XGMII provides "a simple, inexpensive, and easy-to-implement interconnection between the Media Access Control (MAC) sublayer and the Physical layer (PHY)."[1] However, the operational bus length for XGMII is very short—7 centimeters—owing to the separate transmission of clock and data and timing requirements. As a result, the number of ports possible on a system line card is constrained by design factors.

1. Citations are from IEEE 802.3ae, Clause 46.1.

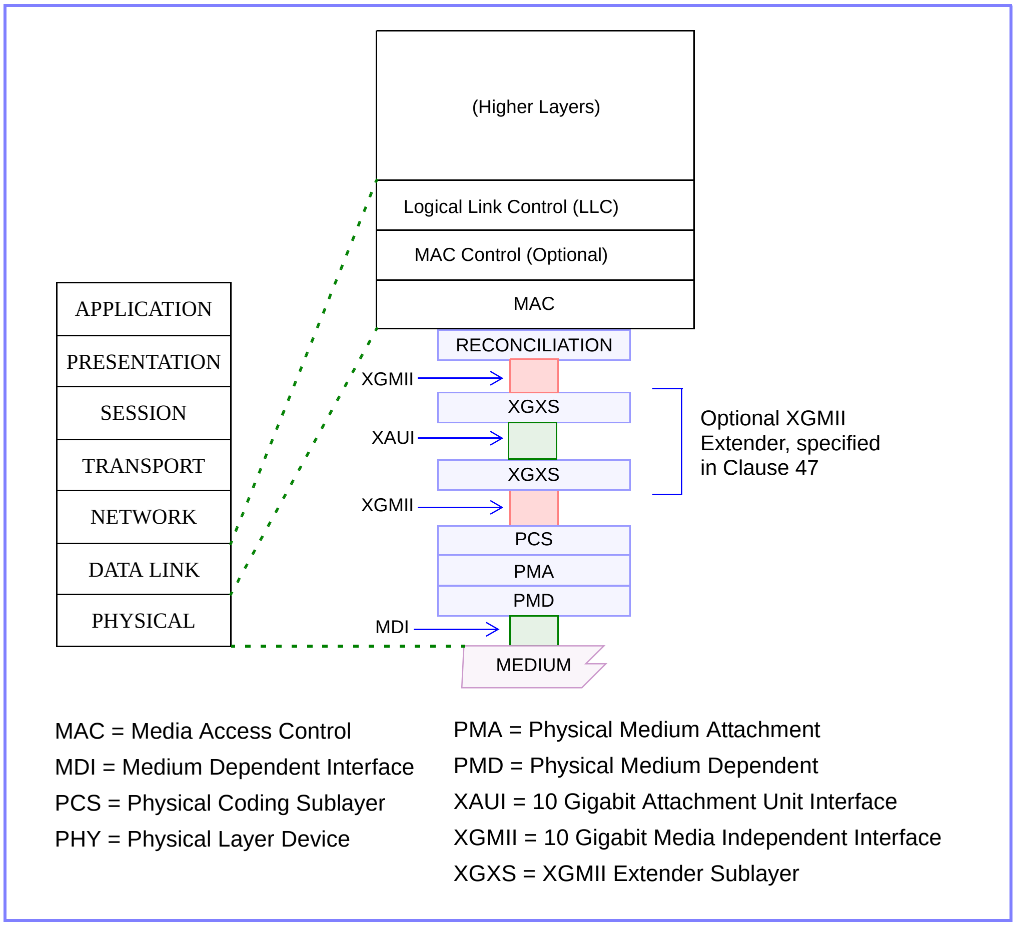


Figure 8-17. Relationship of XAUI and XGXS to ISO Standard Model

In response to this and other limitations, the 10 Gigabit Ethernet Task Force developed XAUI, the *10 Gigabit Attachment Unit Interface*. This amendment to the original specification extends the operational distance of the XGMII from 7 to 50 centimeters, with reduced pin count. XAUI is a full-duplex interface that uses four self-clocked serial differential links in each direction to achieve 10Gbps data throughput. Each serial link uses 8B/10B coding and operates at 3.125Gbps, and accommodates both data and the associated coding overhead. Because each serial link (or lane) is self-clocked, skewing between clock and data is eliminated.

Conversion between the XGMII and XAUI interfaces takes place at the XGXS or 10 Gigabit extender sublayer. In a full implementation, the XGMII extender comprises an XGXS below the MAC (at the reconciliation sublayer), and XGXS at the PHY, and a XAUI in between these two entities. (Refer to *Figure 8-17*.) This reduces the 74-pin wide XGMII interface to a XAUI interface of 16 pins (8 differential pairs). In addition, the source synchronous clocking enables XAUI to cross clock domains, eliminating the need for timing correction within the system.

Figure 8-18 illustrates XGXS inputs and outputs. The XGMII interface is organized into four lanes of eight bits. At the source side of the XAUI interface, bytes on a lane (along with timing clock) are converted into an 8B/10B encoded data stream, then transmitted across a differential pair at 3.125 Gbps. At the destination side, the clock is recovered, and the data stream is decoded and mapped back to the 32-bit XGMII format.

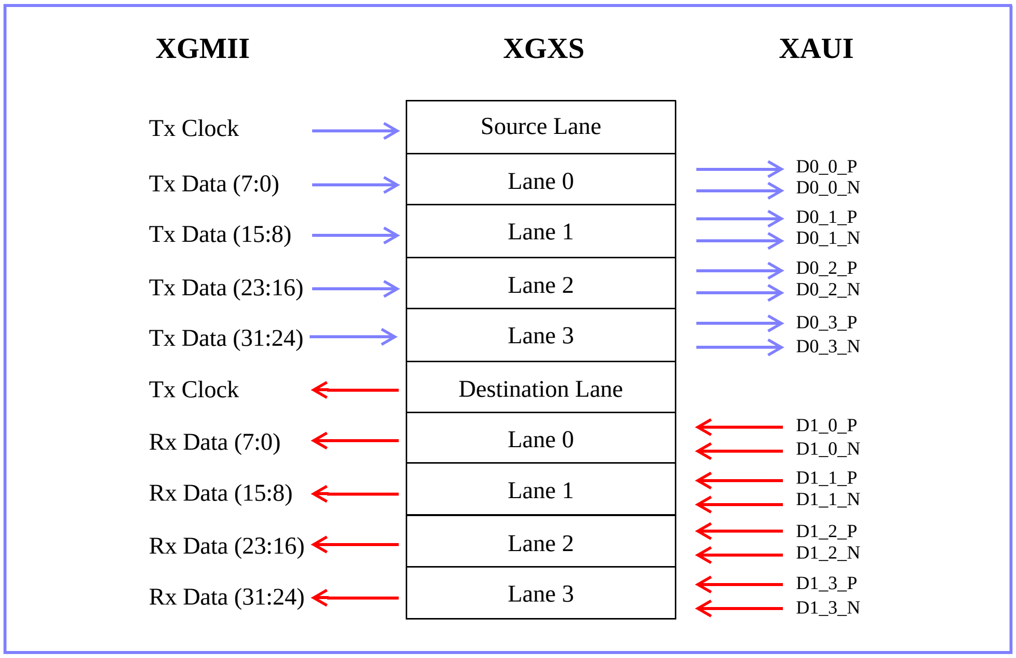


Figure 8-18. XGMII to XAUI at the XGXS

SmartBits XAUI Extender Unit

The SmartBits XAUI extender unit (*Figure 8-19*) plugs into a SmartBits XLW-3720A or XLW-3721A XENPAK module in the same manner as a XENPAK transceiver. It is designed to provide a short path between the SmartBits chassis and the XAUI device under test. This provides optimal signal integrity, which is critical for successful functional, interoperability, and performance testing. The unit is shipped with 16 SMA cables for attachment to the device under test (typically, an evaluation board with XAUI device).

The XAUI extender unit supports the current draft of the IEEE 802.3ae, including Clause 45, which defines the Management Data Input/Output Interface (MDIO). MDIO/MDC features on the extender unit include the following:

- RJ-45 connector to provide access to MDIO registers. (User must provide a suitable interconnecting cable; see *Table 8-8 on page 346* for pin assignments.)
- Independent reset for a device under test
- Interface to LASI signals
- Indication of LASI status; easy access to management registers
- Option for 1.2V or 5V logic for MDIO/MDC
- Ability to query all registers and alarms using the MDIO interface.

Note: Refer to the *XAUI Extender Unit Installation* guide for complete information on installing the XAUI extender unit.

Figure 8-19. XAUI Extender Unit

Typical XAUI Test Bench

Figure 8-20 shows an example of an XAUI test bench.

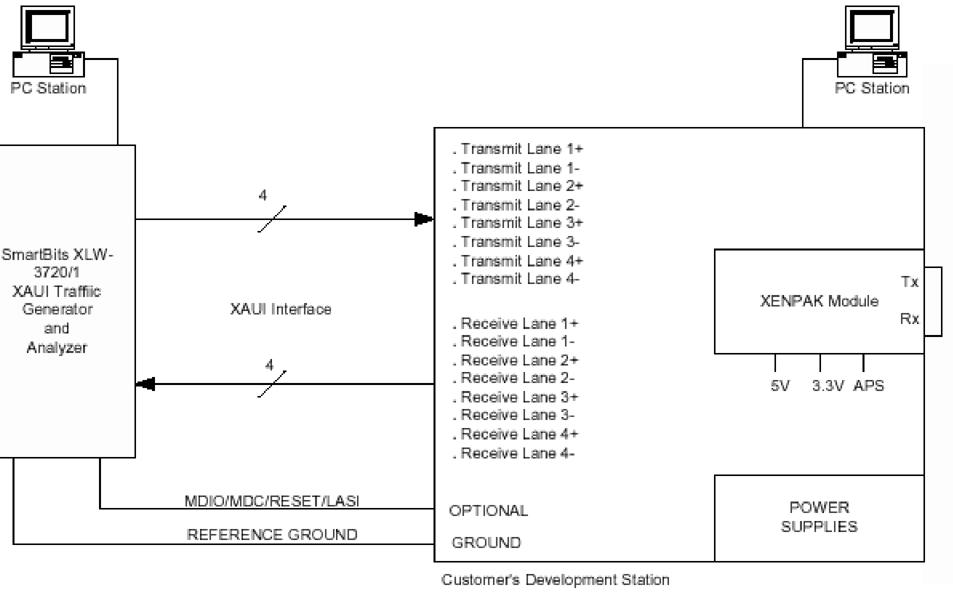


Figure 8-20. XAUI Test Bench (Example)

Table 8-8 lists the signal assignments for the RJ-45 connector on the XAUI extender unit. Use a cable matching these characteristics to extend the MDIO/MDC bus from the SmartBits module to the PHY sublayer devices on the development station.

Table 8-8. Signal Assignments for MDIO/MDC Cable (MDIO/MDC/LASI/Reset)

Pin	Signal	Input/Output	Voltage
1[1]	LASI	Output	Active high
2	MDIO	Input/output	1.2v
3	MDC	Output	1.2v
4	XENPAK reset	Output	Active low
5, 6, 7, 8	Tied together	N/A	Ground
9, 10	Tied together	N/A	Ground

1 Not required for access to MDIO functions in the device under test.

Setting up and Running XAUI Tests

You can perform XAUI testing in SmartWindow by using an XLW-3720A or XLW-3721A XENPAK module with the XAUI extender unit (ACC-3602A). (See *Figure 8-19*.) The extender unit plugs into the XLW-3720A/3721A module in the same manner as a XENPAK transceiver. It supports individual Bit Error Rate Tests (BERTs) of up to four XAUI channels simultaneously.

The following XAUI tests are supported:

- Individual PRBS on each of four channels simultaneously
- Measurement of frame jitter
- External clock out to sync other instruments
- Built-in CRPAT and CJPAT patterns for calculating packet error rate.

Use the following steps to run XAUI tests using SmartWindow and the XLW-3720A/3721A XENPAK modules with a XAUI extender unit.

To install the hardware:

1. Refer to the *XAUI Extended Unit Installation* instructions to complete physical installation of the XAUI unit.
2. Attach the SMA cables between the XAUI extended unit and the device under test. (See *Figure 8-20 on page 346*.)
3. Attach a suitable interconnect cable between the RJ-45 connector on the XAUI unit and the development station. This cable extends the MDIO/MDC bus to the PHY sublayer devices located on the development station. (See *Figure 8-20 on page 346* and *Figure 8-25 on page 353*.)

To launch SmartWindow and set up the test:

1. Start SmartWindow and connect to the SmartBits chassis that contains the XENPAK module with the installed XAUI unit.
2. Reserve the module.
   a. Right-click anywhere on the module image except the port button.
   b. Select **Reserve This Module**.

   The corner indicator LED turns blue when the module is reserved for your use. (Refer to *Chapter 3, “SmartWindow Menus”* for procedures to reserve modules.)
3. Click the port button to open the *Port* menu. Verify that the port is set to traditional mode.
4. Ensure that the **SmartMetrics Mode** option is not enabled on the *Port* menu (*Figure 8-21 on page 348*).

The port must operate in traditional mode. If *SmartMetric Mode* is enabled, click the option to clear it.

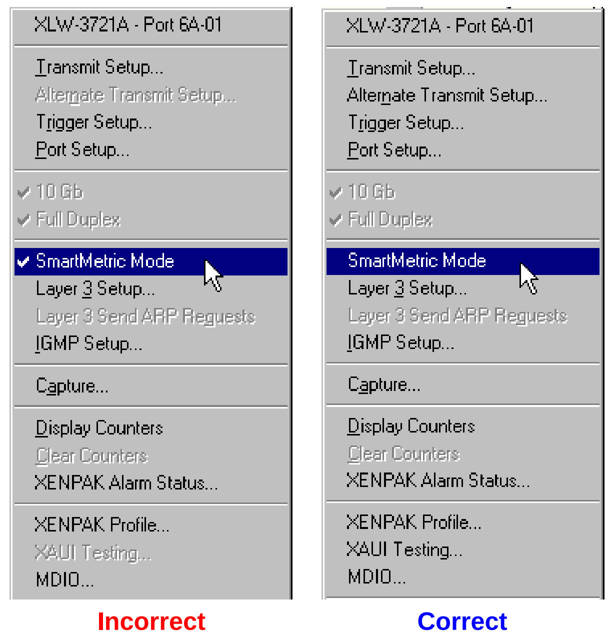


Figure 8-21. Setting Traditional Mode

5 Open the *Port* menu and select **MDIO**. The *MDIO Status* dialog box opens.

Use this dialog box to review and modify the register settings for MDIO devices. The default MDIO template file is `BitBlitz802_3ae45.mdio`, as shown in the *Template File* pane.

Select the MDIO template file.

Select the default MDIO template file in the *Port Setup* window accessed from the *Port* menu (*Figure 8-22 on page 349*) by performing this procedure:

a Close the **MDIO Status** dialog box.

b From the *Port* menu, select **Port Setup**.

c Click the **MDIO** tab.

d Use the **MDIO Registers Template** pane to browse for and select a different file. SmartWindow includes a number of representative template files. These files are located in the same directory as the SmartWindow executable (as installed).

Note: The following steps are for the default file `BitBlitz802_3ae45.mdio`.

Select *MDIO* in the *Port Setup* dialog box from the *Port* menu.

All MDIO template files are located in the same directory as the SmartWindow executable.

The default MDIO template (BitBlitz802_3ae45.mdio) is specifically suited to the XGXS device used in the SmartBits test system.

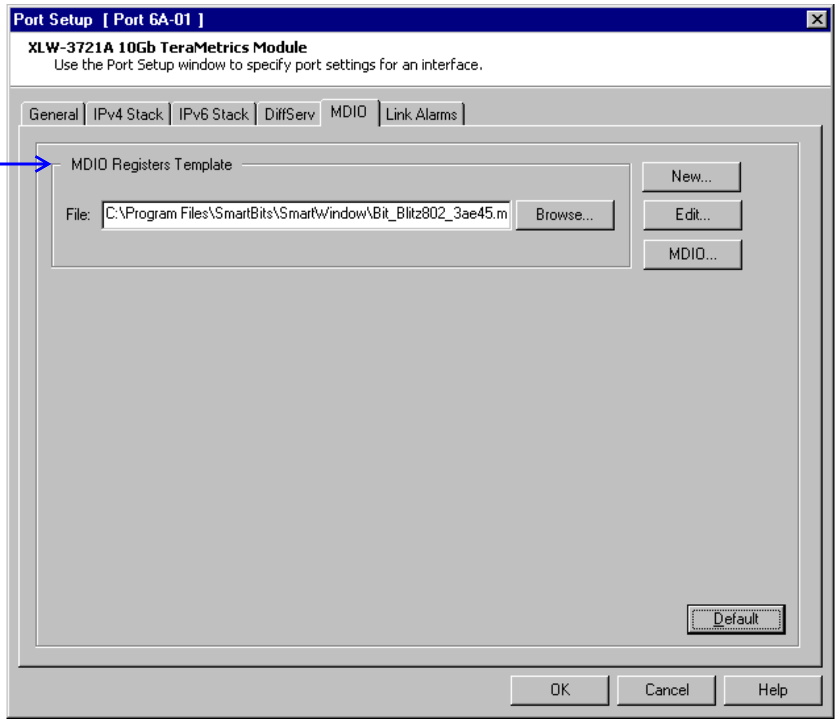


Figure 8-22. Selecting the MDIO Template File

6 Set register values in the MDIO devices, as needed for the test.

a Open the *Port* menu and select **MDIO** to open the *MDIO Status* dialog box.

b To set register values in the BitBlitz XGXS device, select **Device 5** in the *MDIO Devices* field.

c To set register values in other devices at the PHY level in the test system, select **Device 1** through **Device 4**.

The Loss of Signal (LOS), pre-emphasis, and equalization characteristics can be controlled by modifying register values in the BitBlitz (device 5), as follows:

d Ensure that **Device 5 - BitBlitz** is selected in the *MDIO Devices* field.

e To select a register, enter its address directly into the **Register Address** field (either hexadecimal or decimal), then press the **Tab** key. (Clause 45 address format is used.) Clicking the **OK** button sets the value and closes the window. Do not press the **Enter** key since the window will close without saving the value.

f Select **Edit Selected Register** in the *Template File* pane.

The *MDIO Register Edit* dialog box opens. Use the entry fields under *Default Value* to set the value, as required.

Values can be set in the following registers:

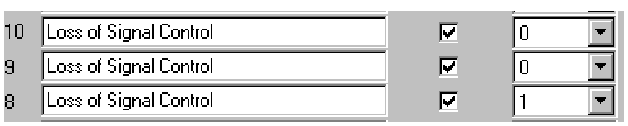
- MII Register 49153d / C0 01h: *Loss of Signal* (*Table 8-9*)
- MII Register 49157d / C0 05h: *Pre-emphasis* and *Equalization* (*Table 8-10*).

Set the bits assigned to each function to select one of the possible hex values, using binary coding. (See *Table 8-9* for an example of setting register bits to select a hex value and its corresponding characteristic.)

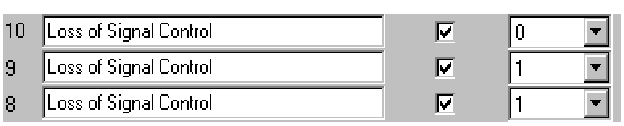
Table 8-9. MII Register 49153 (C0 01h, Clause 45): Loss of Signal (LOS)

Bit	Name	Setting	Default	R/W	Description
10:8	LOS_Control	0h = 160mVp-p 1h = 240mVp-p 2h = 200mVp-p 3h = 120mVp-p 4h = 80mVp-p else = 160mVp-p	000h	R/W	Set the threshold voltage for the Loss of Signal (LOS) detection circuit. Set the three bits to a hex value of 0 through 4, and select the associated LOS setting. Control values shown (**Setting**) are nominal levels.

Examples of setting bit values (LOS_Control shown):



Binary	Hex	Setting
0	1	240mVp-p
0		
1		



Binary	Hex	Setting
0	3	120mVp-p
1		
1		

Table 8-10. MII Register 49157 (C0 05h, Clause 45): Pre-emphasis and Equalization

Bit	Name	Setting	Default	R/W	Description
15:14	PRE_EMP	0h = no pre-emphasis 1h = 0.18 pre-emphasis 2h = 0.38 pre-emphasis 3h = 0.75 pre-emphasis	0h	R/W	Configure the level of pre-emphasis. Set the two bits to a hex value of 0 through 3, and select the associated pre-emphasis setting. Control values shown (**Setting**) are nominal levels.
3:0	EQ_COEFF	0h = no HF boost in equalizer Fh = boost is maximum	0h	R/W	Configure the equalizer. Set the four bits to a hex value of 0 through 15, and select the associated equalization setting.

7 After editing a selected register, click **OK** to close the *MDIO Register Edit* dialog box.

8 After editing all registers, click **OK** to close the *MDIO Status* dialog box.

To run the test:

1. Open the *Port* menu and select **XAUI Testing**.
2. Use the *XAUI* dialog box to select one of the two test types:
   - *Jitter Pattern Generation* described in *"Jitter pattern test"* on this page
   - *Bit Error Test (BERT)* described in *"Bit error test" on page 352*.

View (but not edit) the two predefined jitter test patterns (CRPAT and CJPAT) or create a custom pattern. Select the appropriate radio button, then click the **Pattern** *button to open the* Pattern *window.*

For the bit error test, select the loopback point:

Local DTE XS: *Loopback in the XGXS DTE, the BitBlitz XGMII-to-XAUI device in the SmartBits test system*

Remote PHY XS: *Loopback in the XGXS PHY subsystem in the SmartBits test system*

Results of the bit error test appear in the Pseudo Random Bit Stream Sequence Analysis *pane*.

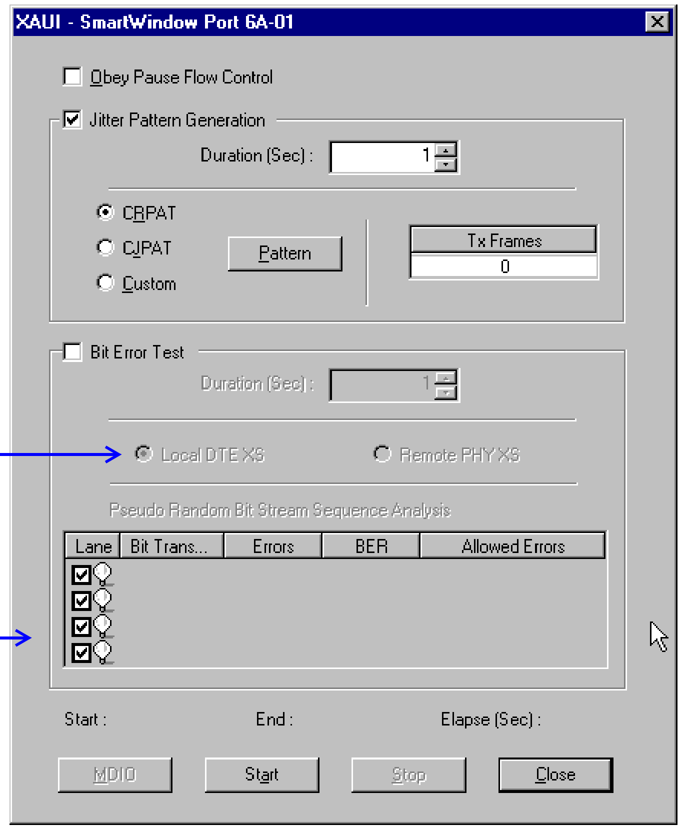


Figure 8-23. XAUI Testing Dialog

Jitter pattern test

In this test, the port generates Layer 2 frames of 1,532 bytes that include the selected standard pattern or a defined custom pattern.

To run the jitter pattern test:

1. In the *XAUI* window, select one of the predefined patterns or define a custom pattern for the test. View the predefined patterns or edit the custom pattern by clicking the **Pattern** button. (Predefined patterns cannot be edited.)
2. Enter a *Duration (Sec)* field value.

Note: The *Tx Frames* field is read-only and shows the number of test frames actually sent.

3 Start data capture on the port:

  a Open the *Port* menu and select **Capture**.

  b Accept the default settings (i.e., capture *All Frames*), and click **Start**.

4 In the *XAUI Testing* window, click **Start** to begin the test.

5 When the test has finished:

  a Return to the *Capture* window.

  b Click **View Result** in the *Capturing* popup.

The *Capture* window shows the received pattern data.

Bit error test

To run the bit error test:

1 Enter the *Duration (Sec)* field value and the number of frames to be sent (in the *Tx Frames* field).

2 Select the loopback point (*Figure 8-24* and *Figure 8-25 on page 353*).

- **Local DTE XS**

  Loopback in the XGXS DTE, an XGMII-to-XAUI interface chip located in the XLW-3720A/3721A module

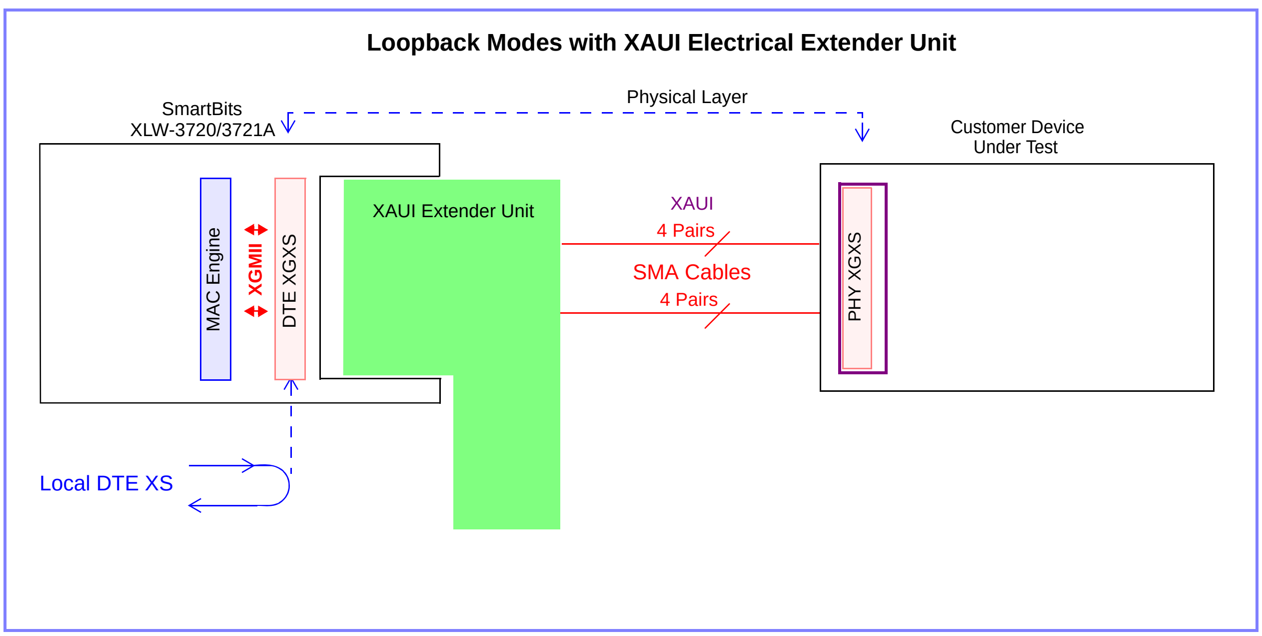


Figure 8-24. Loopback Modes with the XAUI Extender

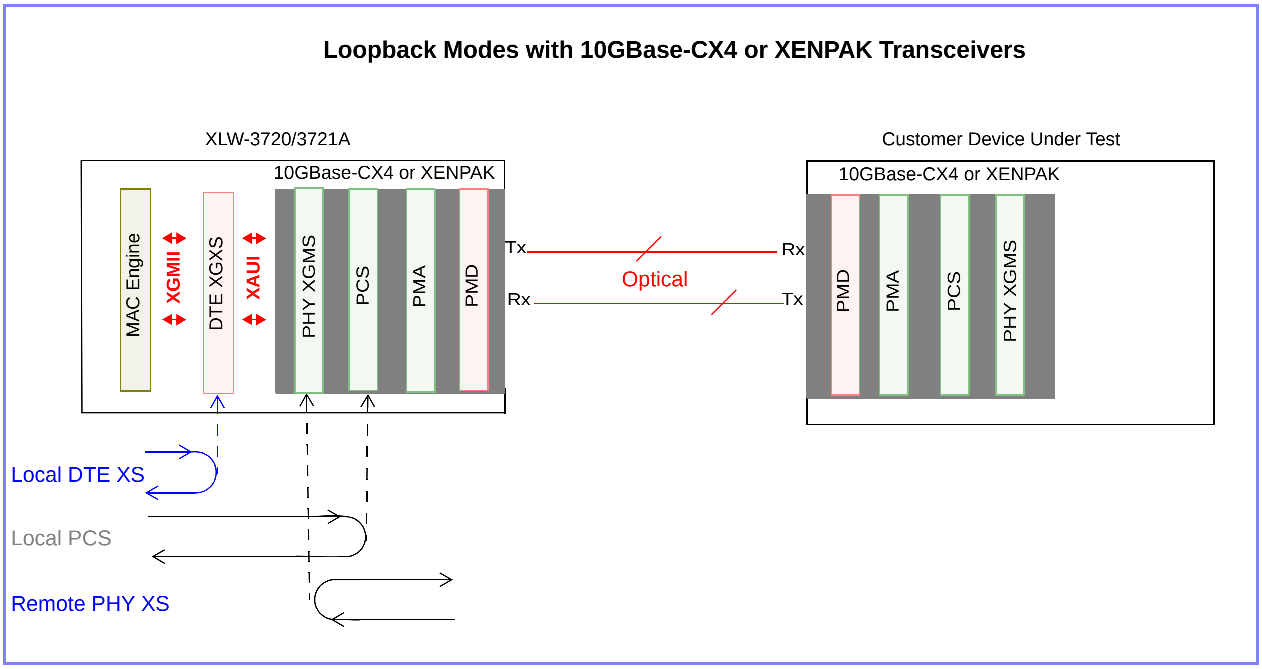


Figure 8-25. Loopback Modes with the XENPAK and 10GBase-CX4 Transceivers

3 Deselect/clear lanes to remove them from the test, if desired.

4 Click **Start** to begin the test.

Results

In the *XAUI* dialog box, the *Pseudo Random Bit Stream Sequence Analysis* pane shows the results for the bit error test.(See *Figure 8-26 on page 354*.)

Results of the bit error test appear in this pane.

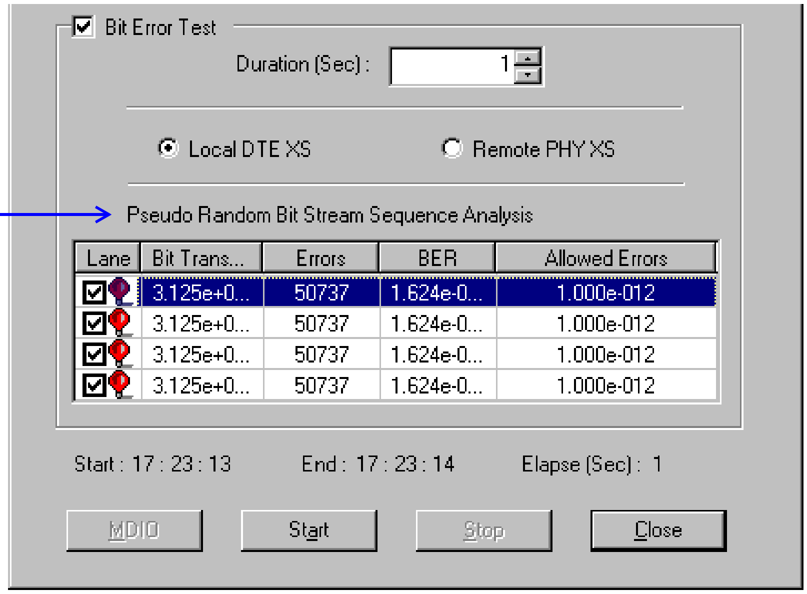


Figure 8-26. Bit Error Test Results

Test Using the LAN-3710AL/AE/AS 10GbE Module

This section provides an example of test setup for the LAN-3710AL/AE/AS 10Gb Ethernet module.

See *"Defining OAM Patterns" on page 445* for information on additional capabilities not covered in this example.

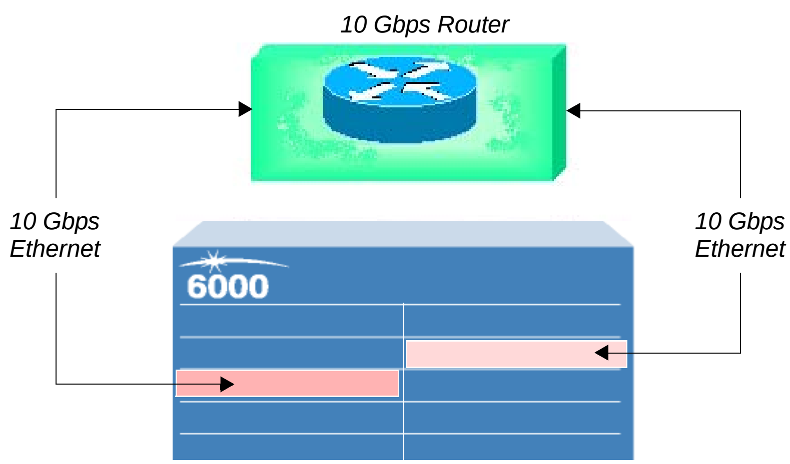
Note: This test setup uses two LAN-3710AL/AE/AS modules. These modules are required for 10 Gbps testing.

About the LAN-3710AL/AE/AS 10GbE Module

The LAN-3710AL/AE/AS 10 Gigabit modules provide 10,000 Mbps wire-rate traffic generation, analysis, and capture conforming to the draft standard currently being defined by the IEEE 802.3ae task force.

Each module has one test port. A typical test setup includes two modules installed in the SmartBits 6000x chassis, with one module sending test traffic to the 10 Gbps Device Under Test (DUT), and the other module receiving frames and tallying results. The example described here uses this setup. Steps apply to each module, except where noted.

Caution: Not more than one LAN-3710AL/AE/AS module may be installed in the Smart-Bits 600x.



SmartBits 6000C with Two LAN-3710AL/AE/AS Modules

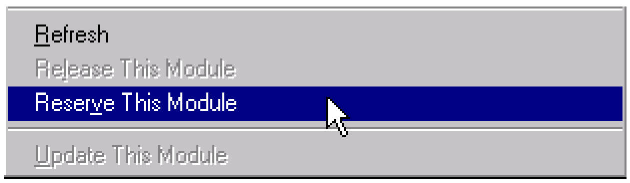
Reserve the Ports

Connect SmartWindow to the SmartBits 6000x chassis, then perform the following procedure.

Note: See *Chapter 2, "Install and Connect"* for the steps to make a connection from your PC and SmartWindow to the SmartBits chassis.

To reserve the module:

1 Click anywhere on the card image except the **Start** button, and choose **Reserve This Module**.

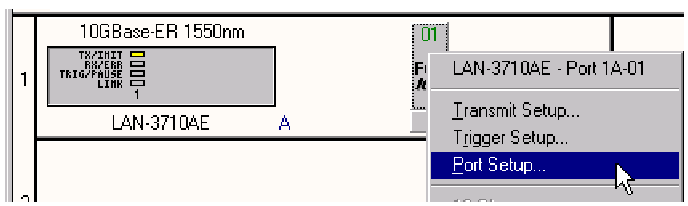


Review the Port Setup

To review port setup:

1 Click the port button for port 01 to open the card menu.

2 Choose **Port Setup**.



3 The *Port Setup* window appears (*Figure 8-27 on page 357*).

General tab

On the *General* tab, the *Preamble* parameter is fixed at **8** and cannot be changed.

Configure the SmartBits port to obey pause flow control from the DUT, if desired. (Use the *Obey PAUSE flow control* checkbox to enable this option.)

Note: IEEE 802.3ae specifies no autonegotiation for 10GbE. The link is always full duplex and runs at the full line rate of 10 Gbps.

DiffServ tab

The *DiffServ* tab is used to set up DiffServ counters. This option is used on the receiving port. In the test results, it enables you to measure the number of received frames that contain TOS values. It also provides a tally of specific TOS values (for IPv4 only).

See *"DiffServ Counters" on page 437* for the steps to set up this option.

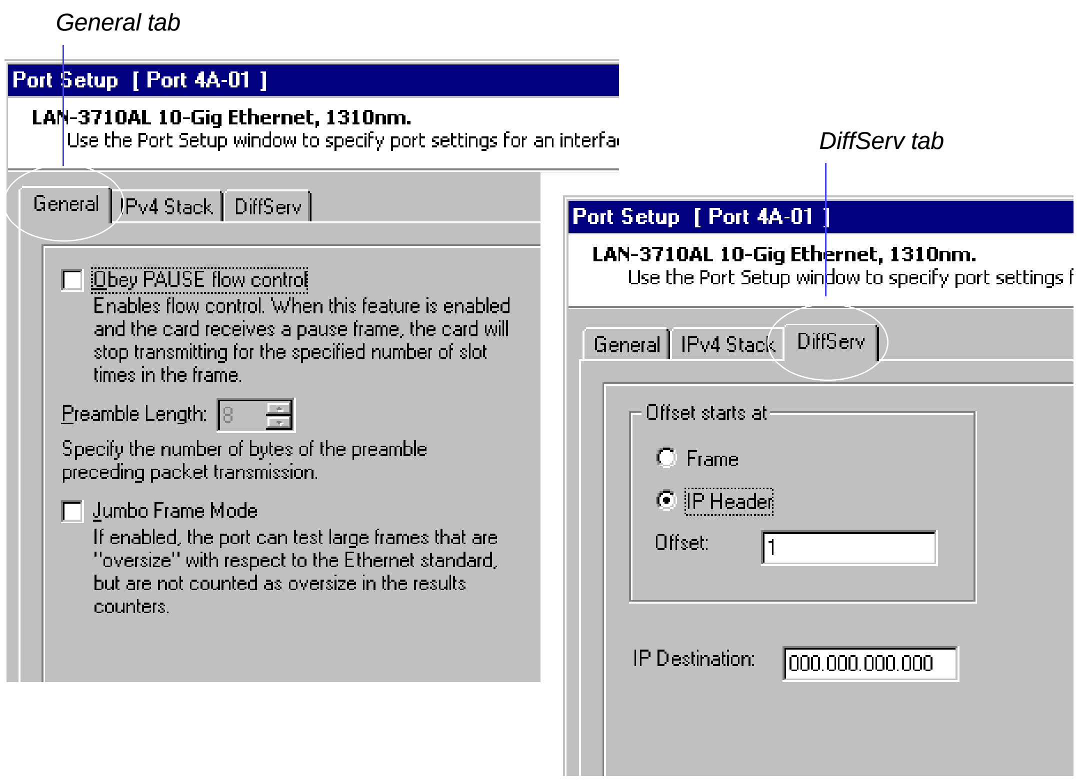


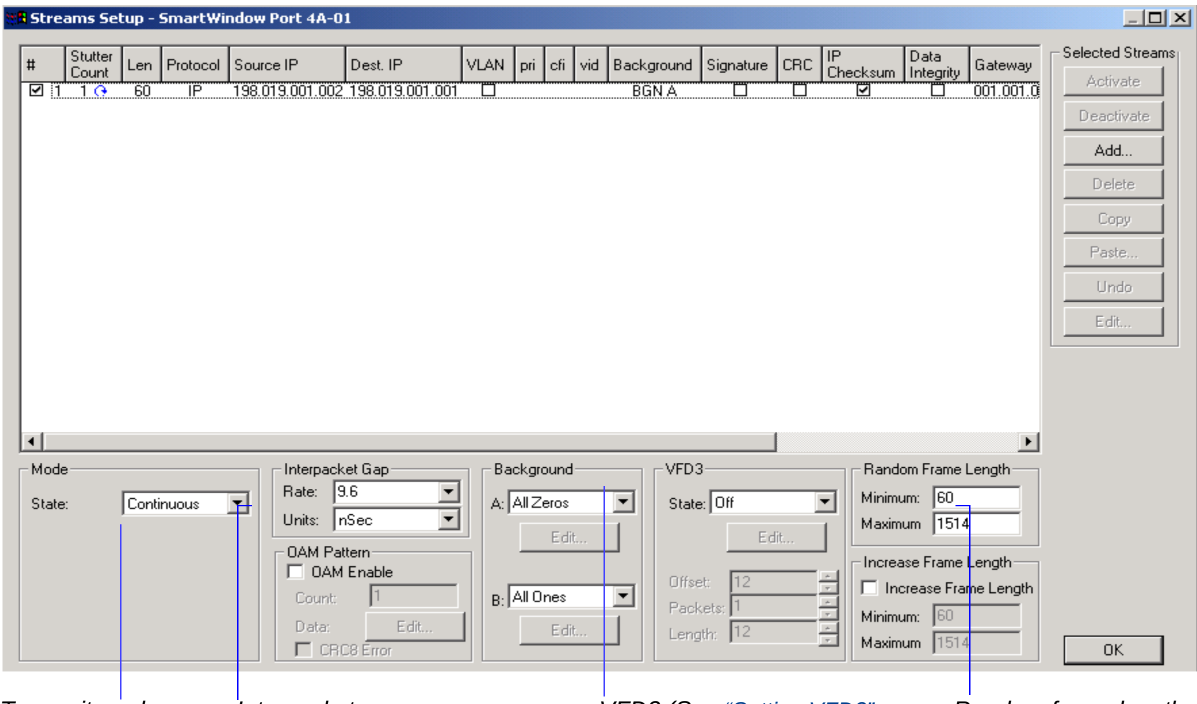
Figure 8-27. Port Setup window

Configure Streams on the Transmitting Port

To set up the streams and set global stream parameters:

In this example, two streams are set up.

1. Click the port button and select **Transmit Setup**. The *Streams Setup* window opens. Use the panes at the bottom of the *Streams Setup* window to set global options. These options apply to all streams transmitted through the port.



2. Set the **Transmit Mode** to **Single Burst**. The port transmits one burst at the selected interpacket gap.
3. Accept the default value for **Interpacket Gap**. This value conforms to the IEEE 802.3ae standard of 9.6 nanoseconds. (If desired, this value can be varied in increments of 0.8 nanoseconds. Different values can also be selected for *Units* field.
4. Select the two global **Background** patterns (**A** and **B**). Assign one of the selected patterns to each stream.
5. Specify that the port send frames of random sizes, if required. Use the **Random Frame Length** fields (without FCS) to set the minimum and maximum values.

Setting VFD3

VFD3 is a global, user-defined variable field. When enabled, it is written over the background data pattern at any location in a frame (under certain conditions, as specified below). General characteristics are as follows:

- VFD3 uses a buffer of 4 Kbytes. The buffer contains a number of fixed-length patterns that can be specified, and it behaves like a First-In, First-Out (FIFO) buffer. The fixed-length patterns are overlaid on the outgoing test frame. These patterns can contain different protocol data. As frames are transmitted, the VFD3 buffer cycles through the number of specified fields. When VFD3 is enabled, all transmitted streams contain VFD3 data.
- The *Offset* field identifies the position of the VFD3 data in the transmitted frame. The minimum offset is zero bytes. The maximum offset is equal to the desired frame length (without FCS) minus 16 bytes.
- *Packets* field contains the number of fixed length patterns. The minimum is 1 byte; the maximum is 512 bytes.
- *Length* field (without FCS) specifies the length of each data pattern. The minimum is 1 byte. The maximum is 4 Kbytes or the desired frame length minus 16 bytes.

How to select the Length *value*

The *Length* field value (without FCS) must be calculated by using the following formula, or the LAN-3710AL/AE/AE modules may generate intermittent frames with corrupted data.

Length (bytes) + Offset (bytes) <= Frame Length w/o CRC (bytes) – 16 bytes

Examples:

Offset = 0 bytes

Frame Length with CRC = 95 bytes

Frame Length without CRC = 91 bytes

Maximum VFD3 Length = **75 bytes**

Offset = 0 bytes

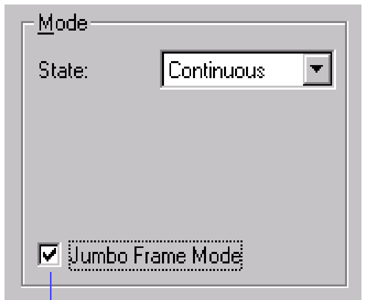
Frame Length with CRC = 100 bytes

Frame Length without CRC = 96 bytes

Maximum VFD3 Length = **80 bytes**

About the Jumbo Frame Mode *checkbox*

When the *Jumbo Frame Mode* checkbox is selected in the *Streams Setup* window, the port can send or receive test frames that are oversize with respect to the Ethernet standard, but are not counted as oversize by the receiving port.



Jumbo Frame Mode

Frame size can legally exceed the Ethernet standard (1,518 bytes), without being considered oversize, when:

- VLAN tags are enabled in the stream definition. VLAN tags add 4 bytes to the frame size.
- *Jumbo Frame Mode* checkbox is selected. A jumbo frame can be up to 10,000 bytes long.

Enable these two options (VLAN or jumbo frames) either separately or together. *Table 8-11* shows how these options affect frame size in terms of oversize counts.

Table 8-11. Legal Oversize Frames with VLAN or Jumbo Frame Mode

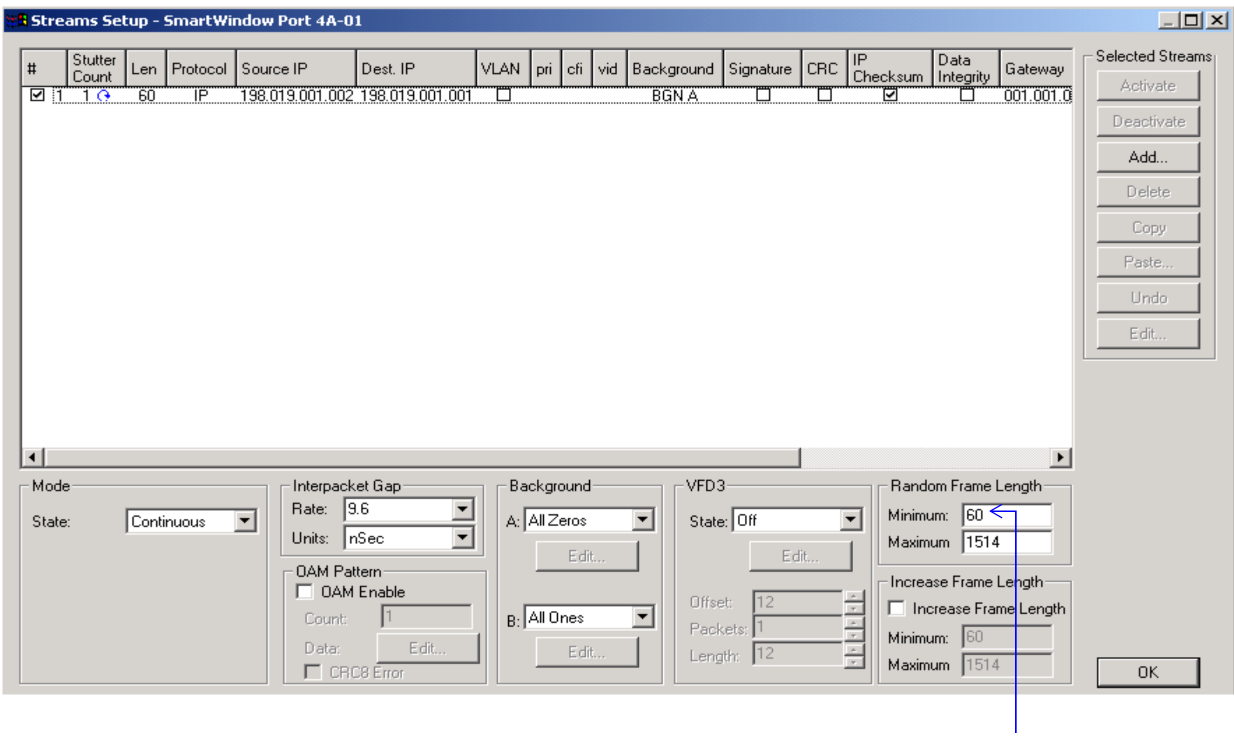
Jumbo Frames?	VLAN Enabled?	Oversize if Length (Without FCS) is Greater Than:	Jumbo if Length (Without FCS) is Greater Than:
No	No	1,518 bytes	N/A
No	Yes	1,522 bytes	N/A
Yes	No	9,018 bytes	1,518 bytes
Yes	Yes	9,022 bytes	1,522 bytes

Increase frame length

The LAN-3710AL/AE/AS can automatically increase the length (without FCS) of frames as they are transmitted during the test. When this option is enabled, frames increase in length by one byte as they are sent, up to the maximum value. Then the frame size reverts to the minimum value, with frame transmission continuing.

The smallest possible *Minimum* field value is 40 bytes. The largest possible *Maximum* field value is 10000 bytes.

Note: When this option is enabled, the *Length* (without FCS) settings in the *General Stream Setup* pane of the *Tx Control Panel* are disabled.



Increase frame length without FCS. When enabled, each transmitted test frame increases in length by one byte, up to the maximum value.

To add two streams:

1. Click the **Add** button. The *Add Streams* dialog box appears.
2. Set **Streams** to **2**.
3. Accept the default values for frame length (without FCS) and protocol.
4. Click **OK**. The *Streams Setup* window reappears.

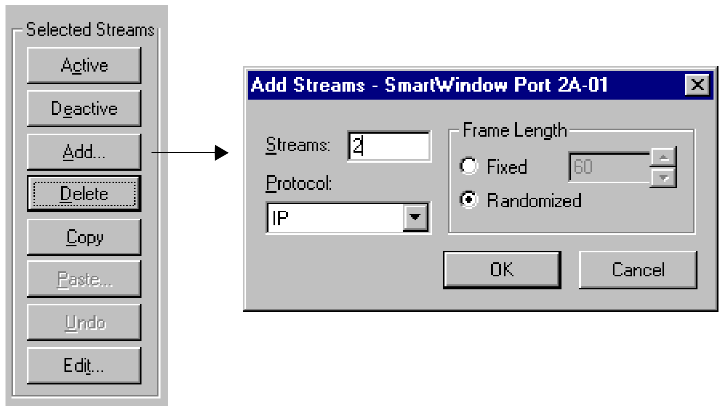


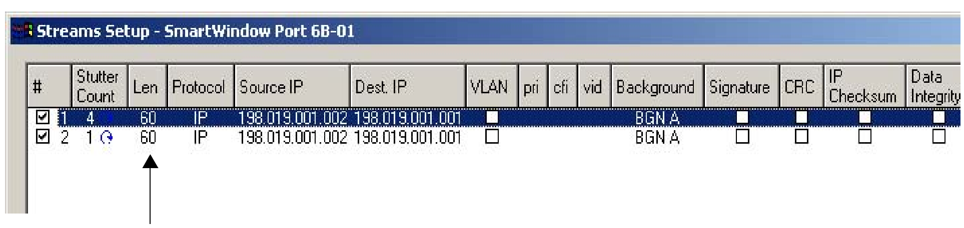
Figure 8-28. Adding Streams

To edit basic stream characteristics:

1 Set the **Stutter Count** for stream #1 to **4**.

Do this by editing the stream "in place": Double-click the *Transmit count* value in the displayed stream definition, then type the new value.

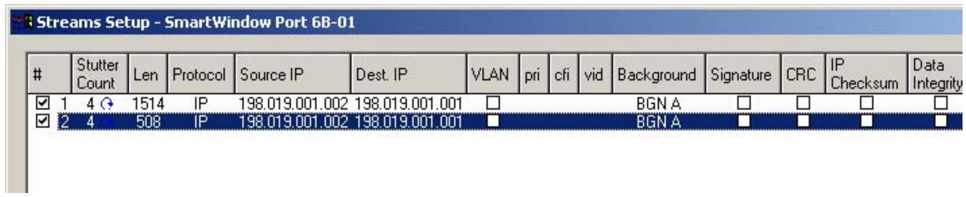
Note: See *"Stream Transmit Table" on page 364* for a description of how the stream order and *Stutter Count* parameter set up a stream transmit table.



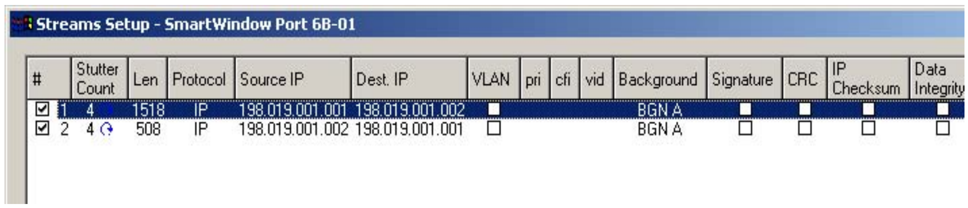
You can edit many stream parameters "in place." Double-click the value, then select from the menu or type the value.

2 For stream #2, set **Stutter Count** to **4**.

3 Set the **Len** (frame length, without FCS) to **1514** for stream #1 and to **508** for stream #2.



4 Edit the IP addresses, if necessary.



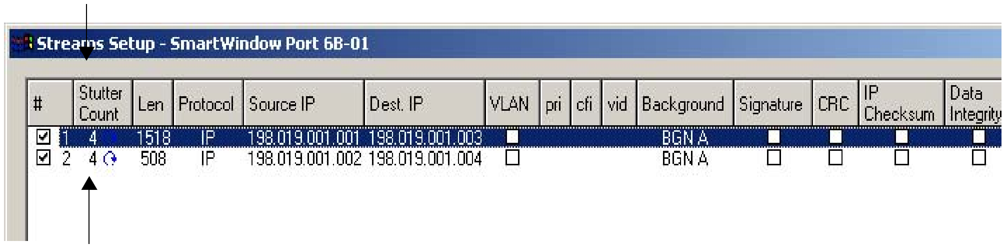
Stream Transmit Table

When streams are added and values set in the *Stutter Count* field, you establish:

- The order in which streams are transmitted
- How many times each stream is transmitted in its turn.

In this example, two streams are set up, each with a *Stutter Count* field value of **4**. As a result, the frames sent by the transmitting port follow the order shown below:

Transmit table = Order of streams and *Stutter Count* value for each stream



In this example, the order of test frames sent by the transmitting port (by stream #) is:

1	1	1	1	2	2	2	2

A more complicated stream table might set a variety of frame characteristics and repetitions per transmit cycle. As an example:

1	1	1	1	1				
2	2	2	2	2				
3	3							
4	4	4	4	4	4	4	4	4

(continues through Stream 8)

Editing Streams in the Tx Control Panel

To edit stream parameters in more detail by using the Tx Control Panel pane:

1. Click the stream to highlight it.
2. Click the **Edit** button in the *Selected Streams* pane.

   The *Transmit Setup* dialog box opens (*Figure 8-29*) with the *Tx Control Panel* pane and *General Stream Setup* pane. Use the *General Stream Setup* pane to modify stream characteristics such as frame size.

   Use the options in the *Tx Control Panel* pane to modify the stream protocol and background pattern and to set up flows (*"Setting up Flows for Each Stream" on page 369*).
3. Select the **VLAN** checkbox to enable VLAN tags.The *SETUP: VLAN TAG* pane appears. See Help text for more information on configuring and using VLANS as well as VLAN stacking (QnQ) TX side support features.

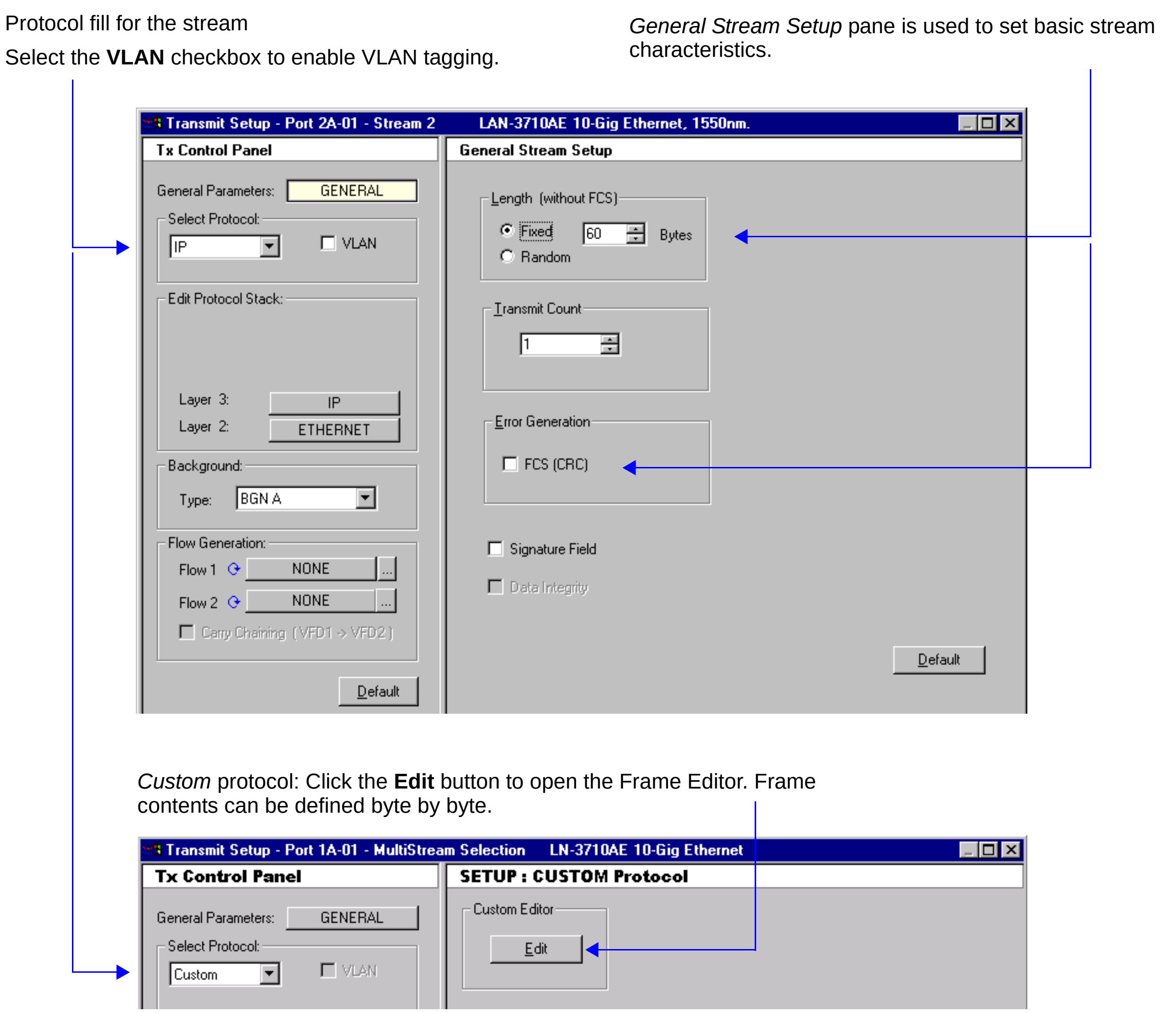
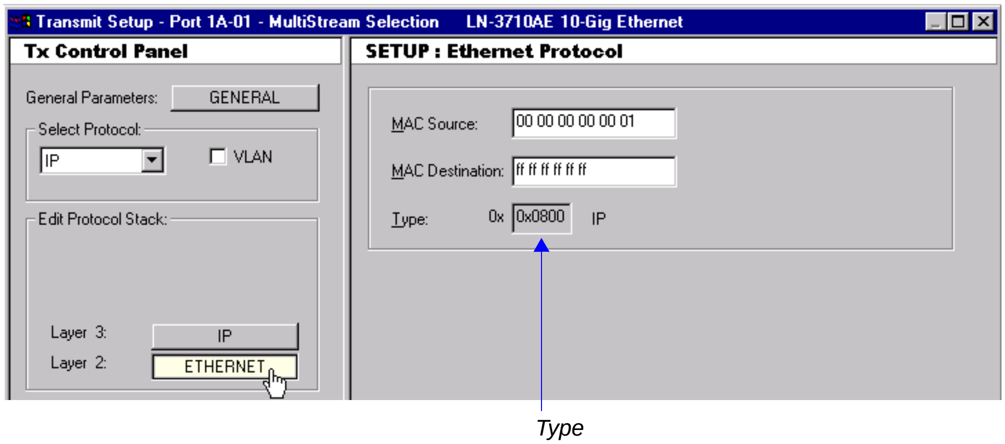


Figure 8-29. Tx Control Panel (General Stream Setup)

Editing MAC Addresses and IP Addresses

To set values for the Ethernet and IP protocol layers:

1. Click the **ETHERNET** button in the *Edit Protocol Stack* pane to open the *SETUP:Ethernet Protocol* pane.



2. Set the desired MAC addresses.
3. The *Type* field value is a read-only entry. It displays **0800** for Ethernet (by default) or **8100** for VLAN if the *VLAN* checkbox is selected in the *Select Protocol* pane. (In this case, a *VLAN* button in the *Select Protocol* pane enables you to set up VLAN tags.)

4 Click the **IP** button in the *Edit Protocol Stack* pane to open the *SETUP:IP (Internet Protocol)* pane.

5 Set IP addresses, Type of Service (TOS), and IP error generation, as necessary. *Figure 8-30* shows an example of IP addressing for one stream.

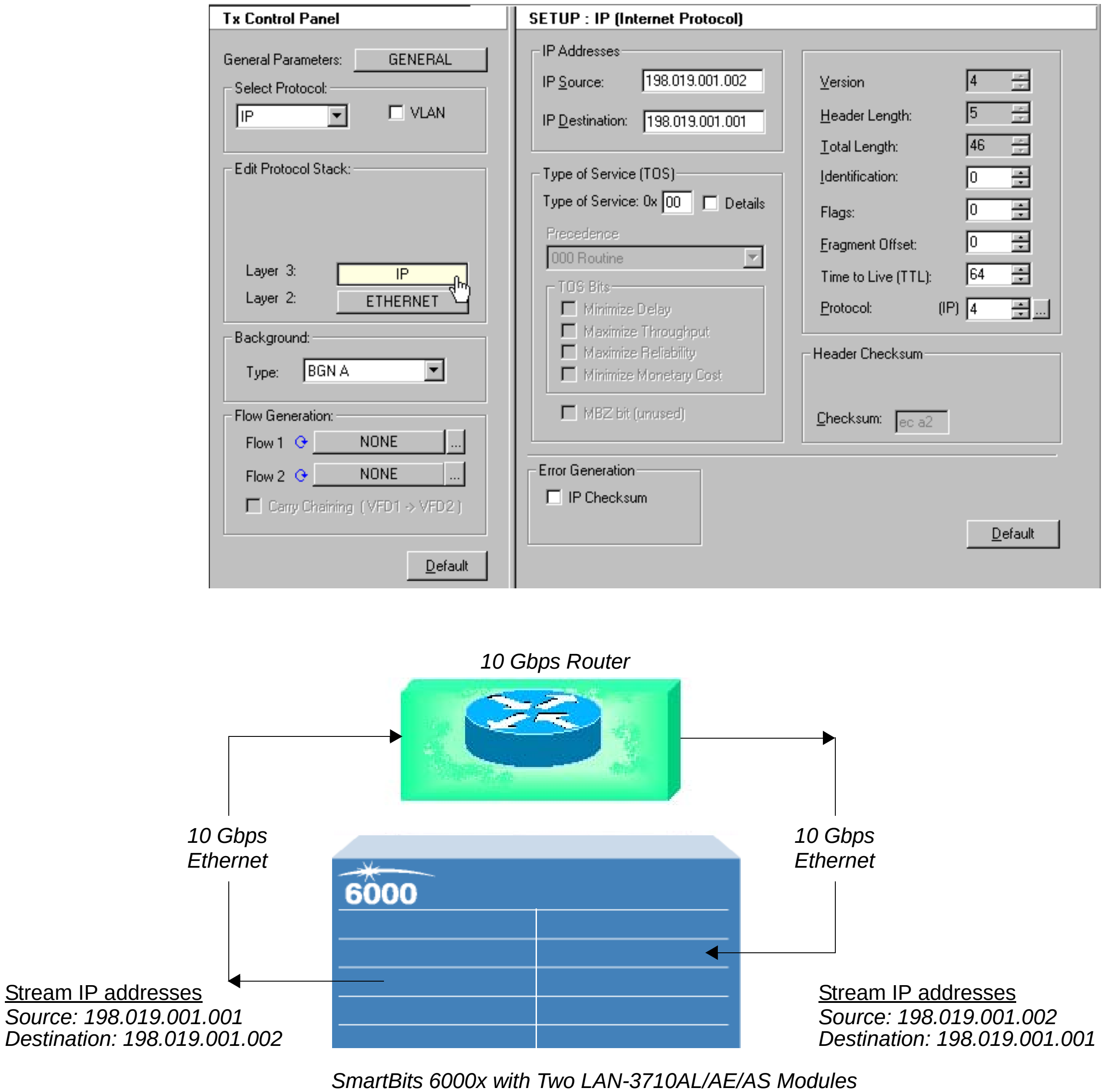


Figure 8-30. Example of IP Address Setup for 10 Gbps Router Testing (One Stream)

Setting Type of Service (TOS) Values and Error Generation

To set up the TOS characteristics for each test stream and enable error generation (*Figure 8-31*):

Note: TOS characteristics are not selectable under IPv6.

1. Set the desired value for **Type of Service** in the *Type of Service (TOS)* pane.
   Notice that the values for *Precedence* and the *TOS Bits* checkboxes automatically adjust, though these options remain greyed out.
2. Click the *Details* button.
   The greyed out options become active, and the edit mode reverses: the *Type of Service* field becomes greyed out, and the *Precedence* and *TOS* options can be set explicitly. Now the *Type of Service* field varies automatically (but remains greyed out) to reflect the *Precedence* and *TOS* values that are set.

   The *MBZ bit (unused)* checkbox toggles the least-significant bit in the TOS octet. This bit (labeled MBZ for "must be zero") is currently unused in normal IP routing, but it may be set for experimental purposes. Normally, the originator of a datagram sets this field to zero. Routers and recipients of datagrams ignore the value of this field. This field is copied on fragmentation.
3. Select the *IP Checksum* checkbox in the *Error Generation pane*, if necessary. (The LAN-3710AL/AE/AS can insert IP checksum errors into generated frames.)

Note: See *"DiffServ Counters" on page 437* for the steps to see TOS tracking results.

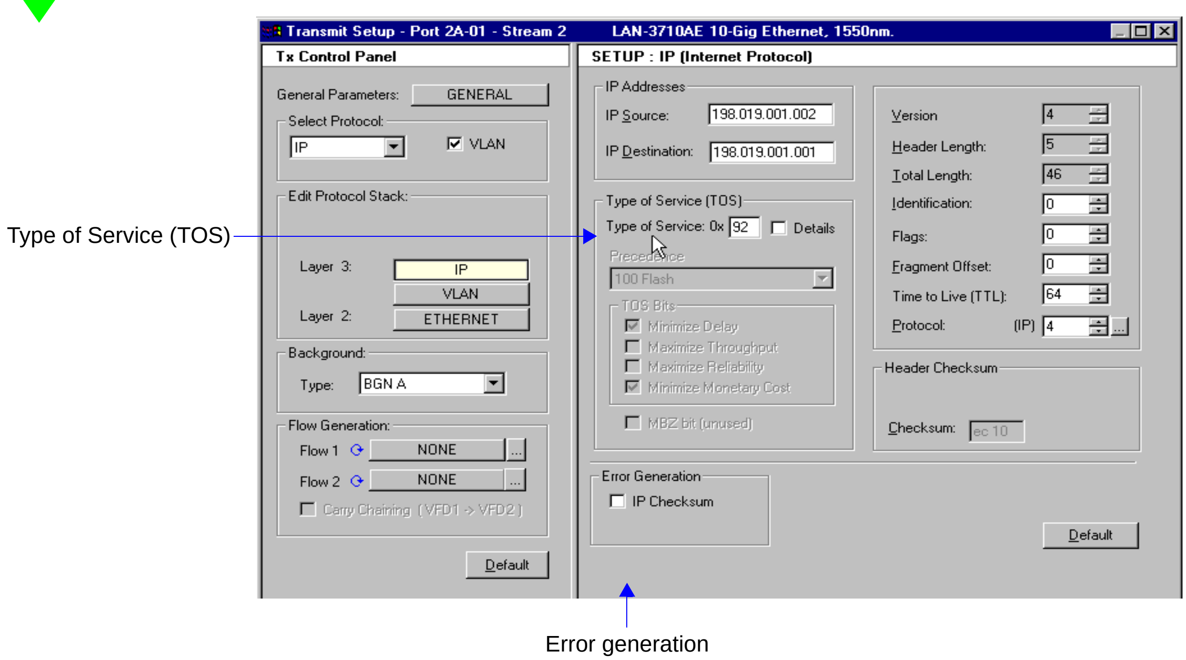


Figure 8-31. Setting TOS and Error Generation

Setting up Flows for Each Stream

You can configure each stream to cycle through up to 16,777,215 flows.

With IP streams, flow generation can be based on IP source or destination address or on VFD fields. With UDP or TCP streams, flow generation can be based on source or destination IP address, or on source or destination port number.

To set up flows for each stream:

1. Select (click) the stream in the *Streams Setup* window.
2. Click the **Edit** button.
3. In the *Flow Generation* pane of the *Tx Control Panel* pane (*Figure 8-32 on page 370*), select the variable to use with flow 1.

   The *SETUP FLOWS* pane changes to show the options for the selected variable. For example, in *Figure 8-32 on page 370*, the *Select Protocol* field value is *IP* and the generation variable for *Flow 1* is *IP ADDR. SOURCE*. The *SETUP FLOWS: IP Source Address* pane shows the options related to this choice.
4. Set values in the related *SETUP FLOWS* pane.

Note: See the following notes for additional guidelines:

- For IP protocol streams, see *"Setting Up IP Flows"* below.
- For UDP or TCP protocol streams, see *"Setting Up Layer 4 Flows (UDP or TCP)" on page 370*.

Setting Up IP Flows

When the *Vary: Host Address* button is clicked in the *Setup Flow*s pane, you can also select the *Skip Subnet and Broadcast Addresses* checkbox. Each transmitted frame then increments the selected IP address by 1 (the **Step** value), skipping 0 and 255, and starting with the IP address set in the *Start Address* field. When all addresses have been cycled through, the process starts again with the initial IP address.

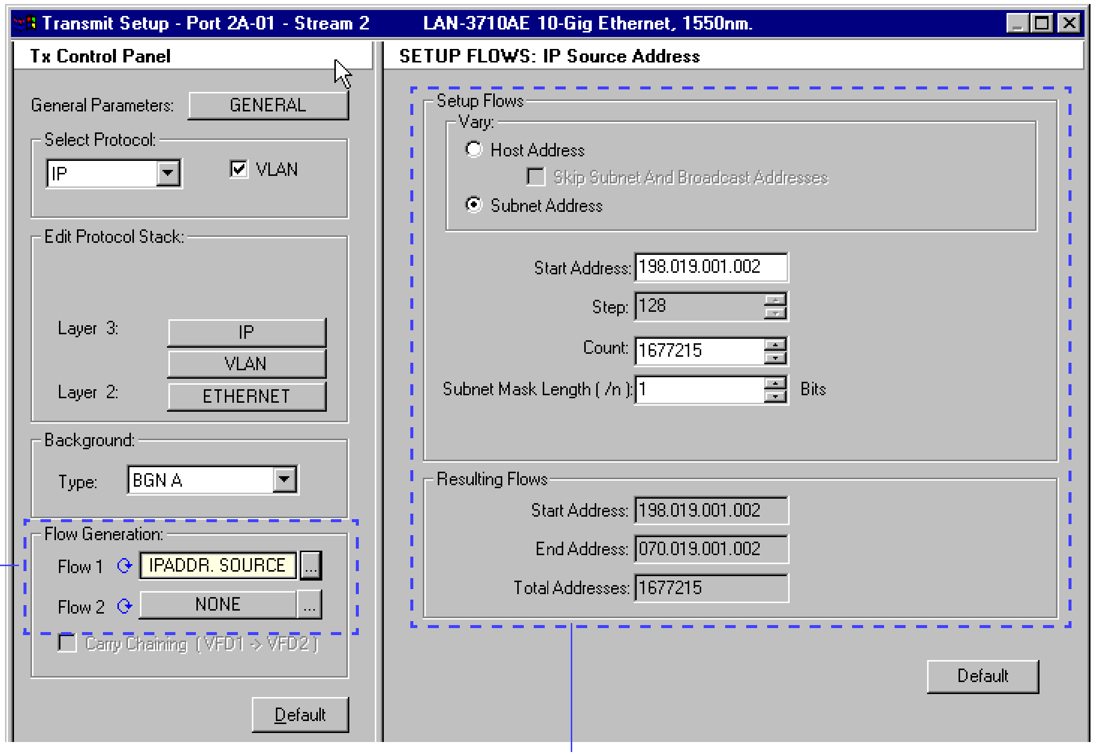
The *Count* field has a maximum value of 16,777,215.

The *Subnet Mask Length (/n)* field has a maximum value of 30 bits.

When the *Vary: Subnet Address* button is clicked in the *Setup Flows* pane, the *Count* field value varies automatically according to the *Subnet Mask Length (/n)* field value.

Use the *Resulting Flows* pane to review the proposed configuration, in terms of starting address, ending address, and total number of flows.

Click the **OK** button when settings are correct.



Use the Flow Generation *pane to select the variables for flows.*

This pane changes to display the associated options.

Figure 8-32. Setup for Flow Generation by IP Source Address

Setting Up Layer 4 Flows (UDP or TCP)

To set up Layer 4 flows:

1 Select *SOURCE PORT* or *DEST. PORT* as the flow generation variable only when a Layer 4 protocol (UDP or TCP) has been selected in the *Select Protocol* field.

The *Source Port* and *Destination Port* fields each have a maximum value of 65535. The *Subnet Mask Length (/n)* field has a maximum value of 30 bits.

2 Click the **OK** button when settings are correct.

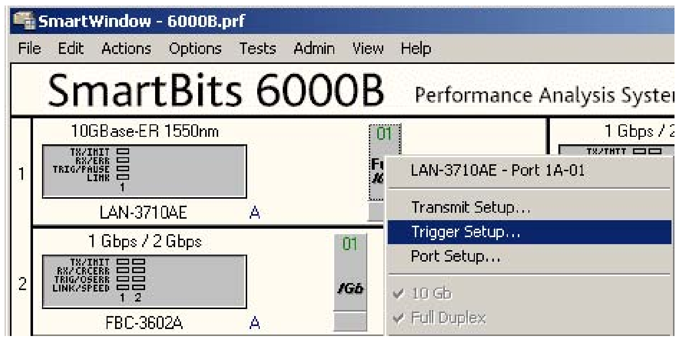
Setting up Triggers

Trigger setup applies to the receiving module. The LAN-3710AL/AE/AS makes it possible to define trigger patterns down to the bit level.

Note: See *"Using Triggers and Capture" on page 145* for further information on using triggers.

To set up triggers on the receiving LAN-3710AL/AE/AS modules:

1 Click the port button and select **Trigger Setup**.



2 Use the *Receive Trigger Setup* dialog box to define the *Byte Offset* and *Byte Length* field values. (The defaults specify the MAC source address as the trigger pattern.)

3 Enter a **Data** field value to specify the exact byte sequence that makes up the trigger.

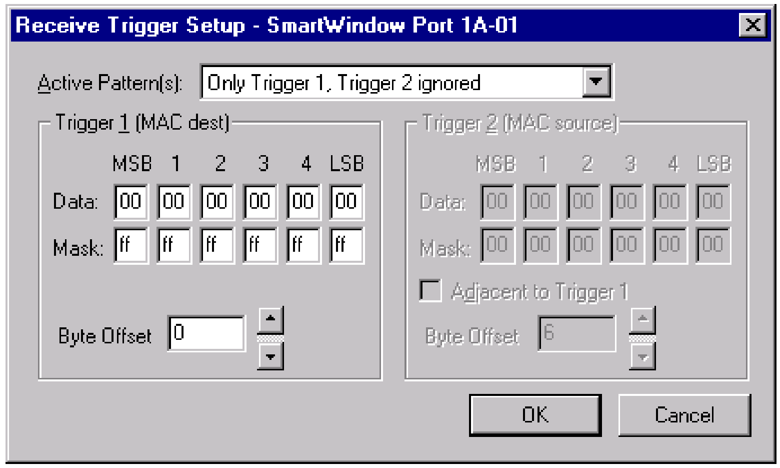
4 Set the **Mask** fields to either allow or disallow selected bits in the *Data* pattern.

Table 8-12 illustrates an example of setting the *Data* and *Mask* fields and shows the resulting bytes in the active trigger pattern.

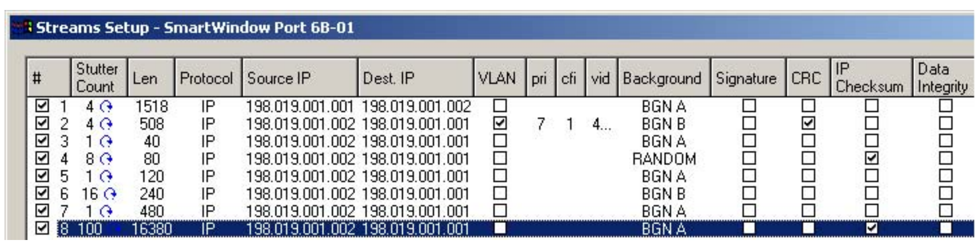
Table 8-12. Example of Setting up a Trigger on the Receiving Port

Byte	Data	Mask	Active Trigger Value
MSB	0x11	0x0F	**0x01** 00000000 00000001
1	0x22	0xF0	**0x20** 00000010 00000000
2	0x33	0xFF	**0x33** 00000011 00000011
3	0x44	0x0F	**0x04** 00000000 00000100
4	0x55	0xF0	**0x50** 00000101 00000000
LSB	0x8A	0xF0	**0x80** 00001000 00000000

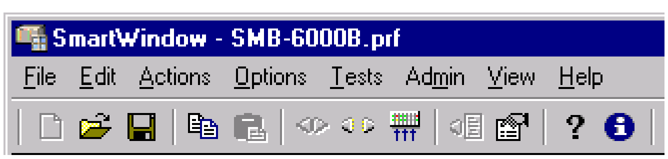
5 The *Byte Offset* field value defines the position (in bytes) within the frame to start checking for the specified pattern. An offset of zero refers to the first data byte of the frame. (This default setting sets the trigger 1 pattern to the MAC destination address.)



To send the configuration to the card:



1 Click the **Update** button on the SmartWindow toolbar to copy the configuration to the card, or select **Actions** > **Update** from the main menu.



Click the Update *button on the toolbar to send the configuration to the module.*

To configure the Gigabit setup and IP addresses of the receiving card:

The line interface and the IP addresses on the receiving card need to be configured. However, streams do not need to be created unless there will be two-way transmission and reception.

1. Repeat the procedures described for the transmitting module in *"Configure Streams on the Transmitting Port" on page 358* to configure a card to receive.

Set up the DUT

Refer to *"Configuring the DUT" on page 413* for a description of how to set up the DUT.

Send Traffic and View Counters

Now you are ready to transmit traffic and view counters. Refer to *"Running SmartCounters" on page 435*.

Note: See also *"DiffServ Counters" on page 437* for information regarding the results of DiffServ tracking on the receiving port.

Test Using the LAN-3311A TeraMetrics Module

This section provides an example of test setup for the LAN-3311A TeraMetrics module. Refer to *"Testing Gigabit Routers with SmartMetrics" on page 316* for an overview. This section covers the following topics:

- *"Gigabit Setup" on page 375*
- *"Layer 3 Setup" on page 377*
- *"Configure Streams on the Transmitting Card" on page 378*
- *"Set up the DUT" on page 379*
- *"Send Traffic and View Counters" on page 379*.

For additional information on the configuration process, see the following topics:

- *"Configuring Transmit Streams on TeraMetrics Modules" on page 392*
- *"Configuring SmartCounters" on page 415*.

Note: This test setup uses the LAN-3311A. Additional cards and modules that support this test include the following:

- WAN-3415/3420 over frame relay
- LAN-3200A/As
- ML-7710
- LAN-3101A/B as ping target.

About the LAN-3311A TeraMetrics Module

The GBIC-based LAN-3311A TeraMetrics module supports 1,000 Mbps over single- and multi-mode fiber. The module is capable of simulating the millions of client and server sessions required to fully test network systems, yielding per-flow metrics for billions of IP flows. It complies with the IEEE 802.3z draft specification in Gigabit mode.

The module features SmartMetrics test support for per-flow frame loss, latency, latency and sequence, and latency distribution tracking. Capabilities include:

- Stream-based, wire-rate traffic generation and analysis at up to 1,448,095 frames per second, with frame sizes of 64 to 16,384 bytes.
- Ports that are completely independent in operation.
- Full-duplex operation.
- Support for autonegotiation.
- Up to 512 independent IP streams (peer-to-peer), with analysis of up to 64K streams. Instruments a nearly unlimited number of flows per stream, thereby stressing a router by having it perform a different routing decision for every frame. (See *Table 5-13 on*

page 170 for a listing of the maximum number streams allowable for each type of module.)

- Realistic frame-length generation (without FCS), including fixed frame length that is uniformly distributed, and multi-mode frame length (without FCS) that is variably distributed.
- Optional MPLS label stack encapsulation.
- Arbitrary stream sequencing that enables mixing of frame rates.

Test Methodology

The type of test described in this section can determine throughput in terms of packet sequencing, latency, latency distribution, and overall capacity of a Gigabit router. However, the overall objective is to test the Quality of Service (QOS) capabilities of the router.

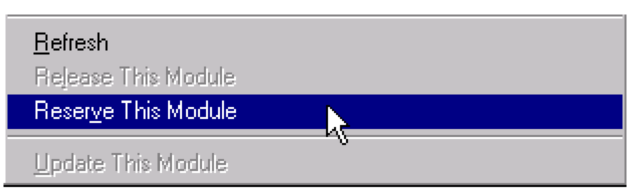
Table 8-13. Gigabit Test Methodology for SmartMetrics Results (LAN-3311A)

Step	Objective	Description
1	Gigabit setup	Configure the Gigabit Ethernet ports in the SmartBits, setting values for Ethernet line and Layer 3 parameters.
2	Configure streams	Set up five test streams. Each stream presents a different QOS level and is capable of cycling 64,000 IP addresses.
3	Configure DUT	Configure the IP parameters at the DUT to match those of the Gigabit Ethernet ports.
4	Run tests	Run the Sequence and Latency test.
5	View results	Using MS Excel, view the results in histogram format.

Gigabit Setup

To set up the line parameters:

1. Connect to the SmartBits 6000x chassis.
2. Reserve the modules to be configured. Click anywhere on the card/module image except the **Start** button, and choose **Reserve This Module**.



3. Click the port button for port 3B-01 to open the card menu.

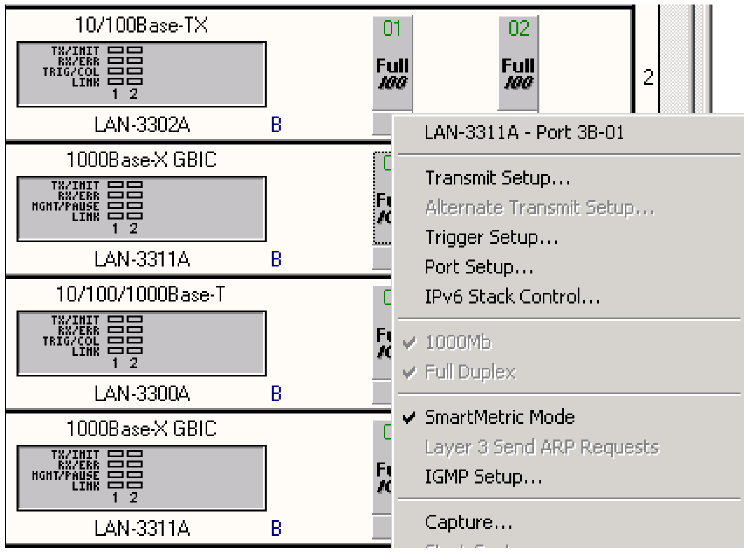


Figure 8-33. LAN-3311A Port Menu

4 Choose **Port Setup**. (*Figure 8-34* contains an illustration of the *Port Setup* window that includes tabs for general gigabit setup, IPv4 stack configuration, and autonegotiation.)

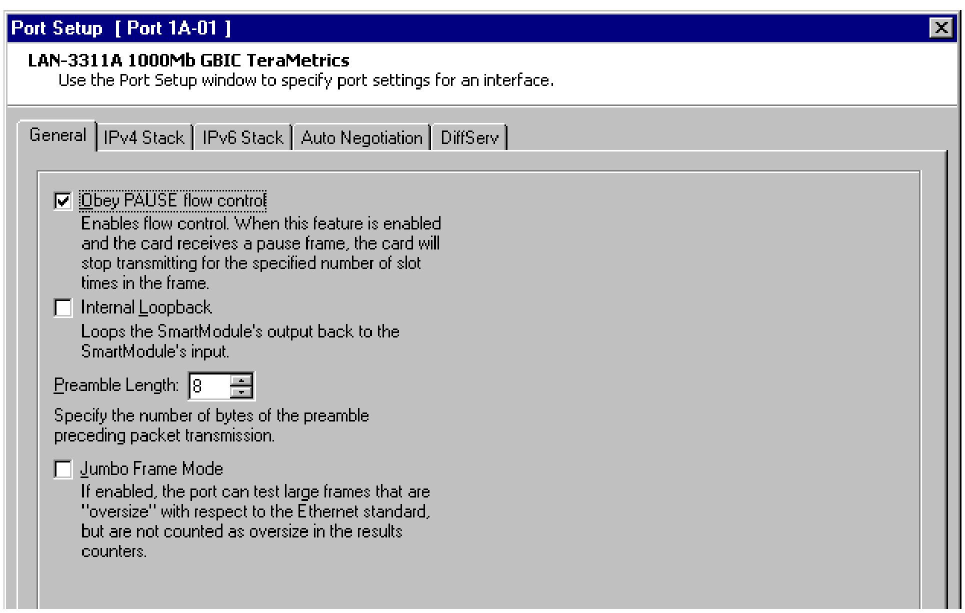


Figure 8-34. Port Setup Window

5 Set the parameters on the **General** tab to match those set at the DUT.

6 Select the **Auto Negotiation** tab, and set these parameteres to match those set at the DUT as well.

Layer 3 Setup

The *IPv4* and *IPv6* tabs on the *Port Setup* window configure the local IP stack. Use these tabs for the following purposes:

- To set the gateway IP address of the router port (DUT). (This is required for Layer 3 switches.)
- To change MAC and IP addresses so that they do not duplicate stream addresses.
- To set the netmask for management frames. (Optional; this operation is ignored by streams.)
- To specify a ping IP address for pings and SNMP frames, if needed (optional), as well as the frequency of ping, SNMP, or RIP packets (optional).
- To enable virtual flow cyclic ARPs. (See *"Virtual Flow Cyclic ARPs and ARP Requests" on page 186* in *Chapter 5, "Advanced Operational Theory"* for further information.)
- To enable gratuitous ARP mode. (See *"Gratuitous ARP Mode" on page 196* in *Chapter 5, "Advanced Operational Theory"* for further information.)

The following procedure uses the *IPv6* tab to set Layer 3 addresses and options. (Refer to *Figure 8-35* as a guide to setting the IP addresses for the DUT and LAN-3311A ports.)

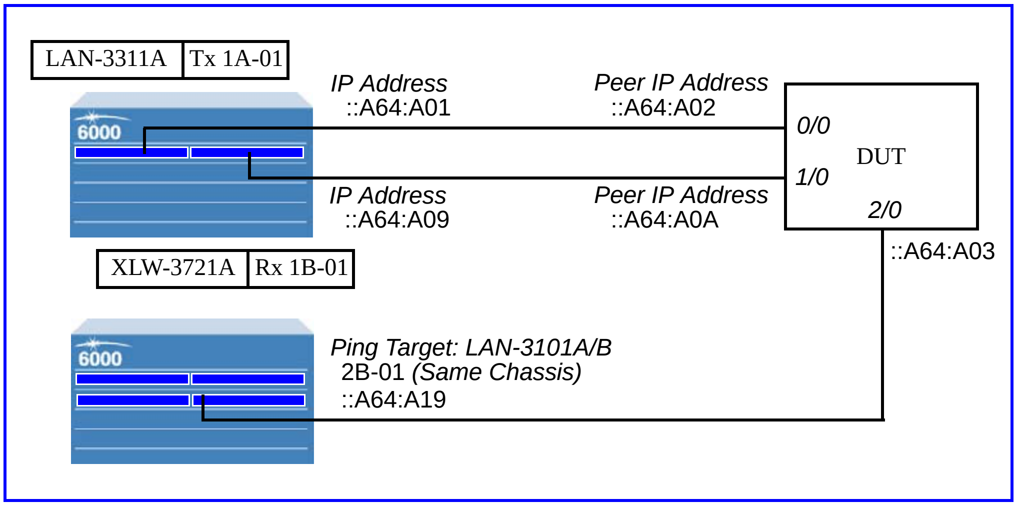


Figure 8-35. "Card Topology" IP Address Configuration

Set the IPv6 Addresses

To set the IP addresses:

1 Select the **IPv6 Stack** tab, and then select the **Address** tab. (See *Figure 8-36*.)

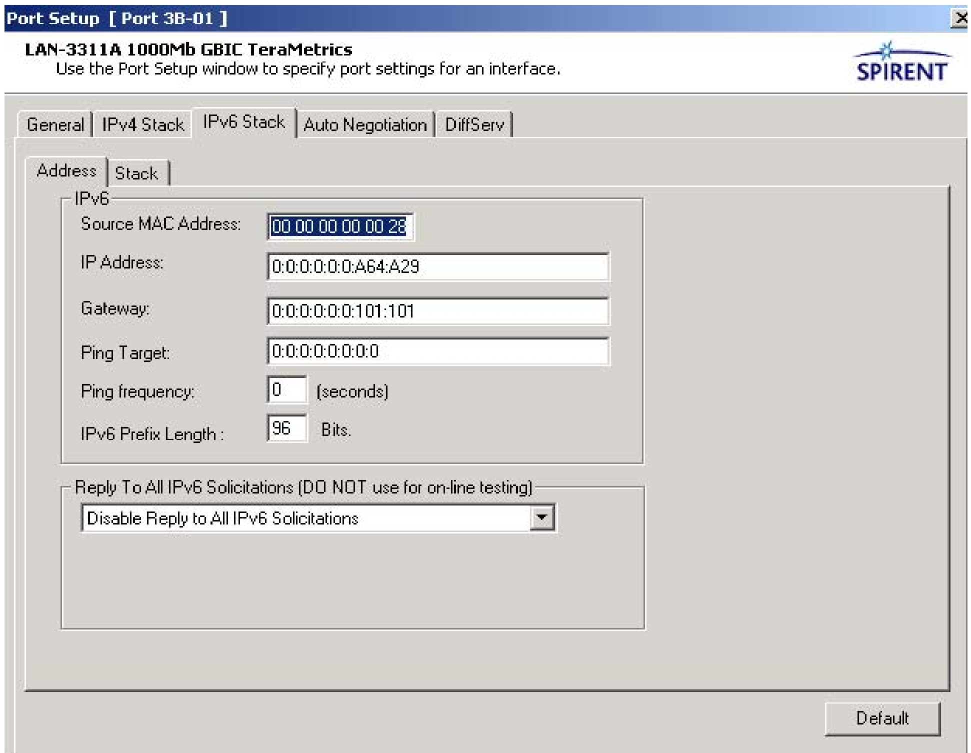


Figure 8-36. LAN-3311A Port Setup Window

2 Refer to *Figure 8-35 on page 377* for the IP address information for port 3B-01 in this example. You may need to add a gateway IP address, depending on the test configuration.

3 Click **OK** to close the window.

Configure Streams on the Transmitting Card

Configure up to 512 IPv6 or IPv4 streams on an LAN-3311A port. In general, however, only enough streams are set up to meet the requirements of the test. (See *Table 5-13 on page 170* for a listing of the maximum number of streams allowable for each type of module.)

Refer to *"Configuring Transmit Streams on TeraMetrics Modules" on page 392* for a description of how to complete this configuration process.

Set up the DUT

Refer to *“Configuring the DUT” on page 413* for a description of how to set up the DUT.

Send Traffic and View Counters

Now you are ready to transmit traffic and view counters. Proceed to *“Running SmartCounters” on page 435* for steps.

Test Using the LAN-3201B/C SmartMetrics Module

Refer to *"Testing Gigabit Routers with SmartMetrics" on page 316* for an overview of test setup and methodology.

This section covers the following topics:

- *"About the LAN-3201B/C SmartMetrics Module" on page 380*
- *"Gigabit Setup" on page 382*
- *"Layer 3 Setup" on page 383*
- *"Configure Streams on the Transmitting Card" on page 384*
- *"Set up the DUT" on page 379*
- *"Send Traffic and View Counters" on page 379*.

Note: This test setup uses the LAN-3201B/C. Additional cards and modules that support this test include the following:

- WAN-3415/3420 over frame relay
- LAN-3200A/As
- ML-7710
- LAN-3101A/B as ping target.

About the LAN-3201B/C SmartMetrics Module

The LAN-3201B/C 1000Base-SX is a multilayer SmartMetrics module for the SmartBits 600x/6000x chassis. Use the module to test Layer 3 as well as Layer 2 functionality and performance in Gigabit Ethernet routers. The module is designed to evaluate key performance parameters under typical or extreme traffic load conditions.

The LAN-3201B/C is capable of full-wire traffic generation and analysis. It features:

- A 850nm ShortWave multi-mode fiber physical interface
- 802.1p, 802.1q, and 802.3 ac VLAN tagging
- 802.3x flow control
- Optional data integrity for checking bit errors in Layer 3 forwarding devices.

The modules provide SmartMetrics results on:

- Per-flow frame loss
- Latency
- Latency and sequence
- Latency distribution tracking
- Raw tags.

Test Methodology

The type of test described in this section can determine throughput in terms of packet sequencing, latency, latency distribution, and overall capacity of a Gigabit router. The overall objective is to test the Quality of Service (QOS) capabilities of the router.

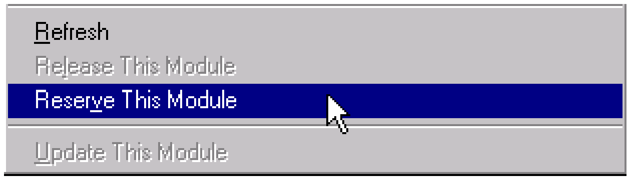
Table 8-14. Gigabit Test Methodology for SmartMetrics Results (LAN-3201B/C)

Step	Objective	Description
1	Gigabit setup	Configure the Gigabit Ethernet ports in the SmartBits, setting values for Ethernet line and Layer 3 parameters.
2	Configure streams	Set up five test streams. Each stream presents a different QOS level and is capable of cycling 64,000 IP addresses.
3	Configure DUT	Configure the IP parameters at the DUT to match those of the Gigabit Ethernet ports.
4	Run tests	Run the Sequence and Latency test.
5	View results	Using MS Excel, view the results in histogram format.

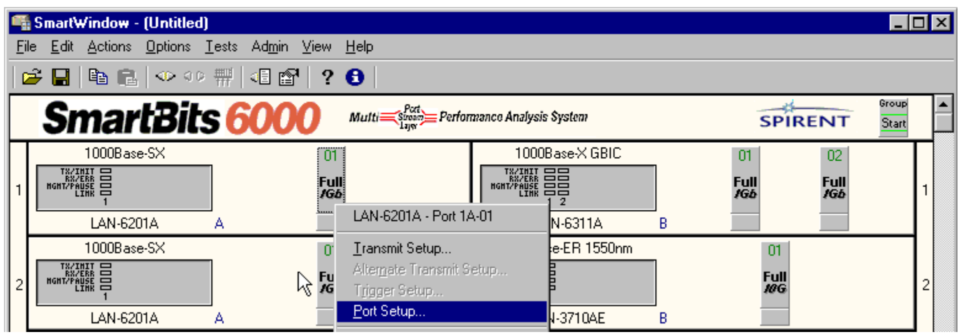
Gigabit Setup

To set up the line parameters:

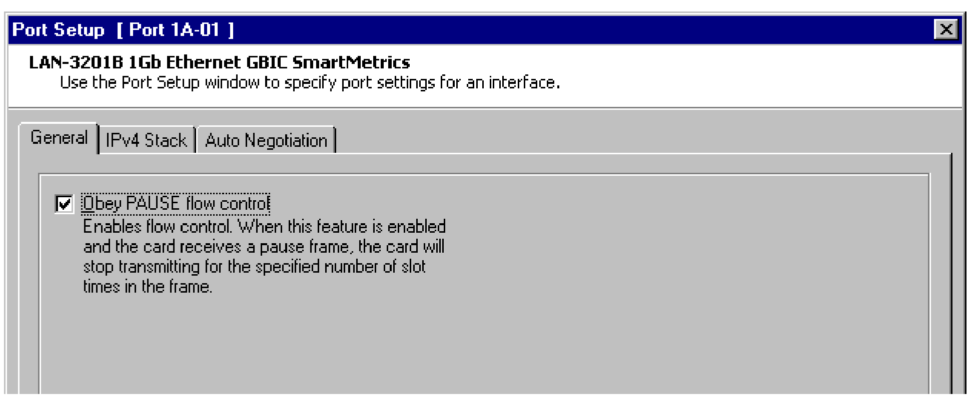
1. Connect to the SmartBits 6000x chassis.
2. Reserve the modules to be configured. Click anywhere on the card/module image except the **Start** button, and choose **Reserve This Module**.



3. Click the port button for port 1A-01 to open the card menu.



4. Choose **Port Setup**.
   The *Port Setup* window includes tabs for general gigabit setup, IPv4 stack configuration, and autonegotiation.



5. Set the parameters on the **General** tab to match those set at the DUT.
6. Select the **Auto Negotiation** tab, and set these parameters to match those set at the DUT as well.

Layer 3 Setup

In the following procedure, use *Figure 8-37* as a guide to setting the IP addresses for the DUT and LAN-3201B/C.

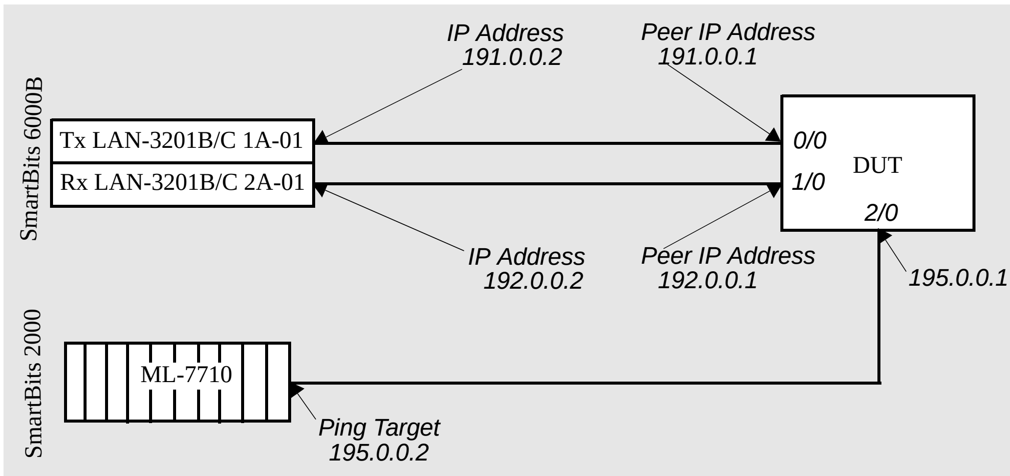
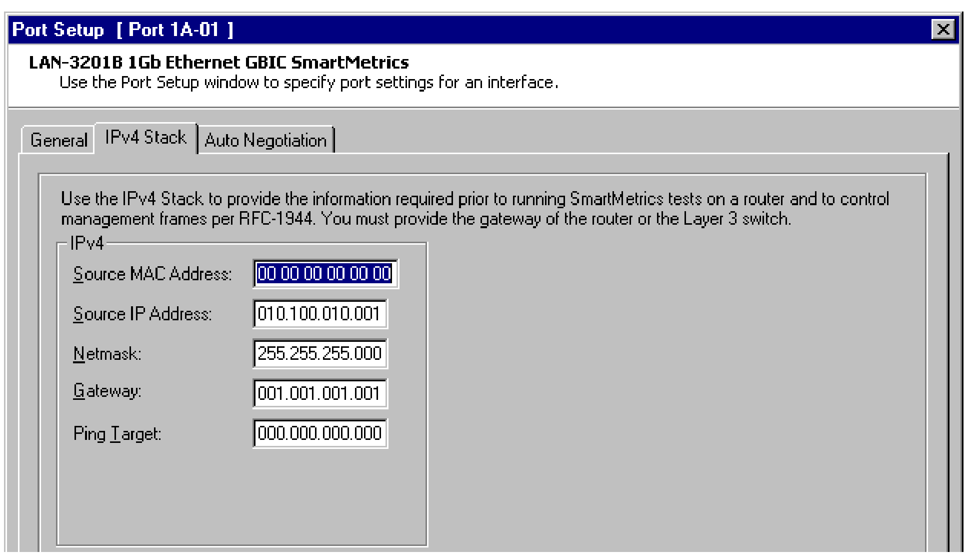


Figure 8-37. "Card Topology" IP Address Configuration

To set the IP addresses:

1. Click the port button for port 1A-01, and verify that the **SmartMetric Mode** option is selected on the card menu.
2. Click the port button again, and choose **Port Setup**.
3. Select the **IPv4 Stack** tab.

   Figure 8-37 shows the IP addresses that should appear in these fields.
4. Ensure that these values are set, and then click **OK**.



Configure Streams on the Transmitting Card

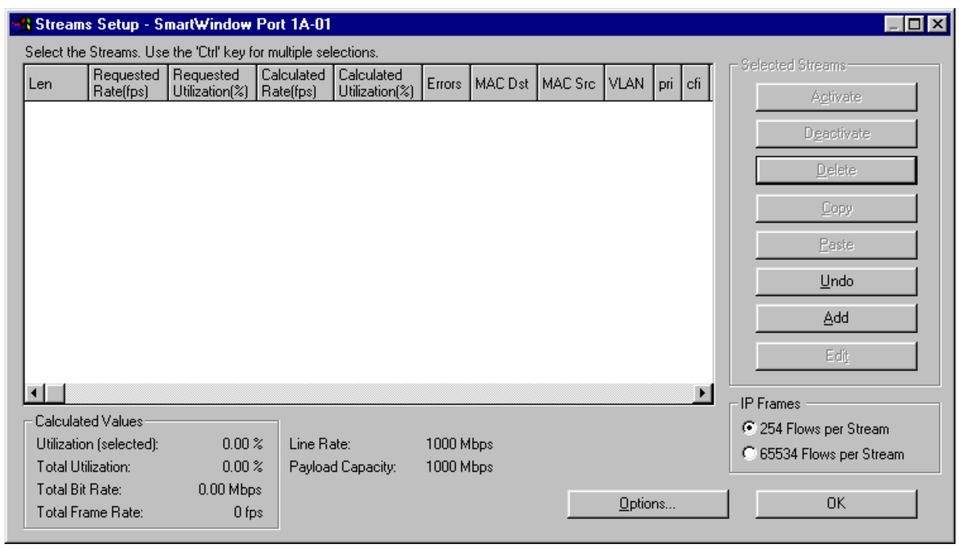
Now configure the test streams. It is possible to configure 2,000 streams, but it generally is not necessary to configure that many. When measuring the QOS capability of a router, it is better to create only enough streams to simulate each type of service.

Example: If there are five levels of service, one stream for each level can be created, for a total of five streams. Because each stream can generate 64,000 individually configurable flows—the equivalent to 320,000 flows per port—the LAN-3201B/C card creates a test case that is more manageable and useful than creating many hard to manage streams.

To set up streams:

Set up streams on the Tx card.

1 From the main menu, click the card to be configured.
2 Choose **Transmit Setup**.
The following window appears.



As streams are created, SmartWindow calculates the individual and total frame rates for the specified card. (See *Table 8-15, "SmartMetrics Gigabit Frame Rates Defined," on page 385.*)

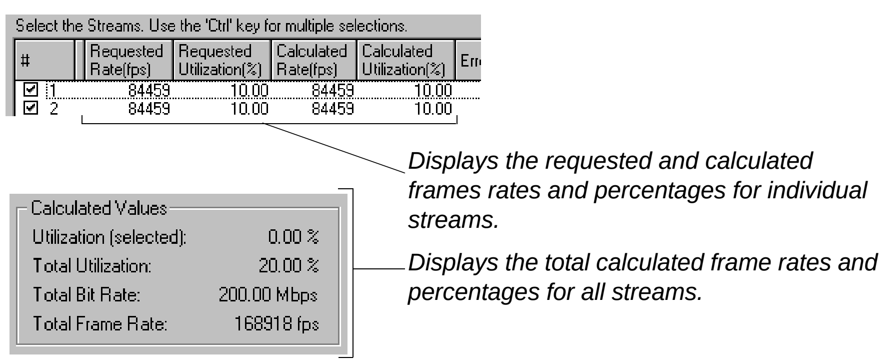


Table 8-15. SmartMetrics Gigabit Frame Rates Defined

Rate	Definition
Requested	The rate (in frames per second) that factors into its calculation the percent of bandwidth for a given transmission speed, frame length (without FCS), length of the CRC, and minimum interframe gap.
Calculated[1]	The rate that factors the actual clock rate into the requested rate, as described.
Actual[2]	The true overall rate at which frames were transmitted.

1 For more detail, see *"Algorithm for Calculated Rate (LAN-3201B/C Module)" on page 685*.
2 This value cannot be computed until frames are received.

3 Click the **Add** button.
The following dialog box appears.

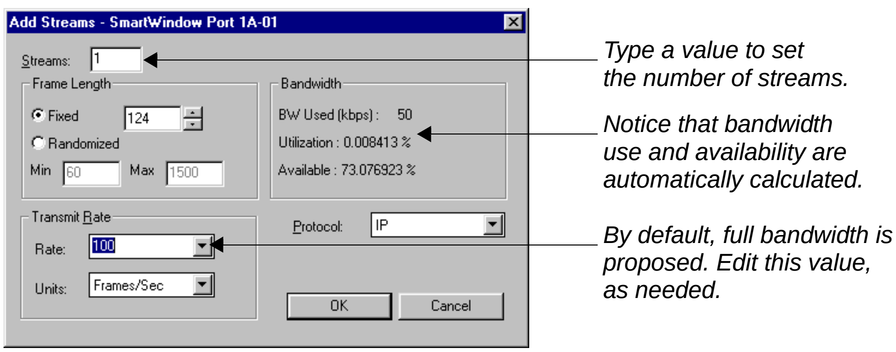
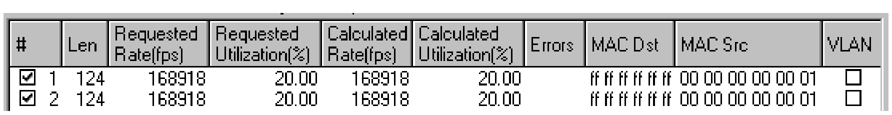


Figure 8-38. Configuring Streams

4 Enter **5** in the **Streams** field.
5 Edit the other fields according to *Figure 8-37 on page 383*.
6 Click **OK** to save field values. The *Streams Setup* window reappears.



#	Len	Requested Rate(fps)	Requested Utilization(%)	Calculated Rate(fps)	Calculated Utilization(%)	Errors	MAC Dst	MAC Src	VLAN
☑ 1	124	168918	20.00	168918	20.00		ff ff ff ff ff ff	00 00 00 00 00 01	☐
☑ 2	124	168918	20.00	168918	20.00		ff ff ff ff ff ff	00 00 00 00 00 01	☐

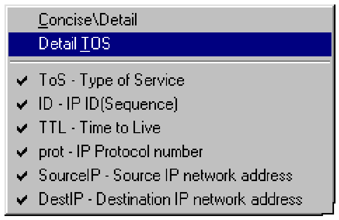
7 Double-click the first stream. The *Transmit Setup* dialog box appears.

Use the Protocol Editor to edit the frame.

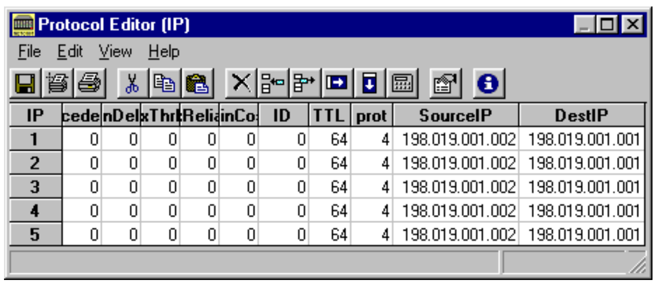
8 Click **Edit** in the **Protocol** field.

The Protocol Editor appears and displays IP header information.

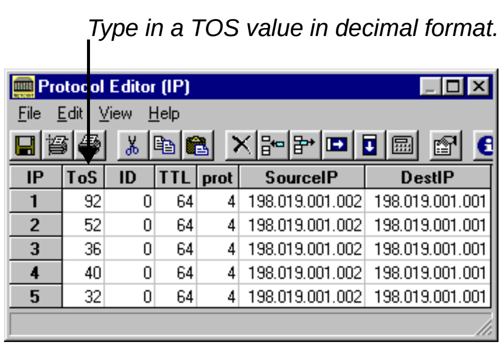
9 Choose **View** > **Detail TOS.**



10 Choose **View** > **Invert Table**.



This action clears the *Detail TOS* field and opens the following view.



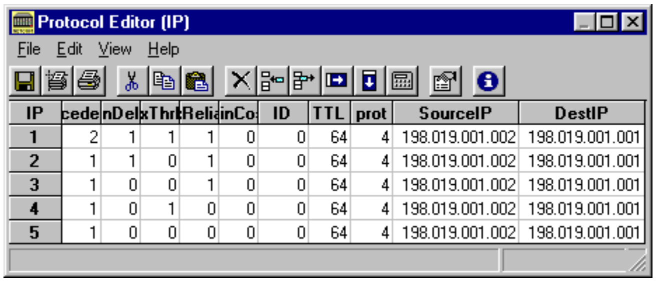
11 Enter a TOS value for stream #1. For this example, enter `92` in the first row of the TOS column. (This is the decimal value for immediate, low delay, high throughput, and high reliability.)

12 Using 52, 36, 40, and 32, respectively, repeat *Step 11* for streams #2 through 5.

By entering these values, you are configuring the five streams that were created with different levels of service. After running a test with these streams, the test results can be loaded into a histogram and viewed in graphic form.

13 Choose **View** > **Detail TOS**.

The following view separates the TOS detail into individual fields.



14 Click the **Close** button and save, when prompted.

The *Stream Setup* window appears and displays the parameters of the streams that were created.

Edit the IP addresses. (Refer to Figure 8-39 for guidance on the addressing scheme.)

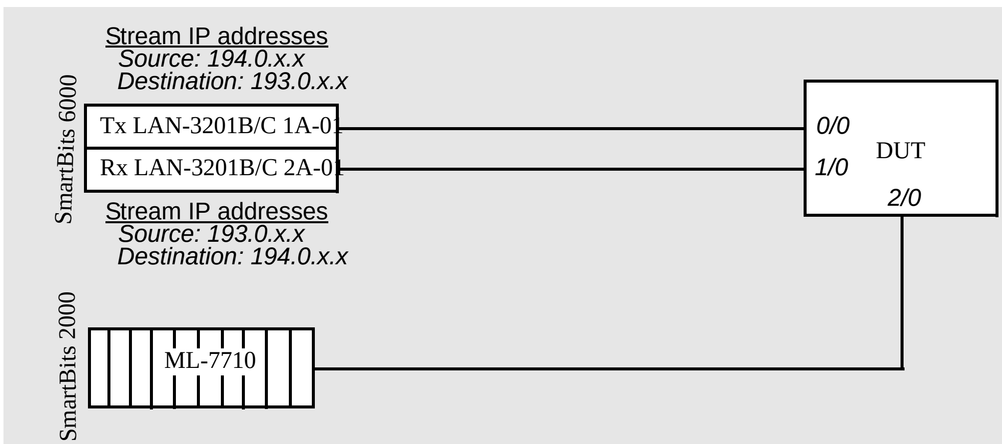
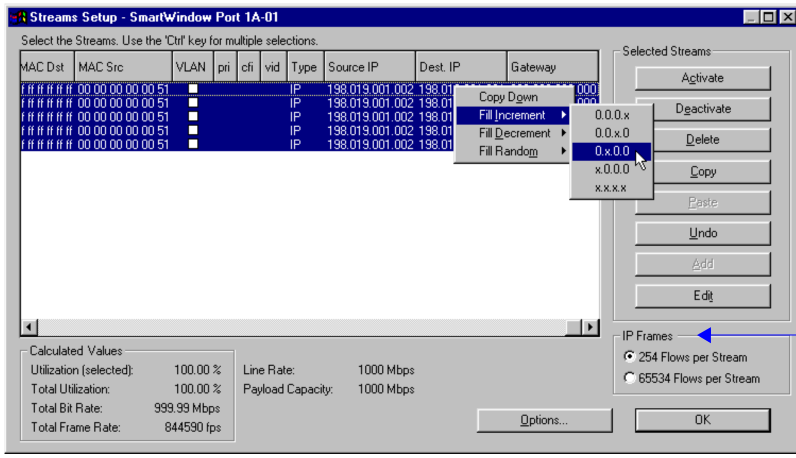
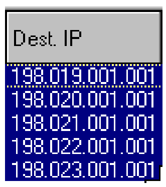


Figure 8-39. Gigabit “Stream” IP Address Configuration

15 Highlight the streams to be edited, then right-click the field to edit within the highlighted area. For example, to increment the destination IP address, choose the **Copy/ Fill** selections from the menu.



For each stream, the selected byte of destination IP address is incremented as follows:



Set up Flows for Each Stream

Each stream cycles through 254 or 65,534 flows, depending on the choice in *IP Flows* field. Consequently, you must create IP addresses for each stream and these IP addresses must be different from the IP addresses of the card or the DUT. Once IP addresses are created, customize each flow, incrementing the IP addresses as described below.

Note: For greater editing precision, highlight a single stream and click **Edit** to invoke the *Transmit Setup* dialog box, then click **Edit** again to invoke the Protocol Editor.

To customize the flows:

1 Click the first stream, and select **Edit**.

The *Transmit Setup* dialog box appears (*Figure 8-40 on page 389*). Customize the flows for each stream by using the options in the *Enable IP Flows* pane.

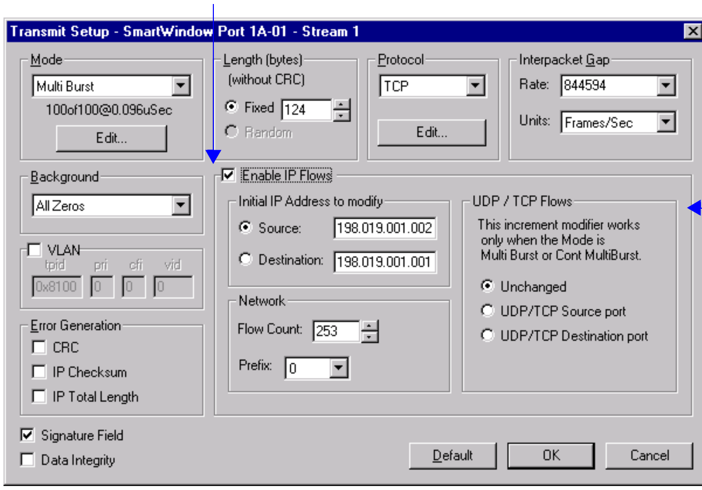


Figure 8-40. Setting Up IP Flows

2 With IP streams, flow generation can be based on IP source or destination address. Select one of the radio buttons, and set the starting address to increment.

If source or destination IP address is selected, each transmitted frame increments the selected IP address by 1, skipping 0 and 255 (starting with the IP address set in the Protocol Editor). When all 65,534 addresses have been cycled through, the cycling process starts again with the IP address set in the Protocol Editor.

3 With UDP or TCP streams, flow generation can be based on the IP addresses, as well as on source or destination port number. Select one of the radio buttons. The options in the *UDP/TCP Flows* pane are active only when the transmit mode (*Mode* option) is set to **Multi Burst** or **Cont MultiBurst**.

4 In the *Network* pane, enter a value (i.e., the number of flows to cycle through) in the *Flow Count* field.

5 Enter a **Prefix** field value to specify the length of the network prefix (network bytes) in the IP address. For example, a value of **8** sets a network prefix length of eight bits, with 24 bits of host address.

6 Ensure that the *Signature Field* checkbox is selected. (This selection is required for SmartMetrics results.)

Note: See *Table 8-16 on page 390* for an explanation of the *Data Integrity Protection* and *Data Integrity Error* checkboxes.

Table 8-16. Data Integrity Protection and Error Checkboxes

Checkbox	Definition
Data Integrity Protection	Selected (enabled) by default. This option causes the transmitting port to insert a data integrity marker (hex value) into each frame. The receiving port examines the marker in received frames to ensure that data has been transmitted and received without corruption. Both SmartMetrics Sequence and Latency test plus capture can detect and record a data integrity error event.
Data Integrity Error	Selecting the *Data Integrity Error* checkbox generates an error in the payload. The purpose of this option is to demonstrate that the card is capable of catching data integrity errors.

7 When finished, click **OK**.

8 Click the **Update** button on the SmartWindow toolbar to copy the configuration to the card.

Configure a Card to Receive

The line interface and IP addresses on the receiving card must be configured. Streams do not need to be created unless two-way transmission and reception are required.

To configure a card to receive:

1 Repeat the procedure in *"Gigabit Setup" on page 382*.

2 Use the information in *Figure 8-37 on page 383* to set the card IP addresses.

Set up the DUT

Refer to *"Configuring the DUT" on page 413* for a description of how to set up the DUT.

Send Traffic and View Counters

Now you are ready to transmit traffic and view counters. Proceed to *"Configuring SmartCounters" on page 415* and *"Running SmartCounters" on page 435* for steps.

Configuring Transmit Streams on TeraMetrics Modules

The TeraMetrics modules have a unique set of windows and menus that provide templates to easily configure streams that use IPv4, IPv6, and other protocols. These configuration techniques are identical for all TeraMetrics modules; however, there may be subtle differences in the layout of the screens. The following example uses a XLW-3731A.

Each stream can generate a large number of individual flows. A test setup with the minimum number of streams and ample flow generation can be more manageable and useful than one involving many streams.

The number of available streams depends on the stream header length. IPv6 streams require a header length of 128 bytes (without FCS). This global setting for the port results in a total stream count of 512, even if IPv4 streams are also configured on the same port. (See *"Set the Stream Header Length"*.)

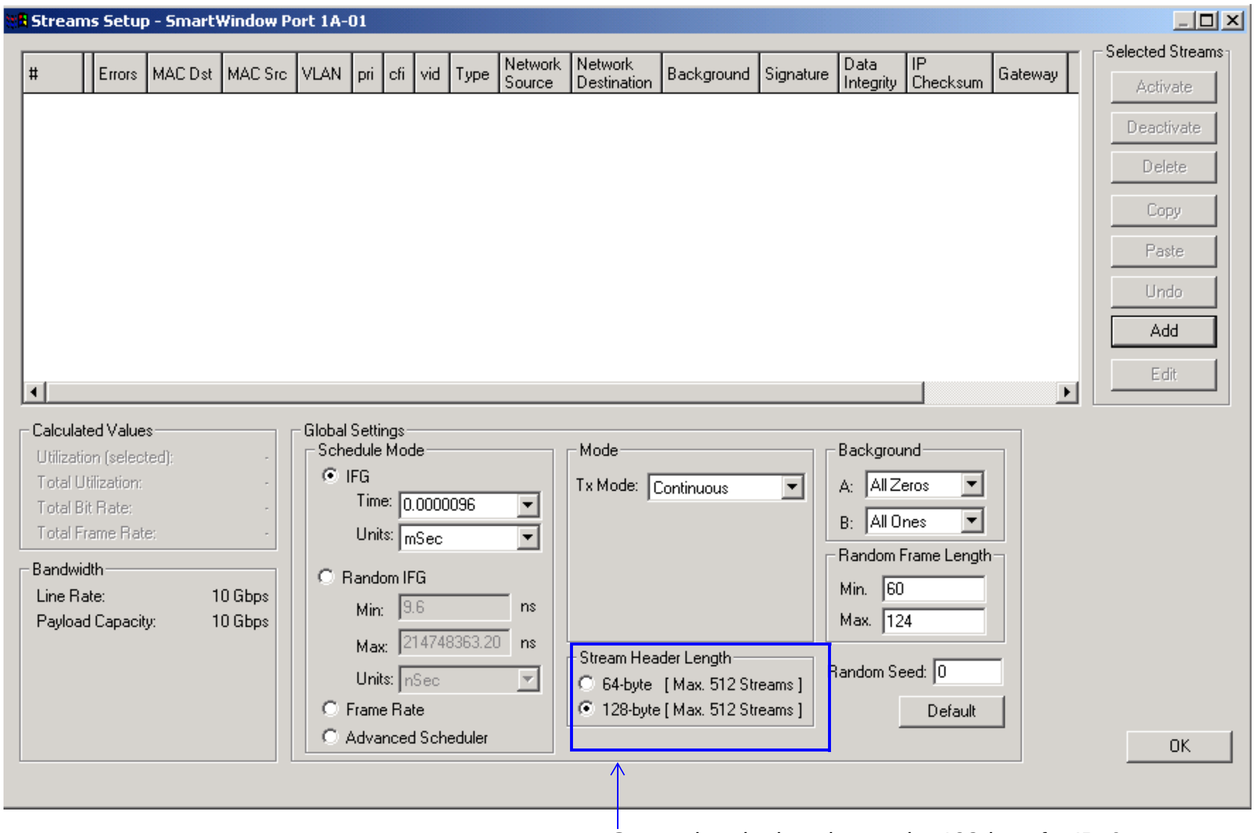
Note: The sample test bed configurations used in this section are designed to explain specific network design principles. These configurations are not necessarily intended to be used in your test beds because of the unique characteristics of each test configuration. Instead, they provide reference points for understanding the different types of stream configurations.

Set the Stream Header Length

To set the length:

1. Click the port button on the card image, and choose **Transmit Setup**.
   The *Streams Setup* window opens. (See *Figure 8-41 on page 393*.)
2. In the *Stream Header Length* pane, click the **128-byte [Max 512 Streams]** (without FCS) button.
   Now define the schedule mode for the port, using the guidelines starting with *"Defining the Schedule Mode" on page 393*.

Note: The LAN-3311A TeraMetrics module does not contain the advanced scheduler mode.



Stream header length must be 128-byte for IPv6 streams.

Figure 8-41. Setting the Stream Header Length (without FCS)

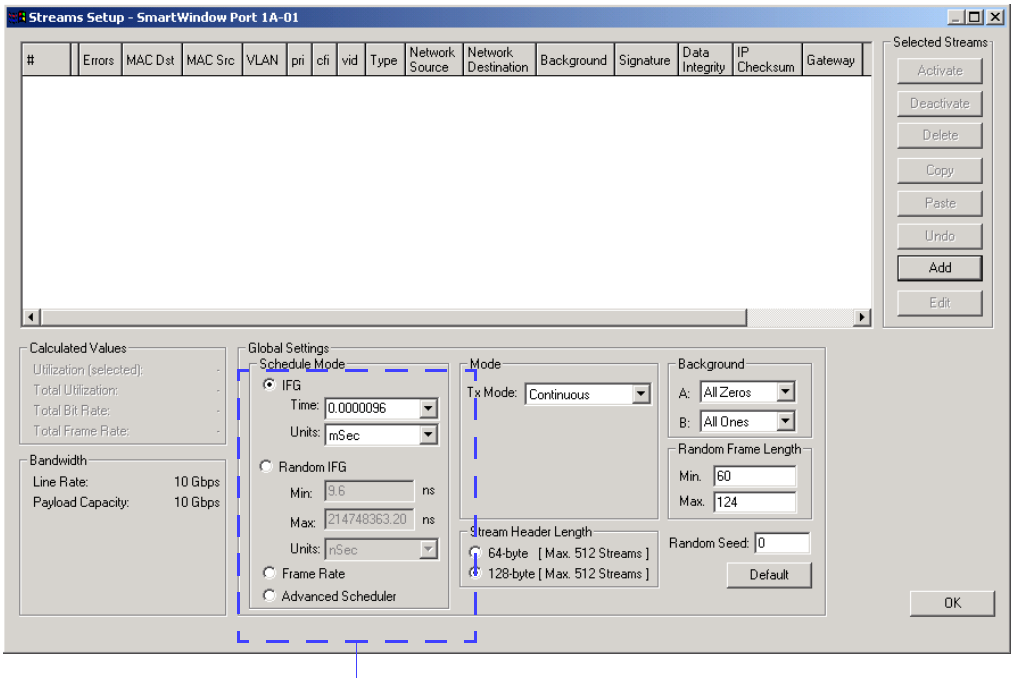
Defining the Schedule Mode

The *Streams Setup* window provides options for defining how the card schedules the streams that it transmits. Define the schedule mode before the streams are added, since this setting applies to the port overall.

In the *Global Settings* pane of *Streams Setup* window (*Figure 8-42 on page 394*), the *Schedule Mode* fields provide four options for scheduling:

- *IFG* — Interframe Gap: a fixed number of bit times between frames.
- *Random IFG* — A varying number of bit times between frames.
- *Frame Rate* — A defined frames-per-second rate of transmission for each stream.
- *Advanced Schedule*r— A scheduling of frames (using frame rate) based on a balanced mix that results in a smoother distribution of traffic between flows. This capability requires the latest firmware and is supported on LAN-3306A, LAN-332xA, POS-3504As/AR, POS-3505As/As, POS-3510A/As, POS-3511A/As, POS-3518As/As, POS-3519As/As, XLW-372xA, XFP-373xA, and FBC-360xA modules.

The selected scheduling mode applies to all streams for the port. However, when frame rate or advanced scheduler is selected as the mode, a different rate can be specified for each stream. (With traffic based on fixed interframe gap, the specified gap applies to all streams.) Once the mode is specified, use the *Add* button to open the *Add Streams* window, which enables you to create one or multiple streams.



These options set the schedule mode, which applies to all streams sent through the port. The mode may be based on fixed Interframe Gap (IFG), random IFG, frame rate ,or advanced scheduler.

Figure 8-42. Schedule Mode Parameters in Streams Setup Window

Note: The advanced scheduler mode uses frame rates similar to the frame rate mode. Refer to for *"Streams Setup Window" on page 253* for an explanation of how the advanced scheduler works and what modules have this capability.

Important: Read the following sections describing the available schedule modes before selecting a mode.

To define a schedule mode:

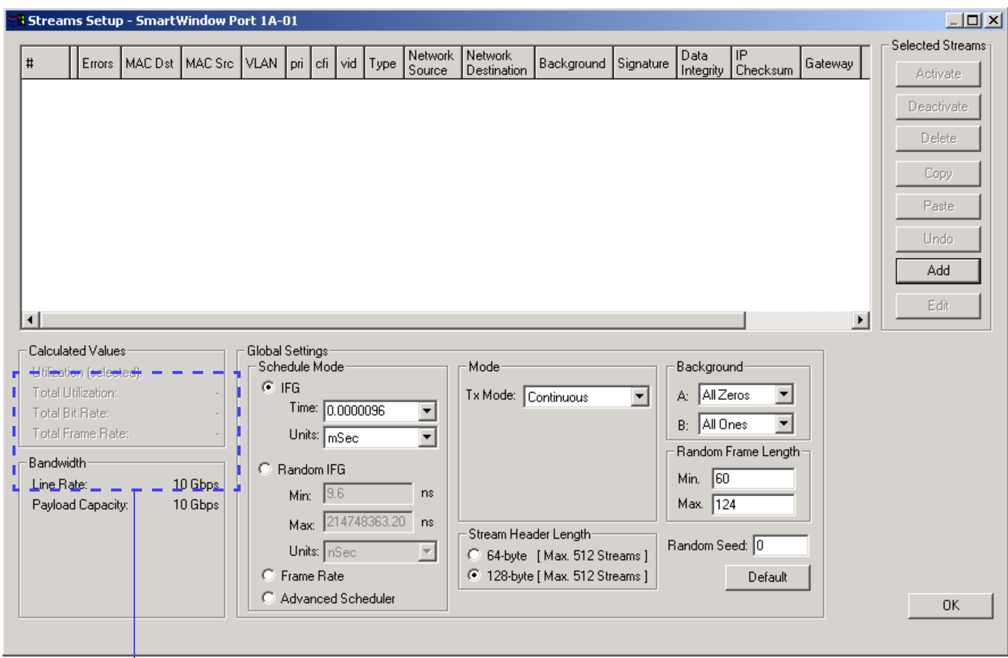
1. In the *Schedule Mode* pane, click the appropriate button.
2. If the *IFG* or *Random IFG* button is clicked, enter the appropriate field values, as required.

Scheduling by Interframe Gap

When IFG or random IFG is selected as the schedule mode, the card sends out test frames separated by the interframe gap that is specified.

The default field values for the IFG mode define the minimum legal interframe gap. (For 10Gb, this is 9.6 nanoseconds.) This value establishes full load on the transmission medium. For random IFG, the gap can vary between a specified minimum and maximum value.

When IFG or random IFG is selected as the schedule mode, the *Streams Setup* window appears as shown in *Figure 8-43*. Notice that the *Calculated Values* fields are greyed out; these fields do not apply to gap-based traffic, but only apply to rate-based traffic.



When the schedule mode is set to IFG or random IFG, these fields are greyed out since they apply only to rate-based traffic.

Figure 8-43. Schedule Mode Parameters for Gap-based Traffic

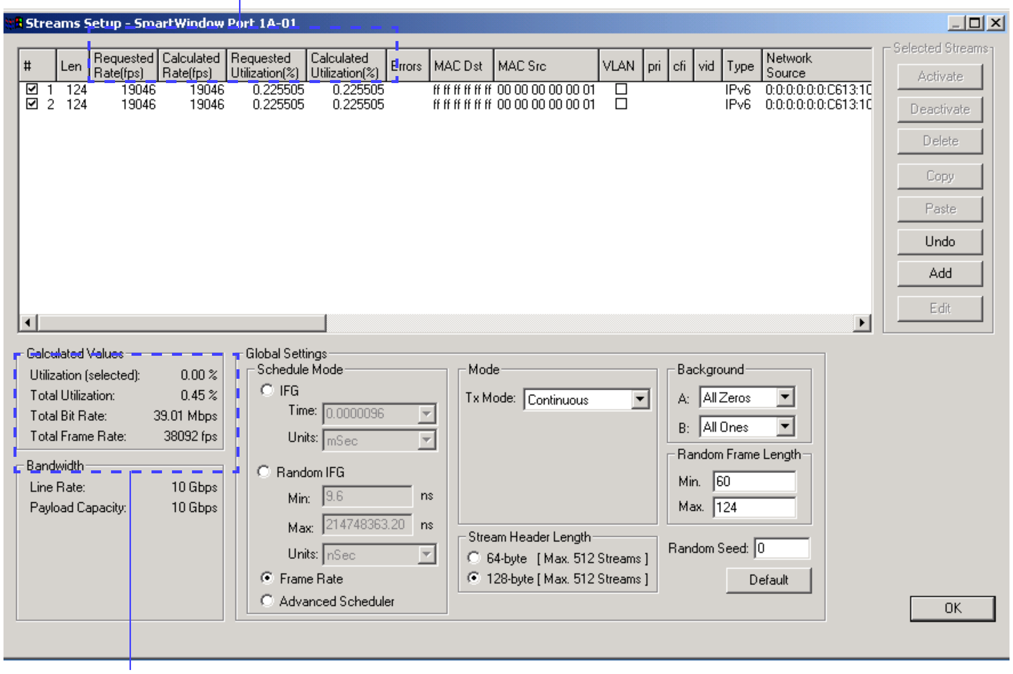
Scheduling by Frame Rate and Advanced Scheduler

When frame rate or advanced scheduler is selected as the schedule mode, the card calculates the frame rate for each stream based upon:

- Total bandwidth available
- Number of streams
- Requested rate for each stream.

Refer to *Figure 8-44 on page 396*.

These fields appear when frame rate or advanced scheduler is selected as the schedule mode and streams are added. The fields show your requested rate per stream and requested utilization, as well as the actual (calculated) frame rate and utilization that results from how the card has allocated the available bandwidth.



When Schedule Mode *is set to* Frame Rate or Advanced Scheduler, *these fields show the total calculated frame rates and percentages for all streams that have been added. As streams are created, SmartWindow calculates the individual and total frame rates for the card, as well as interframe gaps. (See* *Table 8-17 on page 398.**)*

Figure 8-44. Schedule Mode Parameters for Rate-based Traffic

Specify the frame rate in the *Add Streams* window. One stream or multiple streams can be created at a time. In addition, each stream can be assigned a unique frame rate. As streams are added, the card automatically calculates the stream order. It also inserts the needed interframe gap between streams.

In the streams list, the *Calculated Rate* and *Calculated Utilization* fields adjust as streams are added or the settings for any stream are modified. Similarly, the *Calculated Values* pane at the bottom of the window adjusts to reflect the settings. *Figure 8-45* presents an example. Here, three rate-based streams have been added, and each has been allocated about 33% of the total available bandwidth.

In this example, three streams have been added, each with a requested rate of 2802616 frames per second. The calculated utilization changes to accommodate the first two streams.

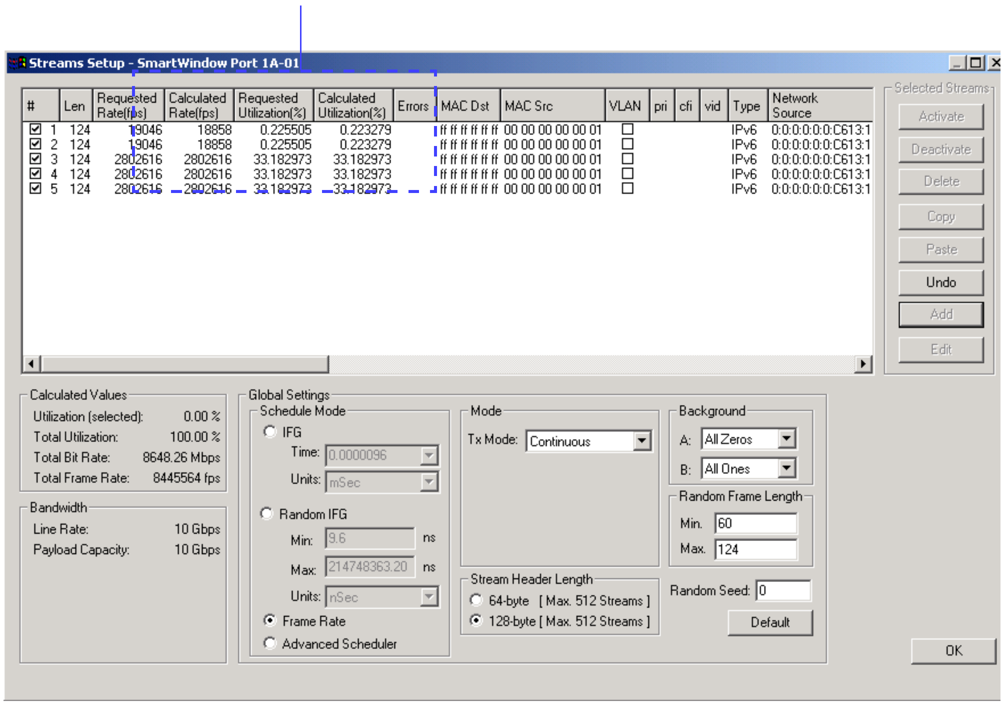


Figure 8-45. Bandwidth Allocation with Frame-based Test Traffic

The algorithm used in rate-based scheduling is designed to provide the greatest accuracy to higher frame rates as opposed to lower frame rates. It meets the requested frame rate most closely for streams that have a high data rate. This means that the actual frame rate for a relatively slow stream may appear disproportionately “skewed” from the requested rate, if other streams with high rates have been added.

Table 8-17 on page 398 describes the values shown in the *Calculated Values* pane.

Table 8-17. Frame Rates Calculations

Rate	Definition
Utilization (selected)	Total calculated bandwidth of all selected (highlighted) streams.
Total Utilization	Total calculated bandwidth of all streams.
Total Bit Rate	Total calculated capacity used by the aggregate of streams.
Total Frame Rate	Multiple of the number of frames times the total frames per second (fps) of each individual stream.

Add New Streams

There are two ways to add streams: use the *Add* button or use the *Copy* and *Paste* buttons in the *Selected Streams* pane on the *Streams Setup* window.

To use the Add button:

1. Click the **Frame Rate** button in the *Schedule Mode* pane and the **128-byte [Max. 512 Streams]** button in the *Stream Header Length* pane.

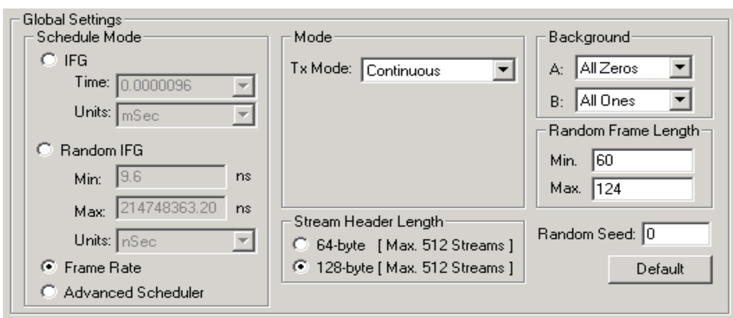


Figure 8-46. Global Settings and Stream Header Length

2. Click the **Add** button in the *Selected Streams* pane. (See *Figure 8-45 on page 397*.)

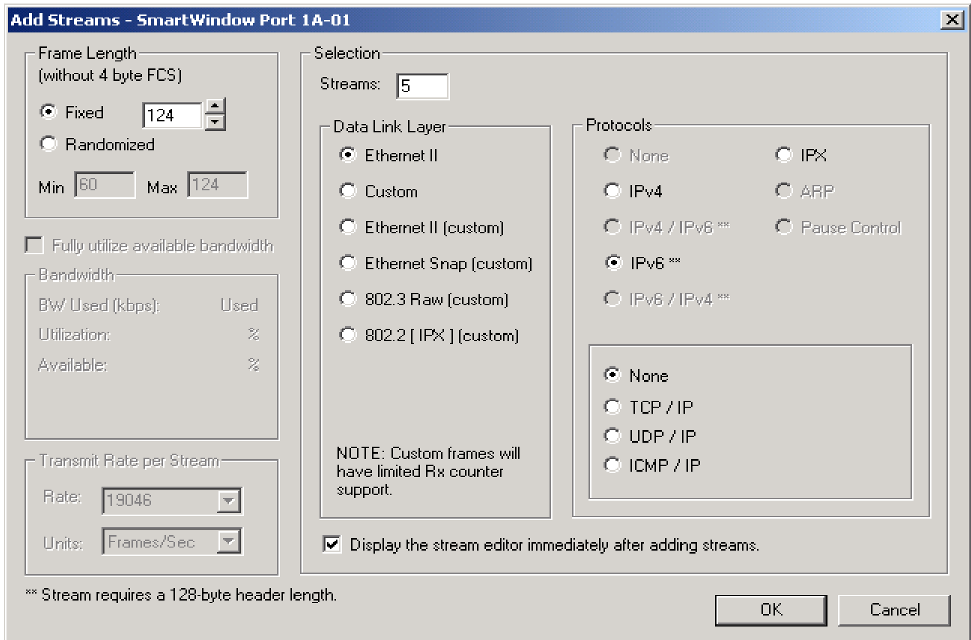


Figure 8-47. Add Streams

3 In the *Protocols* pane, click the **IPv6** button.

4 Click the **Ethernet II** button in the *Data Link Layer* pane.

5 Click **OK**. The *Transmit Setup* window displays.

6 Click the **OK** button at the bottom of the window. The *Streams Setup* window redisplays showing five IPv6 streams.

To use Copy and Paste buttons:

1 On the *Streams Setup* window, highlight the stream that is being copied.

2 Click the **Copy** button and then position the cursor over the area in which to paste the stream.

3 Click the **Paste** button. The *Paste Streams* window appears. (See *Figure 8-48*.)

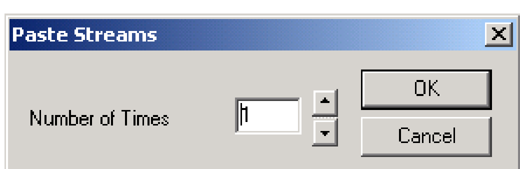


Figure 8-48. Paste Streams window

4 Scroll the field count to **5** (streams), and click **OK**.
The copied stream is inserted five times.

Note: There is a third method for adding streams that uses a pop-up menu. This method is described in *"Configure Stream Addresses"* and allows you to change the stream addresses.

Configure Streams

There are several methods used to modify and configure streams. Each method is dependent upon the type of stream protocol. Also, each method uses a different configuration tool, such as an editor or a template. *Table 8-18* lists the three methods used to configure streams.

Table 8-18. Ways to Configure Streams

Location (Window)	Protocol	Description
Streams Setup	Any	Applies to streams located (added) to the *Streams Setup* window. By using the *Copy Down* function, stream addresses can be sequenced, decremented, and changed in other ways.
Add Streams	Any	Applies to specific protocols supported by the module. Templates are used to quickly define and configure the data link layer and upper layers.of the stream.
Add Streams	Custom	Applies to any protocol supported by the module. Provides the full flexibility to edit the data link layer of the stream through the use of a Frame Editor.

Configure Stream Addresses

There are four ways to configure the addresses of streams. (See *Table 8-19*.)

Table 8-19. Configuring Stream Addresses

Method	Chapter	Location
Copy down and fill increment	*Chapter 8, "Testing Gigabit Routers"*	*"Configure Stream Addresses"* (in this section)

Table 8-19. Configuring Stream Addresses (continued)

Method	Chapter	Location
Streams setup	*Chapter 7, "SmartMetrics Testing"*	*"Access the Streams Setup window." on page 260.*
Add streams	*Chapter 7, "SmartMetrics Testing"*	*"Access the Add Streams window." on page 260.*
User preferences	*Chapter 7, "SmartMetrics Testing"*	*"Access the Add Streams window, and confirm the IPv4 and MAC addresses." on page 262.*

The copy down and fill increment mode is different when configuring the MAC, IP, source, and destination addresses. The copied stream can be identically replicated, replicated with sequential addresses, replicated with the port address, and replicated with other addressing schemes. See *Table 8-20* for a synopsis of these different ways to configure stream addresses.

Table 8-20. Types of Copy Down and Fill Increment Modes

Address	Method
MAC destination	Copy down, fill increment, fill decrement, and fill random
MAC source	Copy down, fill increment (with roll next byte), fill decrement, fill random, and use port values
Network destination	Copy down, fill increment, fill decrement, and fill random
Network source	Copy down, fill increment, fill decrement, fill random, and use port values

The following example configures the network source address using the copy down and fill increment methods for an IPv6 stream.

To configure stream addresses:

1 Access the **Streams Setup** window and add six streams using the methods described in *"" on page 398*. Be sure to click the **128-byte [Max. 512 Streams]** button in the *Stream Header Length* pane to allow for IPv6 addresses.

2 Select one stream and double-click the **Network Source** field. Change the IP address.

3 Hold down the **Shift** key and move the mouse to highlight all the streams to be changed.

Note: This copy function is available for streams that use the same protocol. Therefore when selecting the streams to be configured, be sure those streams use the protocol that the primary (copied) stream is using

4. Right-click the **Network Source** field, and choose **Copy Down** from the pop-up menu.
5. The IP address is duplicated for all streams.
6. Right-click the **Network Source** field again and choose **Fill Increment > 0.0.0.0.0.0.0.0.0.0.0.x.0.0.0.0.0**. The selected byte in the IP address (**x**) is incremented with each successive stream.

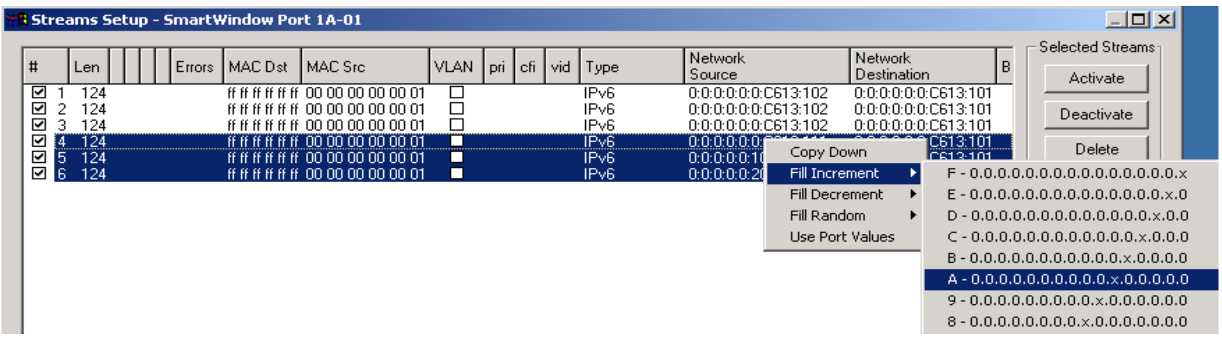


Figure 8-49. Using Copy Down and Fill Increment

Use the Add Streams Window to Configure Streams

The *Add Streams* window was briefly described and used in the paragraph *"Add New Streams" on page 398*. This window provides many additional capabilities such as changing the network and data link addresses, adding streams, configuring the data link layer, and configuring Layer 3 and Layer 4. This section gives a brief overview of how to configure Layer 2 and Layer 3.

For information on the other aspects of the *Add Streams* window, see *Chapter 7, "SmartMetrics Testing."*

The *Add Streams* window has four window panes: *Frame Length*, *Bandwidth*, *Transmit Rate per Stream*, and *Selection*. The *Selection* pane contains an additional two panes. (See *Figure 8-50 on page 403* for an illustration of the *Add Streams* window.)

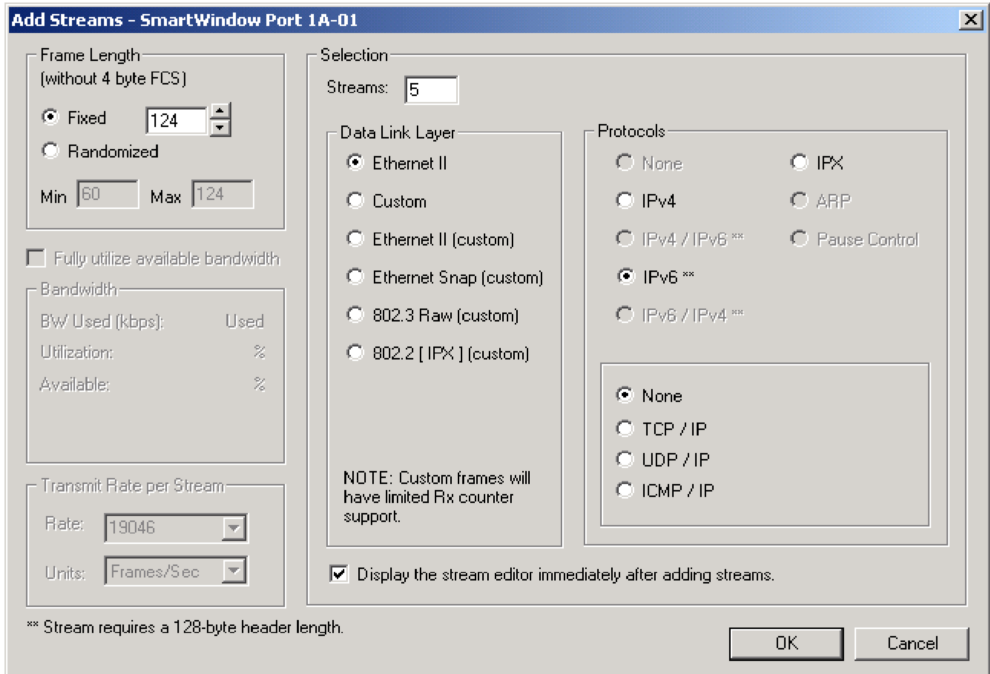


Figure 8-50. Add Streams Window

Configuring Ethernet II and IPv6

The *Data Link Layer* pane lists six types of Layer 2 protocols. Adjacent to each protocol is a radio button that is used to enable/disable the protocol.The *Protocols* panes contain eight protocols and three stacked protocols.

To configure Ethernet II and IPv6:

1. Return to the *Port* menu and select **Transmit Setup** to display the *Streams Setup* window.
2. In the *Stream Header Length* pane, click the **128-byte [Max. 512 Streams]** button.
3. Click the **IFG** button to choose that schedule mode.
4. In the *Selected Streams* pane, click the **Add** button to display the *Add Streams* window.
5. Add five streams by selecting **5** in the *Streams* field in the *Selection* pane.
6. Click the **Ethernet II** and **IPv6** buttons to enable those protocols.
7. Select the **Display the stream editor immediately after adding streams** checkbox.
8. Click **OK** to display the *Transmit Setup* window. (Refer to *Figure 8-51 on page 404*.)

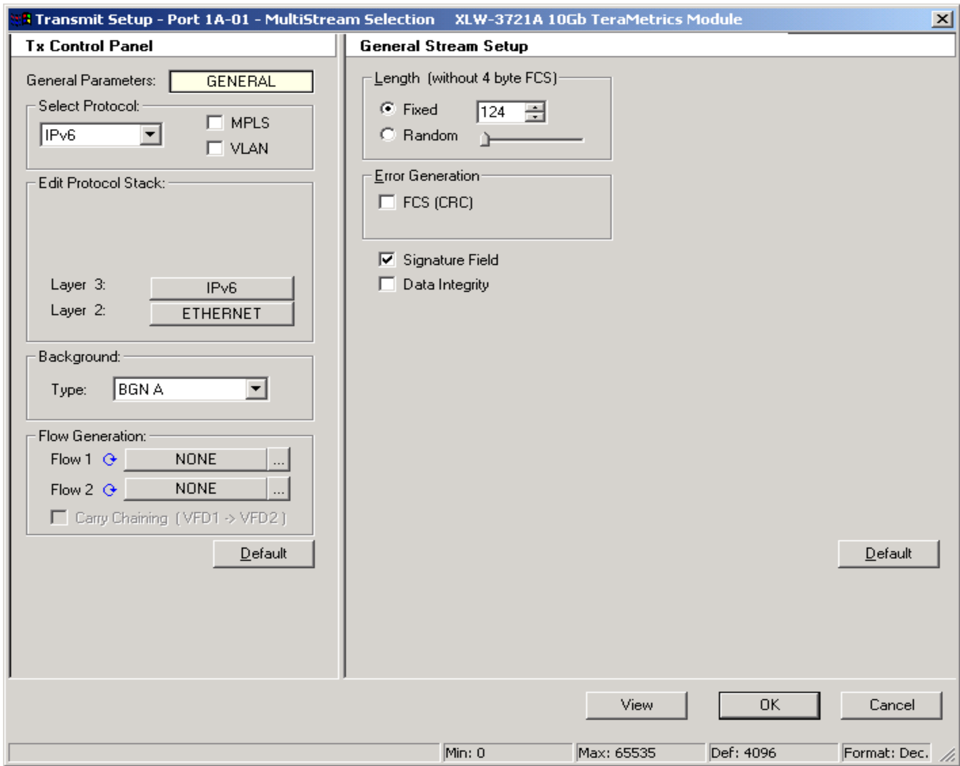


Figure 8-51. Transmit Setup window

The *Transmit Setup* window contains the *Tx Control Panel* and *General Stream Setup* panes that change according to the parameters set in the *Add Streams* window. The *Ethernet II* and *IPv6* buttons depict the two layers set in the *Add Streams* window.

Configuring Ethernet II

Ethernet II is a Layer 2 protocol that requires configuration of the source and destination addresses. However, you can also use these data link addresses for flow control. This section describes how to use the Ethernet addresses for flow control.

Configure each stream to cycle through up to 16,777,215 flows (for IPv4 or IPv6 protocol streams) or 65,535 flows (for UDP or TCP protocol streams).

For the XLW-3720/3721A modules, flow generation can be based on the two variable field data fields (VFD1 and VFD2), VLAN ID, IP address source, and IP address destination.

To configure Ethernet II:

1. Locate the *Flow Generation* pane in the *Tx Control Panel* pane.
2. Click the **...** button adjacent to the **Flow 1** button to access a pull-down menu, and select **MAC.ADDR.DEST**. (See *Figure 8-52*.) Use this programmable variable field in the test frame as the basis to generate flows.

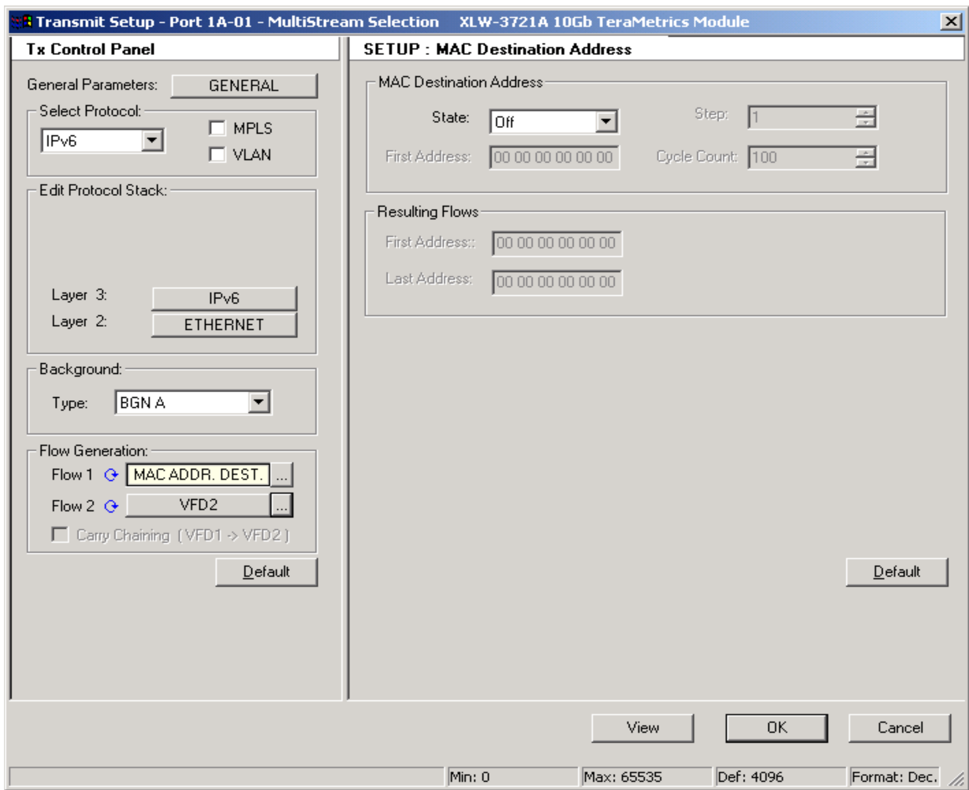


Figure 8-52. Layer 2 Flow Control

Both VFD1 and VFD2 can be up to 6 bytes long. When a VFD is enabled, the defined pattern overwrites the background data of the packet at the specified offset for the length of the VFD.

Note: In this example, only VFD1 was set. VFD2 can be set by using the same options. Its behavior is identical to that of VFD1; the only difference is that it has a different byte location in the packet.

3. In the *SETUP: MAC Destination Address* window pane, set the **State** field to **Increment**.

By selecting an incrementing or decrementing action in the *State* option, the content is changed frame by frame. The combination of *First Address* and *Cycle Count* field values makes it possible to test a source or destination address range.

4 Click the **View** button at the bottom of the *SETUP* pane. (See *Figure 8-53* for an illustration and explanation of the *Protocol Frame Data* dialog box.)

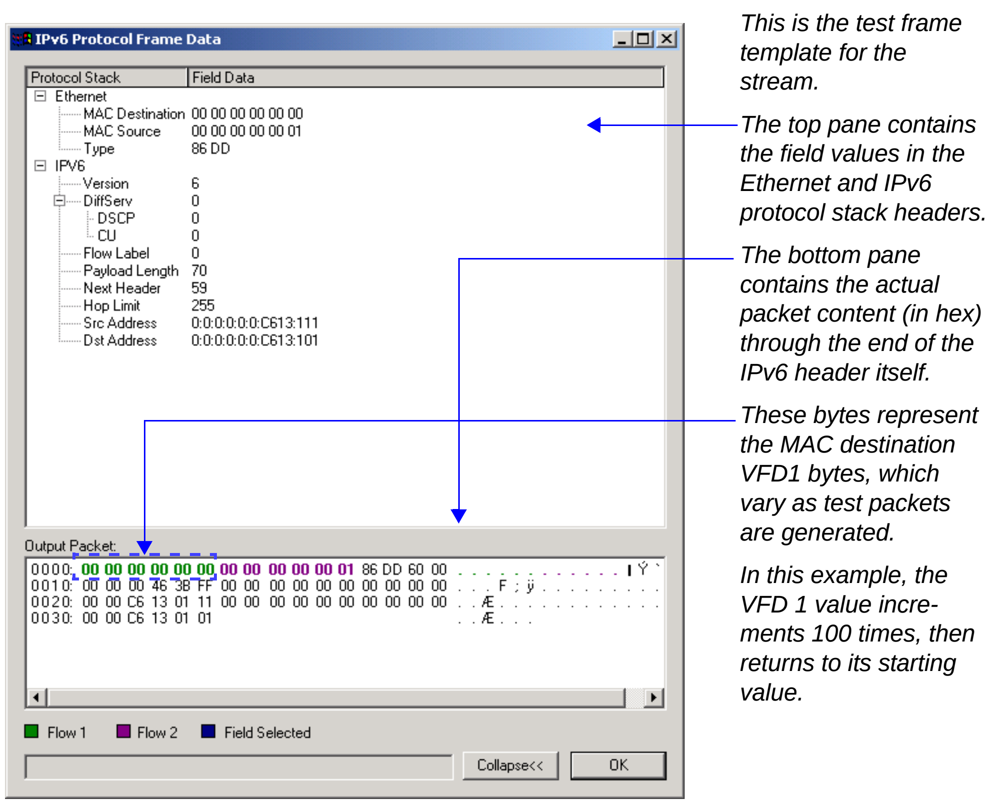


Figure 8-53. Viewing the Packet Contents (Frame Template)

Configuring IPv6

The *IPv6* button in the *Tx Control Panel* pane is used to display a *SETUP* pane with templates for quickly setting stream parameters.

To configure IPv6:

1 Click the **IPv6** button and view the *SETUP* pane. (See *Figure 8-54 on page 407*.)

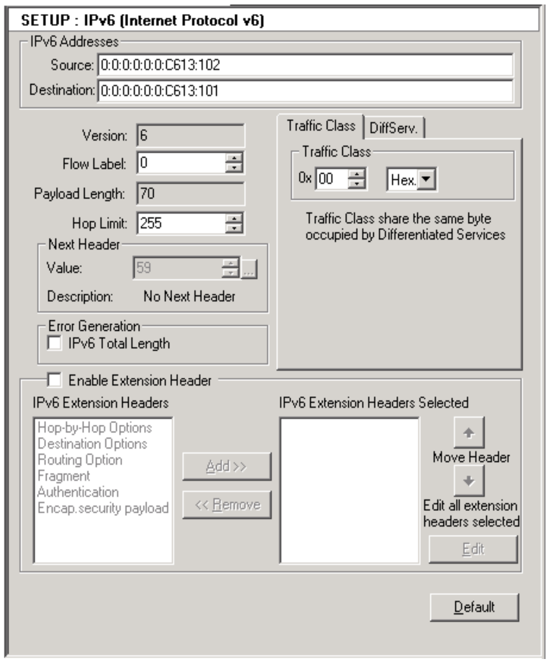


Figure 8-54. IPv6 SETUP Window Pane

2 Move the cursor to the *IPv6 Addresses* pane. These addresses are idential to those shown in the *Streams Setup* window. They can be changed here by editing the fields.

3 Move the cursor to the pane containing the *Traffic Class* and *DiffServ* tabs. Click the tabs to shift between the views of these parameters.

4 Move to the bottom of the *SETUP* pane and click the **View** button. This action displays the *IPv6 Protocol Frame Data* dialog box described in *Figure 8-53 on page 406*.

Configuring the Signature Field and Data Integrity

In the *Tx Control Panel* pane, click the **General** button to display the *General Stream Setup* pane. (See *Figure 8-55 on page 408*.)

To configure the signature field and data integrity:

1 Ensure that the *Signature Field* checkbox is selected.
The *Data Integrity* option is disabled by default. When enabled, the transmitting port inserts a data integrity marker (hex value) into each frame. The receiving port examines the marker in received frames to ensure that data has been transmitted and received without corruption.

Important: The *Data Integrity* checkbox is not enabled unless the *Signature* field checkbox is selected.

Note: The *General Stream Setup* pane shown in *Figure 8-55* has a different design when frame or advanced scheduler mode is used. (In these instances, there are requested and calculated transmit rates.)

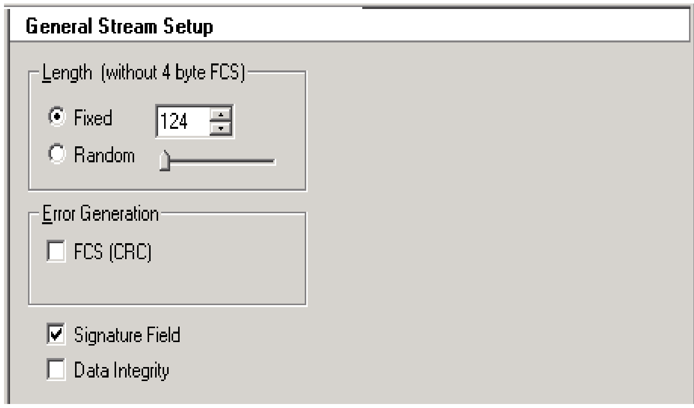


Figure 8-55. Signature and Data Integrity Fields

Configuring a Custom Stream

SmartWindow provides the capability to customize a stream with several types of fill fields and other user-defined data through the use of a Frame Editor.

To configure a custom stream:

1. Access the *Streams Setup* window and highlight an IPv6 stream.
2. Click the **Edit** button to display the *Transmit Setup* window.
3. Access the *Select Protocol* pane (within the *Tx Control Panel* pane), and use the pull-down menu to select **Custom**.
4. Click the **Edit** button in the *SETUP* pane to display the Frame Editor. (See *Figure 8-56*.)

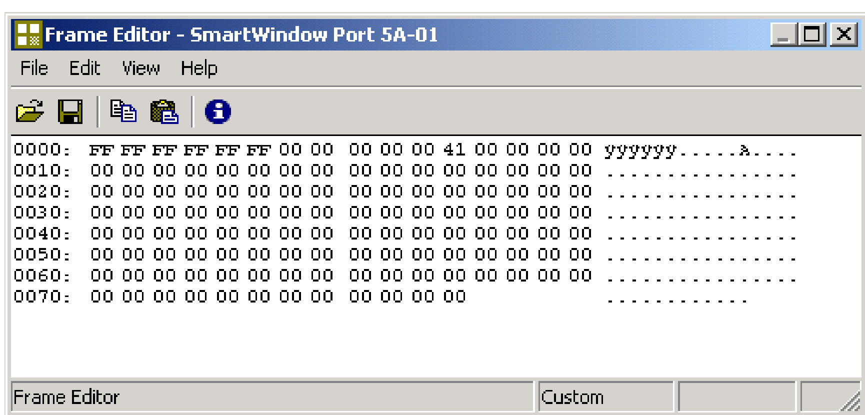


Figure 8-56. Custom Frame Editor

5 Move to the top toolbar and select **Edit**. Select **Pattern** from the pull-down menu to see several patterns that can be pasted into the custom frame.

Configuring a Custom Layer 2

SmartWindow supplies four custom Layer 2 protocols: Ethernet II, Ethernet Snap, 802.3 Raw, and 802.2X. Each protocol has templates to facilitate the setting of Layer 2 parameters.

To configure a custom Layer 2 protocol:

1 Access the *Streams Setup* window and highlight an IPv6 stream.

2 Click the **Edit** button to display the *Transmit Setup* window.

3 Access the *Select Protocol* pane (within the *Tx Control Panel* pane), and use the pull-down menu to select **L2 Custom**.

Note: SmartWindow defaults to a Layer 2 Ethernet II protocol.

4 Click the **Ethernet Snap** button in the *SETUP* pane, and notice that Layer 2 in the *Tx Control Panel* pane changes to the new protocol.

5 Click the **Ethernet Snap** button in the *Tx Control Panel* pane to display the template for this layer. (See *Figure 8-57*.)

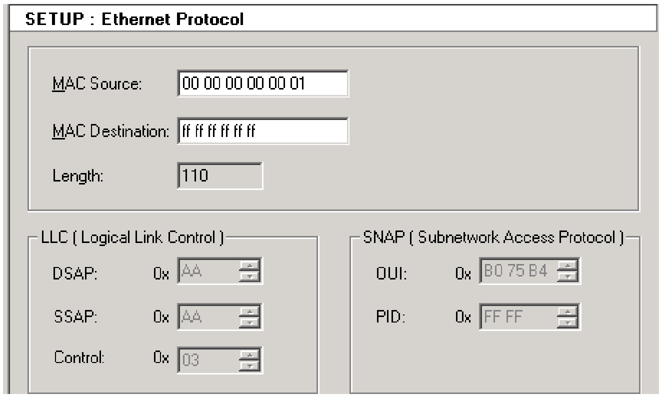


Figure 8-57. Ethernet Snap Template

6 Click the **Protocols** button in the *Tx Control Panel* pane to display other L2 Layer templates.

Configuring Layer 4 Protocols

Layer 4 protocols are configured by selecting a Layer 3/Layer 4 stack.

To configure a Layer 4 protocol:

1. Access the *Streams Setup* window and highlight an IPv6 stream.
2. Click the **Edit** button to display the *Transmit Setup* window.
3. Access the *Select Protocol* pane (within the *Tx Control Panel* pane), and use the pull-down menu to select **IPv6/TCP**.
4. Click the **Layer 4: TCP** button to display the template for this protocol. (See *Figure 8-58*.)

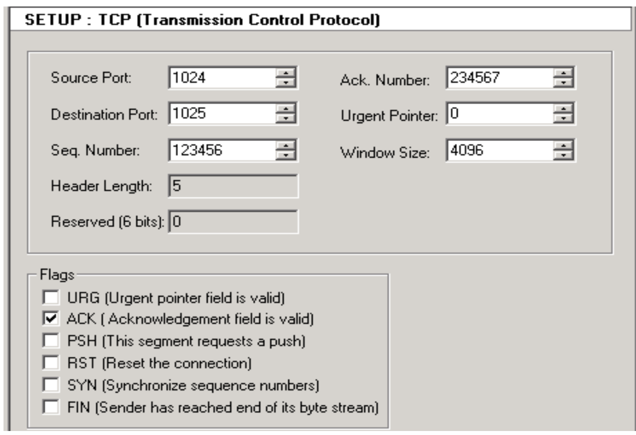


Figure 8-58. TCP Template

Configuring ICMP Streams

The ICMP streams require the configuration of parameters that are interrelated so that when one parameter changes, the options available in another parameter also change. The template is designed to accommodate this relationship by using spin wheels that are adjacent to the parameter.

To configure ICMP streams:

1. Access the *Streams Setup* window and highlight an IPv6 stream.
2. Click the **Edit** button to display the *Transmit Setup* window.
3. Access the *Select Protocol* pane (within the *Tx Control Panel* pane), and use the pull-down menu to select **ICMP/IPv6**.
4. Click the upper **Layer 3: ICMP** button to display the template for this protocol.
5. Select the down arrow in the *Type* field to see a scroll bar. This scroll bar displays an additional five formats for the ICMP message. Any one of these message formats can be selected; however, each format has a unique set of codes that can be used with it. (See *Figure 8-59 on page 411*.)

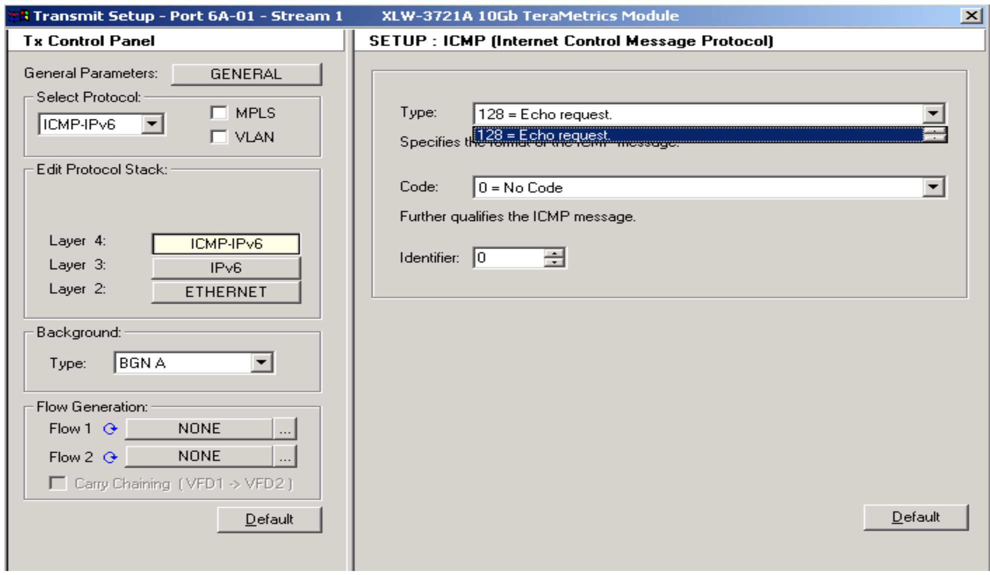


Figure 8-59. ICMP Template

The ICMP parameters are different for IPv4 and IPv6. Refer to *Table 8-21* for a listing of these parameters and when they are enabled.

Table 8-21. ICMP Message Format and Parameters

Protocol	Type	Code
ICMP	8 = Echo*	0 = No Code
	0 = Echo Reply.	0 = No Code
IPv6/ICMP	128 = Echo Request.*	0 = No Code
	129 = Echo Reply.	0 = No Code
	1 = Destination unreachable.	0 - No route to destination, 1- Communication with destination prohibited, 2 - (not assigned), 3 - Address unreachable, 4 - Port unreachable
	2 = Packet too big.	0 = No Code
	3 = Time exceeded.	0 - Hop limited exceeded in transmit, 1 - Fragment reassembly time exceeded

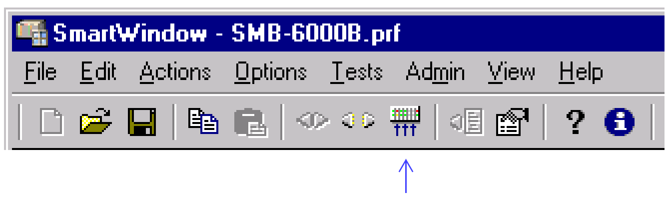
Table 8-21. ICMP Message Format and Parameters (continued)

Protocol	Type	Code
	4 = Parameter problem.	0 = Erroneous header field encountered, 1 = Unrecognized next header type encountered, 2 = Unrecognized IPv6 option encountered.

* Default

Send and Receive Configuration

Click the **Update** button on the SmartWindow toolbar to copy your configuration to the card, or select **Actions > Update** from the main menu.



Click the Update *button on the toolbar to send the configuration to the module.*

Configuring the DUT

This section describes how to configure the DUT and/or the SmartBits 600x/6000x chassis that receives the test streams. The test bed design determines how these units are configured.

The receive unit can be the DUT and/or a SmartBits 600x/6000x chassis. The following list gives some sample chassis/DUT test bed configurations:

- One multiport module on the SmartBits 600x/6000x chassis can transmit and receive test packets to/from the DUT.
- Two modules on the SmartBits 600x/6000x chassis can be used separately, where one transmits test packets and the other receives test data from the DUT.
- Two separate chassis can be used where one transmits test packets to the DUT and the other receives test packets from the DUT.

In all these combinations, it is necessary that port addressing be matched to the design of the network. (For the SmartBits 600x/6000x chassis, the procedure to do this is described in *"Set Port IP Addresses" on page 414*.)

Note: For the DUT, these procedures are located in the DUT installation or user guide.

The type of test traffic is the other aspect of the test bed that impacts the configuration of the receive chassis and DUT. The test traffic can be bi-directional or unidirectional and can come from one chassis or multiple chassis. If the test traffic is bi-directional, with a separate transmit and receive chassis, then it is necessary to configure streams on both units. For:

- XLW-3721A and LAN-331A, refer to *"Configuring Transmit Streams on TeraMetrics Modules" on page 392*.
- LAN-3710AL/AE/AS, refer to *"Test Using the LAN-3710AL/AE/AS 10GbE Module" on page 355*.
- LAN-3201B/C, refer to *"Test Using the LAN-3201B/C SmartMetrics Module" on page 380*.

If the test traffic is unidirectional, then a combination of port configuration and/or stream configuration is required, depending on the movement of test traffic throughout the test bed. Consequently, the traffic generation patterns of the DUT need to match this test design.

Note: Review the profile information of the module to determine the specific SmartBits 600x/6000x chassis interconnection data. (See *Figure 8-3 on page 322* for the item description of a XFP-373xa module.)

Set Port IP Addresses

As indicated in *"Configuring the DUT" on page 413*, the receive chassis may be a different unit (DUT or SmartBits 600x/600x chassis) than the transmit chassis. In this case and in other test beds, the IP port addressing must be changed to accommodate the new test environment. This is accomplished by using the *Port Setup* menu. For:

- XLW-3721A and LAN-331A, refer to *"Layer 3 Setup: IPv4 Stack and IPv6 Stack" on page 339*.
- LAN-3710AL/AE/AS, refer to *"Review the Port Setup" on page 356*.
- LAN-3311A, refer to *"Gigabit Setup" on page 375*.
- LAN-3201B/C, refer to *"Gigabit Setup" on page 382*.

Set DUT Stream IP Addresses

The Gigabit router (DUT) must be able to handle the IP addresses of the streams that were created. Configure the router so that it can build a routing table that knows what to do with each flow. Depending on the router capabilities, this may involve setting up static routes or supernetting, i.e., giving each stream a different second byte, such as 198.19.x.x, 198.20.x.x, 198.21.x.x, etc. This way, as the streams cycle through the frames of a flow, no frames are discarded or lost, and each stream is treated separately in SmartMetrics.

Configuring SmartCounters

SmartWindow has two types of SmartCounters with spreadsheet capabilities. Each of these counters is available on one set of modules/cards with a specific hardware chassis. Refer to *Table 8-22* for a listing of these combinations and the associated counter title.

Table 8-22. Counter Title

Card/Module	Chassis	Counter Title
AT-9xxx, GX-1xxx, ML-xxxx, ST-6410, SX-7xxx, and WN-34xx	SmartBits 200/2000	SmartCounters
FBC-360xA, LAN-3xxxA, POS-3xxxA, XLW-372xA, and XFP-373xA	SmartBits 600x/6000x	SmartCounters

Chapter 5, "Advanced Operational Theory" describes the SmartCounters for cards used on the SmartBits 200/2000 chassis. SmartCounters for modules that use the SmartBits 600x/6000x chassis are primarily described in this chapter. Other explanations of SmartCounters are given throughout the SmartWindow User Guide and online Help. In these cases, each description is footnoted with the correct reference to the module and chassis.

The SmartCounters used for the SmartBits 200/2000 chassis counts the cumulative number of transmit frames and calculates the transmit frame rate. The SmartBits 600x/6000x uses a different method in calculating the number of frames.

Accessing SmartCounters

SmartCounters is accessed through the *Actions* window and *Port* menu. (Refer to the *"Actions Menu" on page 59* and *"Capturing Packets" on page 148* for procedures on how to select this window and menu.)

Note: There are two ways to launch SmartCounters through the *Actions* window: selecting *SmartCounters* or selecting *Launch Workshop*. (See the sections starting with *"SmartCounters Structure" on page 416* for a description of the SmartCounters technique. See *"Launch Workshop" on page 431* for a description of the Launch Workshop technique.)

SmartCounters Structure

SmartBits 600x/6000x modules have a series of SmartCounter windows that provide a number of ways to compute, design, and display counter data. SmartCounters consists of one primary window *(Results Framework)* with two nested windows *(Port Statistics* and *Stream Statistics*), one *Ports Explore*r window, one *Streams Explorer* window, and a status bar. See *Table 8-23* for a listing of these SmartCounters components. (An illustration of these components is shown in *Figure 8-60 on page 417*.)

Table 8-23. Components of SmartCounters

Name	Description
Results Framework	The entry point into the SmartCounters windows. Contains a menu bar that includes *File*, *View*, *Actions*, *Tools*, and *Help* options. Below the menu bar is a toolbar with four icons used for printing and saving files along with displaying the nested windows.
Port Statistics	Located within the *Results Framework* window. Used to display port counter data. Has a customizable toolbar that includes an *Defined Views* pull-down menu plus *Pause Counters*, *Clear Counters*, *Workshop*, and *Timed Save* options.
Ports Explorer	Positioned left of the *Port Statistics* window, it displays the port and module assignments.
Stream Statistics	Located within the *Results Framework* window. Used to display stream counter data. Has a customizable toolbar that includes an *Defined Views* pull-down menu plus *Pause Counters*, *Clear Counters*, *Workshop*, and *Timed Save* options.
Streams Explorer	Positioned left of the *Streams Statistics* window, it displays the stream assignments.
Status Bar	Located at the bottom of the *Results Framework* window. It lists the status of the SmartCounters operation, such as *Ready*, *Port Statistics Workshop*, *Port Statistics Paused*, and others. Also there are corner handles that are used for sizing the *Results Framework* window.

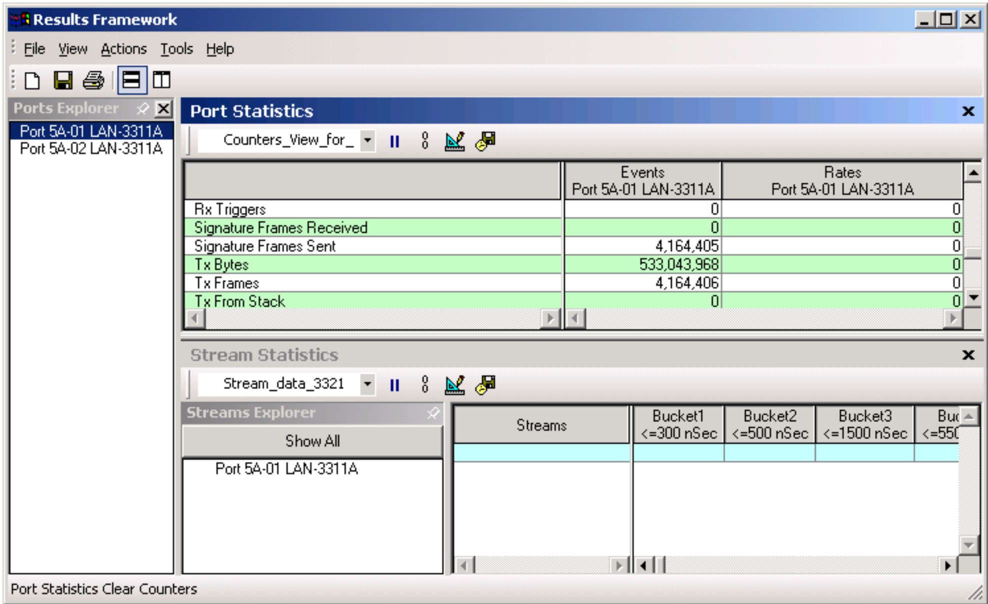


Figure 8-60. SmartCounters

Results Framework

The *Results Framework* window has a complete set of functions that allow you to access and manipulate the display and recording of SmartCounters data. Within the *Results Framework* window is a series of windows, described briefly in *Table 8-23 on page 416*.

Tour of Results Framework Menu Bar and Toolbar

The menu bar and toolbar are located in the top portion of the *Results Framework* window. These tools provide ways to save, display, list, and analyze the counter data.

To understand the menu bar and toolbar:

1 Select **Display Counters** from the *Port* menu to display the *Results Framework* window shown in *Figure 8-60*. SmartCounters can also be displayed through the *Actions* menu in the main window. (Refer to *"Actions Menu" on page 59* for more information on how to use this menu.)

2 Locate the menu bar and toolbar in the top portion of the window. From the menu bar, select **File**. This pull-down menu displays several options for saving and printing files. The *Save As* selection enables you to save the data file (port and stream counters) with a .csv format. The *Save* selection enables you to quickly save the file using that format.

3 Select **View**. This pull-down menu displays four options: *Ports Explorer*, *Results*, *Toolbar*, and *Status Bar*. The *Ports Explorer* option enables you to toggle on/off this window. The *Results* option provides a mechanism to select one or both of the data windows: *Port Statistics* and *Streams Statistics*. The *Toolbar* option toggles the icons on or off. The *Status Bar* option toggles the status bar (located at the bottom of the *Results Framework* window) on or off.

4 Select **Actions**. This pull-down menu displays *Tx Start* and *Tx Stop* options. Use these selections to initiate or stop a test. (Refer to *"Types of Tests" on page 109* for other ways to start and stop tests.)

5 Select **Tools** to access three options: *View Organizer*, *Counter Workshop*, and *Options*. (The *View Organizer* option is described in *"Tour of the View Organizer" on page 419*; the *Counter Workshop* option is described in *"Tour of the Workshop Window" on page 425*.)

6 Select **Tools/Options/Options.** The *Port Statistics* and *Stream Statistics* windows use either a predefined counter layout that you configured (*"Tour of the View Organizer" on page 419*) or one of the default layouts provided with SmartWindow. The *Options* pop-up window provides the ability to change the default views of the *Port Statistics* and *Stream Statistics* windows. (Refer to *Figure 8-61* for the display of a sample *Options* pop-up window.)

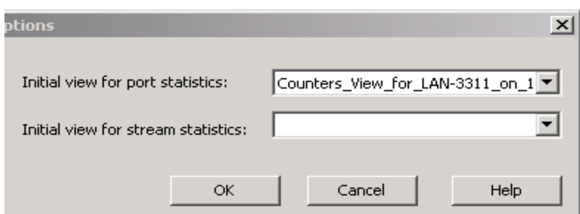


Figure 8-61. Options Window

7 Return to the *Results Framework* menu bar and select **Help**. This action accesses the online Help.

Note: Each of the main windows has direct access to online Help text. Press the **F1** key over these windows to access information online about the *Results Framework*, *Counter Workshop*, *Port Statistics*, *Stream Statistics*, *View Organizer*, *Time Save*, and *Counter Options* windows.

8 Locate the toolbar below the menu bar. The first three icons provide global file actions: *New file*, *Save file*, and *Print file*. The last two icons enable you to configure the layout of the *Port Statistics* and *Stream Statistics* windows.

9 Confirm that the *Port Statistics* and *Stream Statistics* windows are available by returning to the *Results Framework* menu bar and selecting **View/Results**. The *Port Statistics* and *Stream Statistics* checkboxes should be selected.

10 Access the *Results Framework* toolbar and select the last icon (vertical layout). This action changes the display of the statistics windows to the vertical position. Selecting the horizontal layout icon changes the display of the statistics windows to the horizontal position. This feature enables you to customize the view of the statistics windows to show different aspects of the counter data.

11 Access the *Port* menu, without closing the *Results Framework* window, and select **Display Counters**. A second *Results Framework* window appears that allows you to track and analyze different sets of counter data.

Tour of the View Organizer

The *View Organizer* option enables you to add, edit, delete, or copy a predefined layout for the *Port Statistics* and *Stream Statistics* windows. Also, the predefined layouts can be used within the Launch Workshop SmartCounter structure that is described in *"Launch Workshop" on page 431*.

Refer to *Figure 8-62* for an illustration of a sample *View Organizer* window.

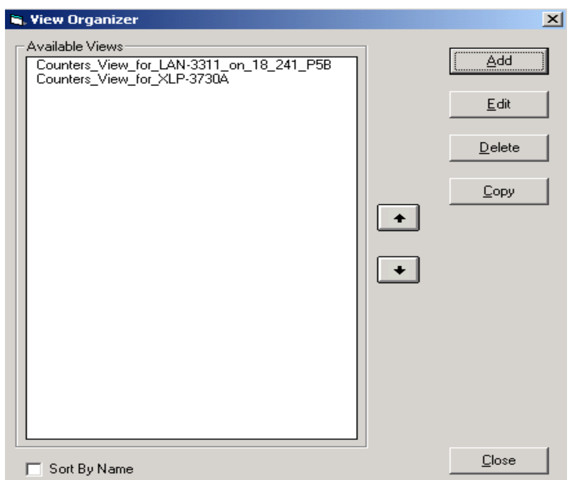


Figure 8-62. View Organizer

To understand the View Organizer window:

1 Go to the *Results Framework* menu bar and select **Tools** to see three options: *View Organizer*, *Counter Workshop*, and *Options*.

2 Select **View Organizer** to see a single-paned window that contains a list of files. Adjacent to this pane are a series of buttons that allow you to organize and configure the counter layouts.

The listed files contain a set of default layouts in addition to those that were created. Predefined layouts are saved within SmartWindow, regardless of what module is connected. See *Table 8-24 on page 420* for a listing and brief description of the seven predefined views that are included with SmartWindow.

Table 8-24. Predefined Views

Title	Counters (Partial list)
Port counters	All port counters for LAN-33xxA modules, except MPLS.
Stream counters	Rx packets and rates, out of order packets, minimum latency, maximum latency, and average latency
POS-PPP counters	POS counters including transmit/receive, ping, IPv4, IPv6, IGMP plus sent and receive messages
Fibre channel counters	Fibre channel counters including transmit/receive, FLOGI, PLOGI, and signature
LAN-error counters	LAN error counters including CRC, oversize, checksum, and data integrity
L3 counters	IPv4 frames received, IPv6 Rx frames received, IPv4/IPv6 QoS 0-7 (DSCP 0-63), and signature frames received
Stacks counters	ARP, ping, IPv6 ping, and Tx/Rx to/from stack

3 Locate the *Delete* and *Copy* buttons on the right side of the *View Organizer* window. Highlighting a file and clicking the *Delete* button removes the file from SmartCounters. Copying a file gives you the ability to create and edit a layout without having to create a new file that has a similar set of counter fields.

4 Select a counter layout file in the *View Organizer* window. Locate the up and down arrows to the right of the pane. Click the down arrow button. Notice how the selected file moves down a position. Click the up arrow to move the selected file up a position. This feature gives you the ability to group or separate the counter layouts by type of module or other criteria.

5 Return to the *View Organizer* window, select a counter layout file, and click the **Edit** button to see a double-paned window titled *Edit View*. Use this window to edit an existing layout that is used in the *Port* and/or *Stream Statistics* window. (Refer to *Figure 8-63 on page 421* for a sample illustration of this window.)

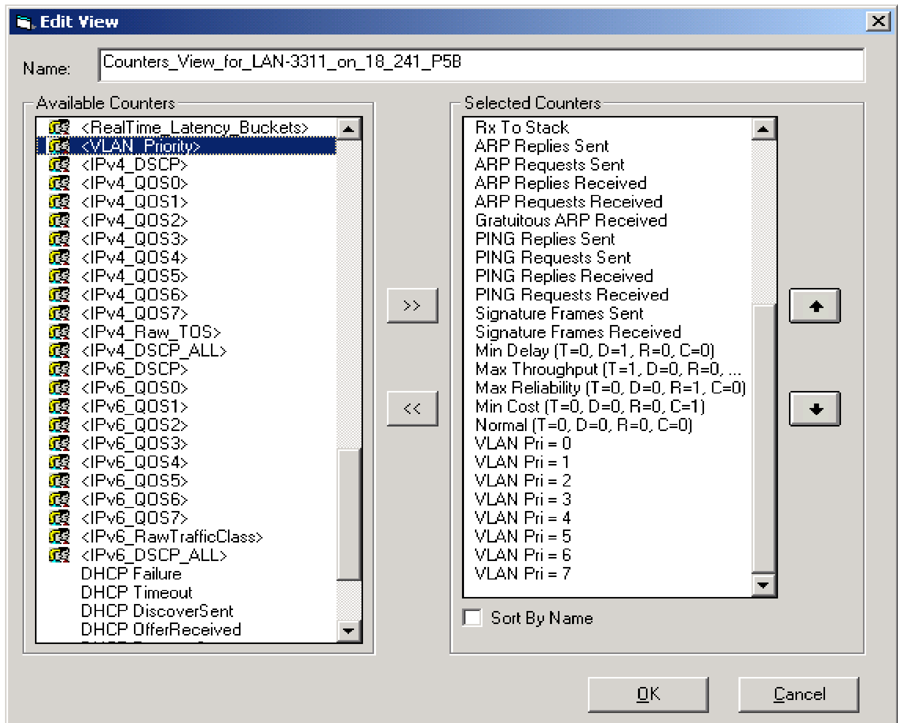


Figure 8-63. Edit View

6 Locate the scroll bar adjacent to the left pane and scroll through the *Available Counters* listing. Move to the right pane and scroll through the *Selected Counters* listing.

The right pane contains the counters used in this uniquely predefined layout file that is titled *Counters_View_for_LAN3311_on_18_241_P5B*. If the *Stacks Counters* predefined layout file are accessed, you would see ping, ARP, and Tx/Rx to stack counters listed in the right pane.

7 Locate the *Sort By Name* checkbox in the bottom of the right pane. Select this checkbox to sort the counters in alphabetical order.

8 Located on the right side of the right pane is a set of up and down arrows. These arrows are used in the same way as the arrows are used in the *View Organizer* window: the selected field (in this case a counter) is moved up or down the list.

Note: The left pane shows two types of counters: counters that have a people icon and single counters. The counters with an icon represent a group of related counters. These groups provide a way to quickly add the entire group to your view.

9 Right-click the group icon to display the *Members* button that can be clicked to display each counter within the group. In this manner, you can still add individual members of the group to the view rather than the entire group.

10 Right-click the group counter titled **<IPV4 DSCP>**. This action displays the *Member* button.

11 Click the **Member** button and all member counters appear in a pop-up window. (See *Figure 8-64* for an illustration of this window.)

This option presents two ways to display DSCP counter data. You can add the *<IPV4 DSCP>* group counter (using the right arrow button) and all DSCP values are included in the predefined view, or you can selectively add IPV4 QOS values to the predefined window.

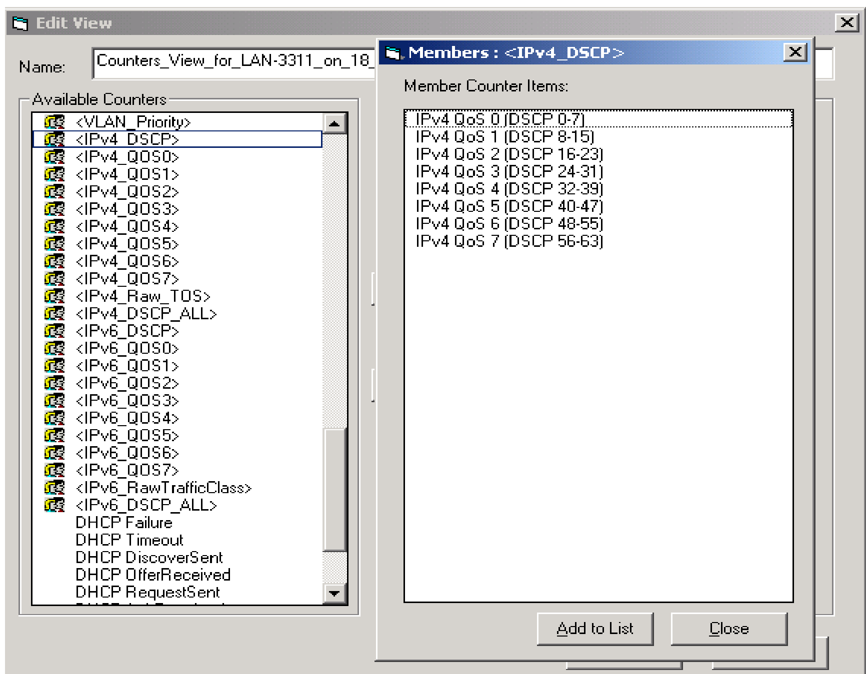


Figure 8-64. Member Selections

12 Right-click the **<VLAN Priority>** group counter in the *Available Counters* pane. This action displays the *Member* button.

13 Click this button to display *VLAN PRI 0* and other counters for the *VLAN Priority* group counter.
Each counter can be individually added to the predefined counter window. All group counters have this ability to be expanded through the use of the *Member* button.

14 Return to the *Edit View* dialog box of the *View Organizer* window so that both panes are displayed with counter values. (The recommended way to do this is by closing all open windows and selecting **Tools/View Organizer** from the *Results Framework* menu bar, selecting a counter layout file, and clicking the **Edit** button.)

15 Select a counter in the right pane.

16 Click the left double-arrow button and the counter is removed from the predefined counter layout file.

17 Select a counter in the left pane.

18 Click the right double-arrow button and the counter is added to the predefined counter layout file.

Port Statistics Window

The *Port Statistics* window displays the port counter data from the tests. This information includes the full spectrum of transmit/receive values and special counters that have been included in the defined counter layout. (See *Figure 8-65* for an illustration of a populated *Port Statistics* window.)

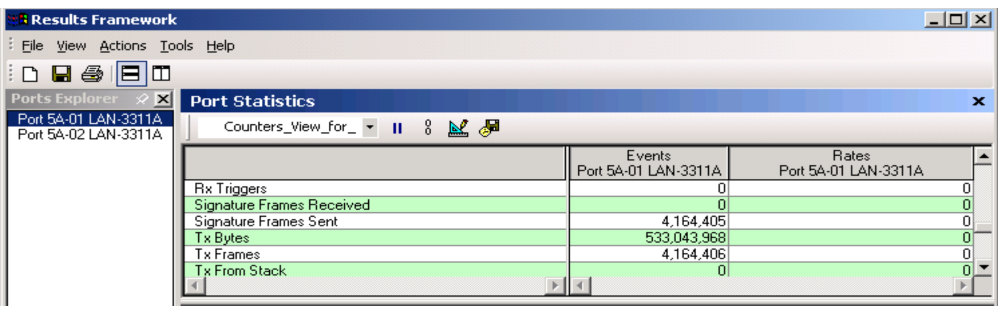


Figure 8-65. Port Statistics Window

Tour of the Toolbar

The *Port Statistics* window displays the predefined layout that was selected in the pull-down menu located on the left portion of the toolbar. This pull-down menu also contains the five predefined layouts that are included with SmartWindow, as well as the predefined layout(s) that were defined per *"Tour of the View Organizer" on page 419*. The counter data from your tests are recorded and posted in this layout.

To understand the toolbar:

1 Access the *Port Statistics* window by selecting **View/Results/Ports** from the menu bar of the *Results Framework* window. The *Port Statistics* window is displayed in the top quadrant of the *Results Framework* window. Select a predefined layout from the pull-down menu.

2 Adjacent to the drop-down window is an icon with a set of parallel bars. This icon pauses the SmartCounter operation. Press this icon and note the pause message in the status bar at bottom of window. Pressing this icon again displays the message **Port Statistics Resumes Counters**, indicating the statistics window is operating real-time.

3 The adjacent icon (two chain links) clears the counters. Click this icon to see the message **Port Statistics Clears Counters** in the status bar.

4 Right-click while the cursor is positioned over the *Port Statistics* window. The menu in *Figure 8-66* is displayed.

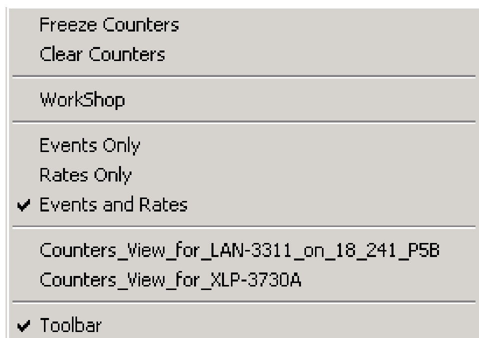


Figure 8-66. Pop-up Port Statistics Menu

This menu contains many of the options available in the *Port Statistics* toolbar, plus the ability to select the *Events Only*, *Rates Only*, and *Events and Rates* options. The toolbar can also be toggled on/off.

5 Locate and select the workshop icon (protractor, ruler, and pencil). This displays the *Workshop* window. *Figure 8-68 on page 425* shows an illustration of this window. (Refer to the *"Tour of the Workshop Window" on page 425* for a description of how to use it.)

6 Adjacent to the workshop icon is the timed save icon (clock and diskette). Select this icon and the pop-up window shown in *Figure 8-67* is displayed.

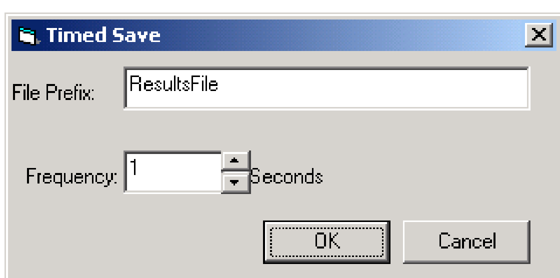


Figure 8-67. Timed Save

The *Timed Save* option enables you to save the counter data file at any interval from 1 to 9,999 seconds. The *File Prefix* field value can contain digits, special characters, alpha, or any combination of these. The length of the prefix is dependent on the parameters of the operating system.

The suffix is the time offset. If you choose the default, the files are named ResultsFile1, ResultsFile2, etc.

The data counter file is saved with a .xls extension.

Tour of the Workshop Window

The *Workshop* window gives you the ability to set formulas, modify the layout, and store the port and stream counter data offline for analysis.

To understand the Workship window:

1 Select the workshop icon (triangle, ruler, and pencil) from the *Port Statistics* toolbar.

Note: The workshop window can be selected from numerous locations within the *Results Framewor*k window. These locations include the *Port Statistics* toolbar, *Stream Statistics* toolbar, and *Results Framework* menu bar.

This action displays a window with the counter values computed from the test(s) that are running or have run. This data may be saved in a port counter data file that is manipulated online or offline. The layout reflects the predefined view that was set up in *"Tour of the View Organizer" on page 419*. (Refer to *Figure 8-68* for an illustration of this window.)

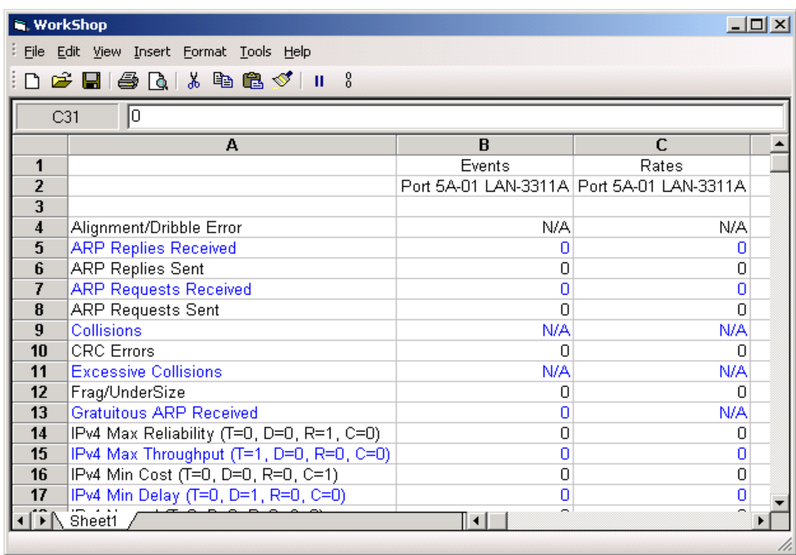


Figure 8-68. Workshop Window

Located at the top of the window are three bars: the menu bar, toolbar, and formula bar. The default *Workshop* window displays all three bars. (See *Figure 8-69 on page 426* for an illustration of these bars.)

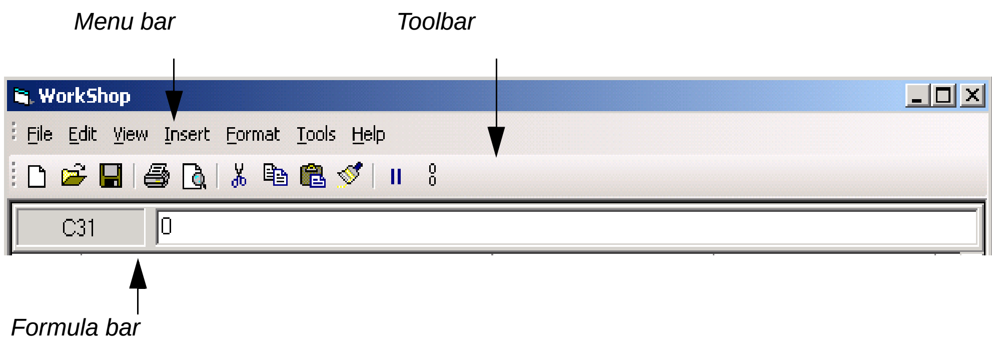


Figure 8-69. Workshop Menu Bar, Toolbar and Formula Bar

The functions of these bars, such as setting formulas and other spreadsheet operations, are used to configure and analyze port counter data.

2 Locate the menu bar at the top of the *Workshop* window. Review each of the menu bar selections, as described in *Table 8-25*.

Table 8-25. Workshop Menu Bar

Title	Description
File	Creates a new file, opens a file, saves a file, displays a print preview, initiates the print function, and exits this option. The save option enables you to save the counter data file in three formats: .xls, .vts, .csv.
Edit	Manipulates the counter data file using *Cut*, *Copy*, *Paste*, *Paste Special*, and *Copy Cell Format* functions.
View	Displays different bars: the toolbar (*Table 8-26 on page 427* contains a description of this bar), formula bar (*Table 8-27 on page 427* contains a description of this bar), and status bar. The status bar is located at the bottom of the *Workshop* window and displays the action that is being implemented.
Insert	Inserts rows, shifts cells, and inserts columns in the counter data file.
Format	Formats cells, rows, and columns in the counter data file.
Tools	This selection has two options: *Recalc* and *Options*. The *Recalc* function calculates the data (for formulas) set up in the counter data file. The *Options* function displays a four-tab table; tabs include *General*, *Calculator*, *Autofill*, and *Color*. These functions present the ability to set up the type of calculation as well as the color of the text for data in the counter file.
Help	Accesses the SmartWindow online Help file.

3 Find the *Workshop* window toolbar located directly under the menu bar. This toolbar is a series of icons, and it displays only if it has been selected by using the *View/Toolbar* option from the menu bar. These toolbar icons are described in *Table 8-26*.

Table 8-26. Workshop Toolbar

Title (icon)	Description
New (blank page)	Creates a new worksheet.
Folder (open folder)	Opens an existing counter data file.
Save (diskette)	Saves the counter data file using .xls, .vts, or .csv formats.
Printer (printer)	Accesses menu to determine when and how to print the counter data file.
Print preview (magnifying glass on paper)	Displays a preview of the printed copy of the counter data file.
Cut (scissors)	Cuts a highlighted segment of data.
Copy (two pages)	Copies highlighted segment of data.
Paste (page and clipboard)	Pastes data located in buffer (from copy function) into selected location in the counter data file.
Format painter (paint brush)	Copies format of cells.
Pause (vertical lines)	Toggles the start and stop of collecting counter data.
Clear counters (unlinked chain)	Clears all data in the counter data file.

4 Locate the formula bar (below the toolbar) or select it by accessing the *View/Toolbar* option from the menu bar. These toolbar menus are described in *Table 8-27*.

Table 8-27. Port Statistics Formula Bar

Title	Description
Cell	Lists the address of the highlighted cell.
Formula Field	Lists the formula in the highlighted cell.

5 Right-click and a pop-up menu displays. This menu contains eight format functions: *Format*, *Cut*, *Copy*, *Paste*, *Clear*, *Insert*, *Copy Right*, and *Copy Down*. These are described in *Table 8-25 on page 426* and *Table 8-26*.

Ports Explorer Window

The *Ports Explorer* window is located in the left side of the *Ports Statistics* window. (Refer to *Figure 8-70* for an illustration of this window.) It lists the port assignments of the module(s) installed in the chassis. By highlighting a module, the representative counter layout is displayed in the *Port Statistics* window.

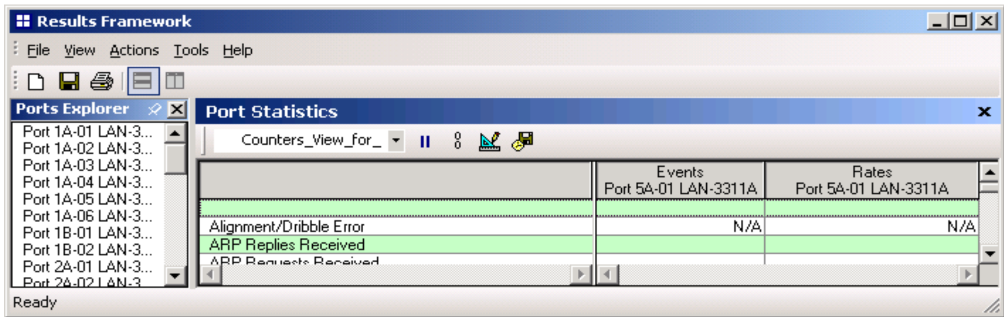


Figure 8-70. Ports Explorer Window

Tour of the Ports Explorer Window

The *Ports Explorer* window is used to select port assignments on specific modules, as well as to adjust the viewing area of the *Port Statistics* window.

To understand the Ports Explorer window:

1. Access the *Ports Explorer* window by highlighting the title bar of the window. If the window is not displayed, select **View/Results** in the menu bar of the *Results Framework* window and select the checkbox next to **Ports Explorer**.
2. Locate the stickpin icon in the top right corner of the *Ports Explorer* window, and click it. Clicking this icon toggles the window between a horizontal (not pinned) and a vertical (pinned) position. When the *Ports Explorer* window is pinned, it remains visible at all times. When it is not pinned, the window becomes visible only when the mouse is moved over the *Ports Explorer* tab in the left side of the *Port Statistics* window. This feature enables you to hide the *Ports Explorer* window and maximize the available viewing space for counters.

Note: When the vertical viewing tab is used, the *Ports Explorer* window is displayed by moving the cursor in an arc between the toolbar and vertical tab. When the cursor is over the toolbar, the window opens and when the cursor is over the vertical tab, the window closes.

3. Click the **X** button in the top portion of the window to close the *Ports Explorer* window and provide a maximum view of the *Port Statistics* window.
4. Move the cursor over the port assignments and right-click. This action displays a pop-up menu with three options: *Start Tx*, *Stop Tx*, and *Clear Counters*. These options can

be used for testing, or the same functions can be accessed at other locations within the *Results Framework* and *Port Statistics* windows

Stream Statistics Window

The *Stream Statistics* window displays the stream counter data from the tests. This includes the real time latency values that are described in the *“Real Time Latency Counters” on page 435*. (See *Figure 8-71* for an illustration of the *Stream Statistics* window.)

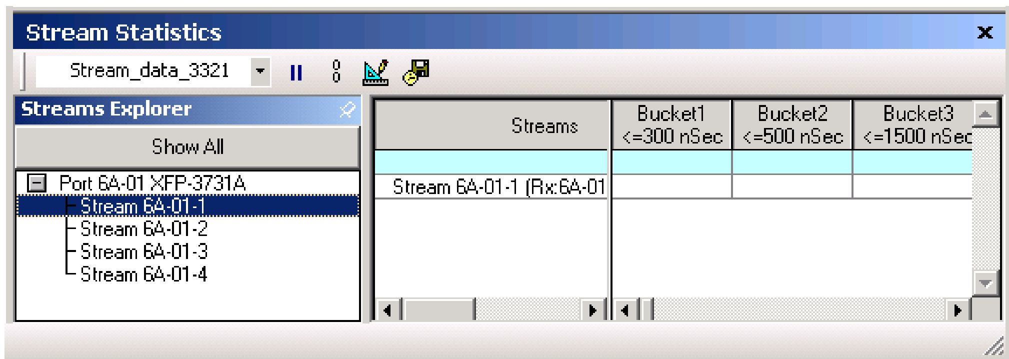


Figure 8-71. Stream Statistics Window

Tour of the Stream Statistics Window

The *Stream Statistics* window has a pull-down menu that contains five predefined layouts, as well as the layouts defined in *“Tour of the View Organizer” on page 419*.

To understand the Streams Statistics window:

1 Access the *Stream Statistics* window by selecting **View/Results/Streams** in the menu bar of the *Results Framework* window. Then highlight the title bar of the *Stream Statistics* window.

Note: The *Stream Statistics* window is populated only after the streams have been configured via the *Transmit Setup* window. (Refer to *“Editing Protocol Bytes in Test Frames” on page 159* for a description of this process.) Data is recorded in this window after configuration of the real time latency counters. (Refer to *“Real Time Latency Counters” on page 435* for a listing of the steps used to configure these counters.)

The top portion of the *Stream Statistics* window contains a toolbar with a drop-down window, four icons, and a drop-down menu. The drop-down window lists the predefined views of the *Stream Statistics* window.

2 Select one view in the drop-down window.The fields from the predefined view are immediately transferred to the column heads.

3 Move the cursor to the counter data fields and notice how it changes to an “I” bar so the width of each column can be adjusted. (Also notice that there are two sections of the data counter area: one for streams and one for counter data.)

4 Move the cursor up to the toolbar and click the pause icon (two parallel bars). Notice that the status bar displays *Stream Statistics Paused*, indicating that the counters have paused.
The other icons on the toolbar have the same identification and function as those on the toolbar located in the *Port Statistics* window. Refer to *“Port Statistics Window” on page 423* for a description of how to use these icons.

Streams Explorer Window

The *Streams Explorer* window is located within the *Stream Statistics* window in the left side of the data counter fields. (Refer to *Figure 8-72* for an illustration of this window.)

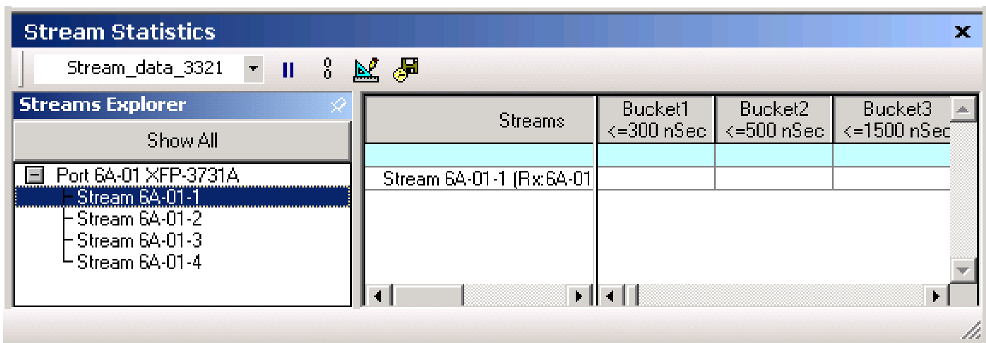


Figure 8-72. Streams Explorer Window

Tour of Streams Explorer

The *Streams Explorer* window is used to select stream assignments on specific modules, as well as to adjust the viewing area of the *Streams Statistics* window.

To understand the Streams Explorer window:

1 Access the *Streams Explorer* window by highlighting the title bar of the window. If the *Streams Explorer* window is not displayed, select **View/Results** in the menu bar of the *Results Framework* window and select the checkbox next to **Streams Explorer**.

The *Streams Explorer* window displays a hierarchy of ports for the modules installed in the SmartBits 600x/6000x chassis. Those ports that have streams can be expanded so that individual streams are displayed and can be selected to show associated counter data in the *Stream Statistics* window. The ports that have configured streams are distinguished by having a “+” button next to the description when not expanded.

Clicking the + button expands the port description to display the streams. The expansion button also changes to a **-**.

2. Locate the stickpin icon in the top right corner of the *Streams Explorer* window, and click it. Clicking on this icon toggles the window between a horizontal (not pinned) and a vertical (pinned) position. When the *Streams Explorer* window is pinned, it remains visible at all times. When it is not pinned, the window becomes visible only when the mouse is moved over the *Streams Explorer* tab on the left side of the *Stream Statistics* window. This feature enables you to hide the *Streams Explorer* window and maximize the available viewing space for counters.

   Below the title bar is the *Show All* bar. The operation of this bar works in conjunction with the selections highlighted in the *Ports Explorer* window. Selecting a port or series of ports in the *Ports Explorer* window automatically causes the population of those same ports in the *Streams Explorer* window.
3. Highlight a series of ports (that have streams) in the *Ports Explorer* window.
4. Click the **Show All** bar and all the ports/streams in the *Streams Explorer* window become visible. This function enables you to simultaneously and selectively view and record data in the *Port Statistics* and *Stream Statistics* windows.

Launch Workshop

The *Launch Workshop* option is located in the *Actions* window. (See *"Actions Menu" on page 59* for a description of how to access this selection.) Selecting *Launch Workshop* displays the *Workshop Selector* window. (Refer to *Figure 8-73 on page 432* for an illustration of this two-tabbed window.)

The *Launch Workshop* option enables you to configure, display, and analyze SmartCounters. It is different from the *Results Framework* SmartCounter function because port and stream data can be displayed on one data window. Within the *Results Framework* structure, port data is displayed in the *Port Statistics* window and stream data is displayed in the *Stream Statistics* window.

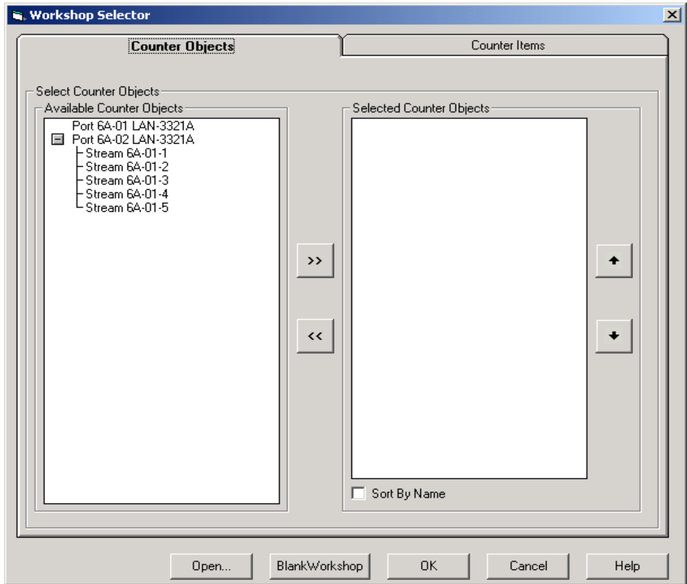


Figure 8-73. Workshop Selector Window

Workshop Selector Structure

The *Workshop Selector* window consists of two tabs: *Counter Objects* and *Counter Items*. The *Counter Object*s tab lists the ports and streams that are available on the modules. The *Counter Items* tab lists the types of counters.

At the bottom of the *Workshop Selector* window are five buttons. These buttons are used to open existing counter files, display a *BlankWorkshop* window, accept a specific action, cancel an operation, and access the online Help.

Tour of Counter Objects

The *Counter Objects* tab contains two panes, a set of double-arrow buttons, a set of up and down arrow buttons, and a *Sort By Name* checkbox. (See *Figure 8-73* for an illustration of the *Counter Objects* tab.)

The counter objects are locations (ports/streams) of the tests. These objects can be moved to the *Selected Counter Objects* pane to define the display of the *SmartCounters* window. The *Selected Counter Objects* pane displays port and stream assignments that have been selected for viewing.

To understand the Counter Objects tab:

1. Highlight a port and click the right, double-arrow button. This action moves the port to the *Selected Counter Objects* window.

2 Highlight a second port and click the right, double-arrow button. This action moves this port to the *Selected Counter Objects* window, directly below the previously moved port.

3 Select the bottom port in the *Selected Counter Objects* window and click the up arrow that is located on the right side of this window. Notice that this action moves the port up the list of ports. Use this feature to categorize the ports/streams to facilitate viewing.

4 Select the *Sort By Name* checkbox at the bottom of the window to sort the lists of ports/streams by name.

5 Click the **Open...** button located at the bottom of the *Workshop Selector* window to open the default SmartLibrary folder. This action enables you to see counter data files that have been saved in any of three formats (.xls, .csv, and vts).

6 Open one of the counter data files. The *SmartWindow:Workshop* window is opened so you can analyze counter data offline while running counter tests or other types SmartWindow operations. (Refer to *"Tour of the Workshop Window" on page 425* for a description of the *Workshop* window that uses the same set of toolbars.)

Tour of Counter Items

The *Counter Items* tab contains two buttons (one with a pull-down menu), two panes, a set of double-arrow buttons, one set of up and down arrow buttons, and the *Sort by Name* checkbox. (See *Figure 8-74* for an illustration of the *Counter Items* tab.)

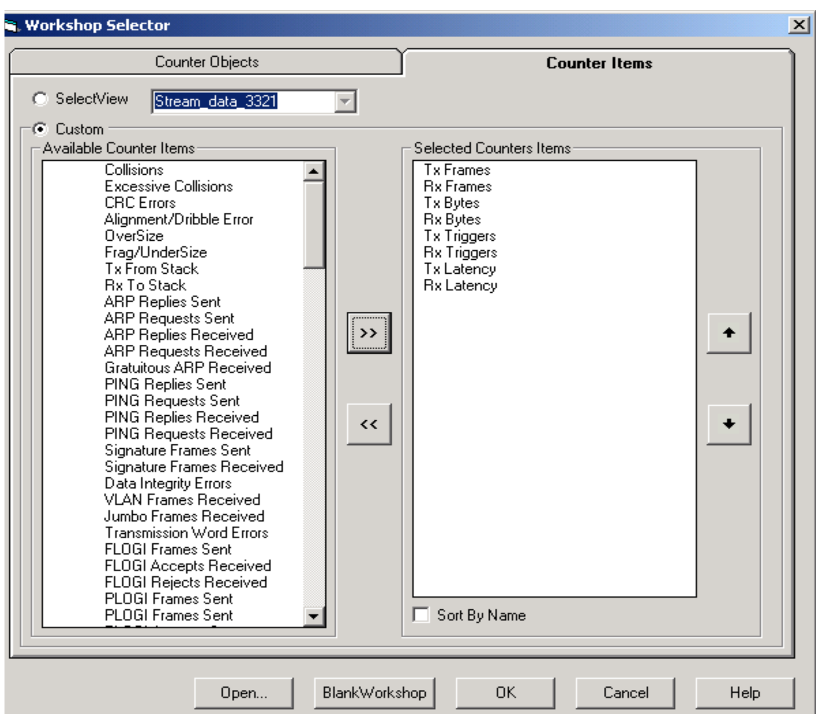


Figure 8-74. Counter Items Tab

To understand the Counter Items tab:

1. Click the **Custom** button in the *Available Counter Items* window. Clicking the *Custom* button makes accessible all of the counters listed in the *Available Counter Items* window. Use the double-arrow keys to move counters to the *Selected Counter Items* pane and create a counter window that meets the test requirements.
2. Locate the up and down arrows and the *Sort By Name* checkbox. These items have same function as those described in the *Counter Objects* tab (on *page 433*). Configure a counter window for your test fixture using these arrows and selections.
3. Start the test and then click the **OK** button in the *Workshop Selector* window. The SmartWindow *Workshop* window is displayed with the counters incrementing according to the results of the test. (Refer to *Figure 8-75* for an illustration of this window.)

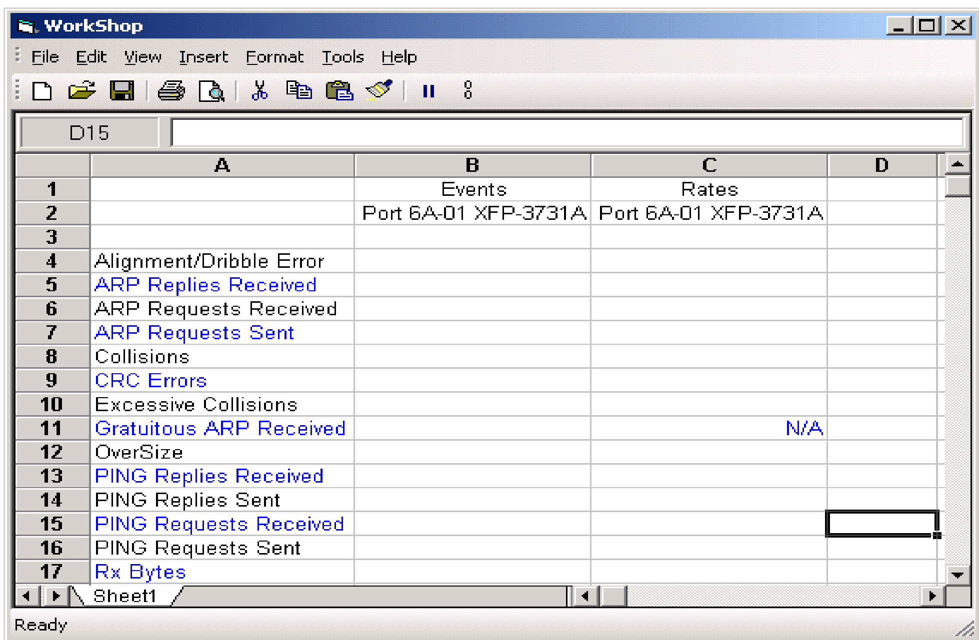


Figure 8-75. SmartWindow: Workshop

The toolbars and operation of this window are identical to those used in the *Workshop* window that is located within the *Results Framework* window. (Refer to *"Results Framework" on page 417* for an explanation of how to use the *Results Framework* window in defining counter data windows. See *"Tour of the Workshop Window" on page 425* for a description of the toolbars and operation of the *Workshop* window.)

4. Stop the test and save the data counter file using the *File* menu option in the menu bar.
5. Locate and click the **Select View** button on the *Counter Items* tab. The *Available Counter Items* are unavailable, and the pull-down menu is highlighted.

6 Click the pull-down menu and scroll through the selections. These selections are predefined windows of SmartCounter data displays. Each selection lists counters in a sequence that is defined by you and/or are one of the seven layouts provided with the SmartWindow test application. (See *Table 8-24 on page 420* for a listing of these counter layout files.)

7 Highlight one of these selections, and press the **OK** button. The *SmartWindow:Workshop* window opens showing the data counter layout of the predefined window. (Refer to *"Tour of the View Organizer" on page 419* for an explanation of how to use the *View Organizer* in configuring SmartCounter data windows.)

8 Click the **BlankWorkshop** button at the bottom of the *Workshop Selecto*r window. A blank workshop window is displayed that can be used to load and analyze data counter files.

Running SmartCounters

Smart Counters is started from the following locations:

- Within the *Actions Menu.* (Refer to *"Actions Menu" on page 59*.)
- Within the *Port Menu*. (Refer to *"Capturing Packets" on page 148*.)

After SmartCounters is configured, the test(s) are initiated from the following locations:

- Within SmartCounters. (Refer to *"Tour of Results Framework Menu Bar and Toolbar" on page 417*.)
- From the main toolbar. (Refer to *"Real Time Latency Test" on page 298*.)
- From the front panel of the virtual chassis. (Refer to *"Connected to SmartBits 600x/6000x" on page 53*.)

You can view SmartCounters data online or offline from two locations: through the *Results Framework* window (*"Configuring Transmit Streams on TeraMetrics Modules" on page 392*) or through the *Workshop Selector* window (*"Launch Workshop" on page 431*).

Real Time Latency Counters

Latency testing requires the configuration of streams (*"Editing Protocol Bytes in Test Frames" on page 159*) and buckets that specify the time intervals of the latency values. The buckets are configured on the main toolbar by accessing *Tests/Realtime Latency Test.* (Refer to *"Real Time Latency Test" on page 298* for a description of this process.)

The real time latency counters are displayed in a SmartCounters predefined window. This process is described starting with *"Tour of the View Organizer" on page 419*. (Refer to *Figure 8-76 on page 436* for an illustration of the *Stream Statistics* window for one type of real time latency counter display. This *Stream Statistics* window is positioned vertically with the *Ports Statistic* window headlined. Refer to *"Tour of Results Framework Menu*

Bar and Toolbar" on page 417 for instructions on how to change the orientation and presentation of the *Stream Statistics* and *Ports Statistics* windows.)

Caution: While running the Real Time Latency Test, selecting **Clear Counters** from the Rx port context menu (accessed by right-clicking the port icon in the main **SmartBits** window) will clear timestamps, causing invalid latency results.

Note: Unlike after-test measurements that are made with all counters halted on the receive port, real time measurements are made with the counters still running. Each counter is read in sequence and when all counters have been read, the results are returned to the user. This means that there can be small discrepancies in similar counters. Often, this is especially noticeable when comparing the total received frames counter with the sum of all frames received in the 16 latency buckets; these two counts can be off by one or off by two simply because the counters are not read at the same instant.

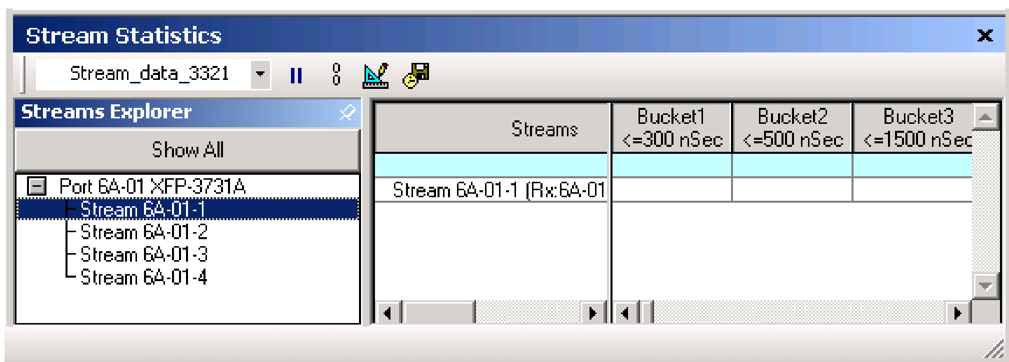


Figure 8-76. RealTime Latency Counter Display

Gigabit Counters

The IEEE standard for Gigabit Ethernet sets forth the formula to derive maximum frame rate as follows.

$$\text{Frame Rate} = \frac{\text{Transmit Clock Frequency}}{(\text{Frame Length} * 8) + \text{Minimum IFG} + \text{Preamble} + \text{Start of Frame Delimiter}}$$

$$= 1{,}000{,}000{,}000 / (64 * 8) + 96 + 56 + 8$$

$$= 1{,}000{,}000{,}000 / 672$$

$$= 1{,}488.095.2 \text{ fps}$$

The standard allows for clock variances, with a maximum error in the range +/–100 PPM. For Gigabit Ethernet, this translates into a rate error of 1.488 frames per second. As a result, a Gigabit device may legally transmit frames at maximum rate between:

1,487,946.4 fps
— and —
1,488,244.0 fps

For 10 Gigabit Ethernet, the formula described above applies but with the transmit clock rate multiplied by a factor of 10. The resulting frames per second rate, at wire speed and with minimum frame size and interframe gap, is 14,880,952 frames per second.

The standard allows for clock variances, with a maximum error in the range +/–100 PPM. For 10 Gigabit Ethernet, this translates into a rate error of 14.88 frames per second. As a result, a 10 Gigabit device may legally transmit frames at maximum rate between:

14,879,464 fps
— and —
14,882,440 fps

DiffServ Counters

Selected Gigabit modules, including the LAN-3710AL/AE, XLW-3720A/3721A, and XFP-3730/3731 10 Gigabit modules support DiffServ tracking on the receiving port. When this option is enabled, the port examines a specified byte in the frame and records the byte value.

Some DiffServ counters are implemented differently for IPv4 and IPv6 applications as well as different modules. For example, IPv4 applications have an option for counting the number of received frames that contain a Type of Service (TOS) byte. These applications also tally the number of frames with specific TOS values. All other DiffServ counters are implemented for both IPv4 and IPv6 applications, including all QOS values.

Note: See *Table 8-28* and *Table 8-29 on page 438* for the functional differences in the configuration of DiffServ counters for selected Ethernet modules.

Table 8-28. Modules That Support DiffServ Counters/Rates

Module	IPv4 DiffServ Counters/ Rates	IPv6 DiffServ Counters/ Rates
LAN-330xA	Yes	No
LAN-331xA	Yes	No
LAN-3306A/LAN-332xA	Yes	Yes
LAN-3710AL/AE	Yes	No
XLW-3720A/3721A XFP-3730A/3731A	Yes	Yes

Table 8-29. DiffServ Configurations

Module	IPv4 Destination Filter	IPv6 Destination Filter	Offset	TOS for IPv4	Other DiffServ Variables
LAN-330xA	Yes	No	No	Yes	Yes
LAN-331xA	Yes	No	No	Yes	Yes
LAN-3306A/ LAN-332xA	Yes	No	No	Yes	Yes
LAN-3710AL/AE	No	No	Yes	Yes	Yes
XLW-3720A/3721A XFP-3730A/3731A	Yes	Yes	No	Yes	Yes

Setting up DiffServ Tracking

Set up DiffServ tracking by selecting the *Port Setup* option from the port menu, then opening the *DiffServ* tab. (Refer to *Figure 8-77*.)

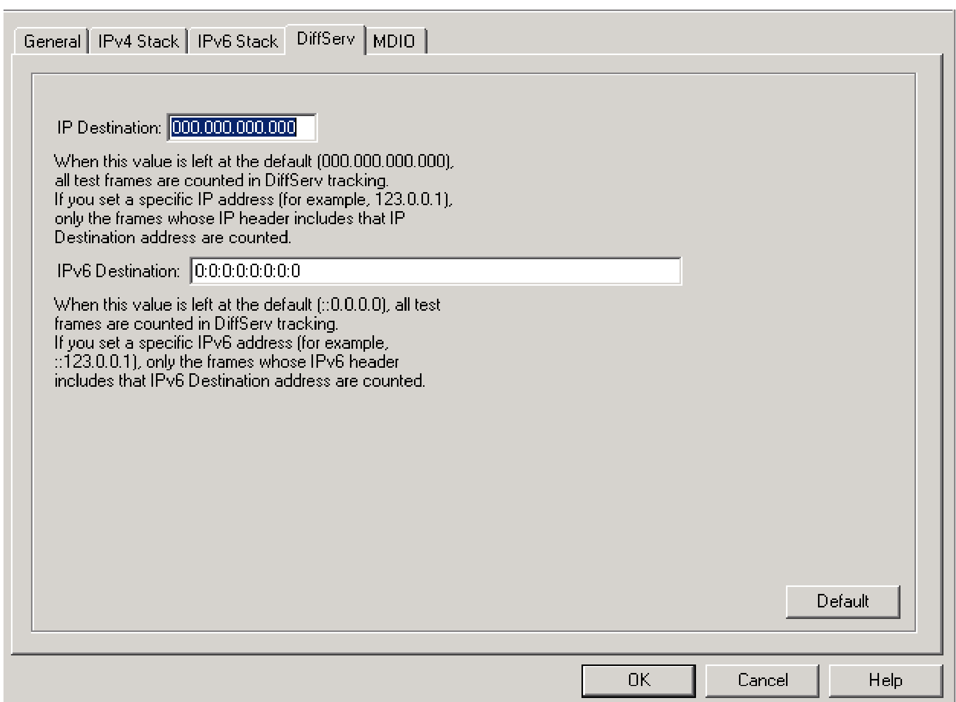


Figure 8-77. IPv4 and IPv6 Destination Fields

IP destination

There are two IP destination fields for XLW and XFP modules, one for IPv4 applications and one for IPv6 applications. These options provide the capability to use a filter on which test frames are examined on the receiving SmartBits port.

- When this value is left at the default (000.000.000.000), all test frames are counted in DiffServ tracking.
- If a specific IP address (e.g., 123.0.0.1) is set, only the frames whose IP header includes that IP destination address are counted.

DiffServ Counter Types

DiffServ counters are displayed within SmartCounters by group or member counters. (See *Step 9 on page 422* for a description of how to select these options on the predefined SmartCounter window.) See *Table 8-30* for a listing of which DiffServ counters are displayed for IPv4 and IPv6 protocols.

Table 8-30. DiffServ Counter Descriptions

Group Counter	Member Counter	IPv6	IPv4
<IPv4_DSCP> <IPv6_DSCP>	IPv4 QoS 0 (DSCP 0-7) ... IPv4 QoS 7 (DSCP 53-63) IPv6 QoS 7 (DSCP 0-7) ... IPv6 QoS 7 (DSCP 53-63)	Yes	Yes
<IPv4 QoS0> <IPv4 QoS1 ... <IPv4 QoS7 <IPv6 QoS0 <IPv6 QoS1 ... <IPv6 QoS7	IPv4 DSCP 0 ... IPv4 DSCP 7 IPv4 DSCP 0 ... ... IPv6 DSCP 0 ... IPv6 DSCP 7 IPv6 DSCP 0	Yes	Yes
Min Delay (T=0 D=1, R=0,C=0) Max Throughput (T=1,D=0,R=0,C=0) Max Reliability (T=0,D=0,R=1,C=0) Min Cost (T=0,D=0,R=0,C=1) Normal (T=0,D=0,R=0,C=0)		No	Yes

Table 8-30. DiffServ Counter Descriptions

Group Counter	Member Counter	IPv6	IPv4
<IPv4 Raw TOS>	IPv4 BITs Value 0 IPv4 BITs Value 1 ..... IPv4 BITs Value 254 IPv4 BITs Value 255	Yes	Yes
<IPv6 Raw Traffic Class>	IPv6 BITs Value 0 IPv6 BITs Value 1 ... IPV6 BITs Value 254 IPV6 BITs Value 255		

VLAN Priority Counters

The VLAN priority counters are supported on the following modules: LAN-3306A, LAN-332xA, XLW-372xA, and XFP-373xA.

This option is enabled during the configuration of the test stream by selecting one of eight values for the *Pri* field. (Refer to*"VLAN Priority"* in *Chapter 5, "Advanced Operational Theory"* for a description of how to configure this field.) These values represent eight levels of VLAN priority that are used to filter traffic into eight separate counters. The VLAN counters are viewed within the *SmartMetrics Counters* window and are shown in *Figure 8-78*.

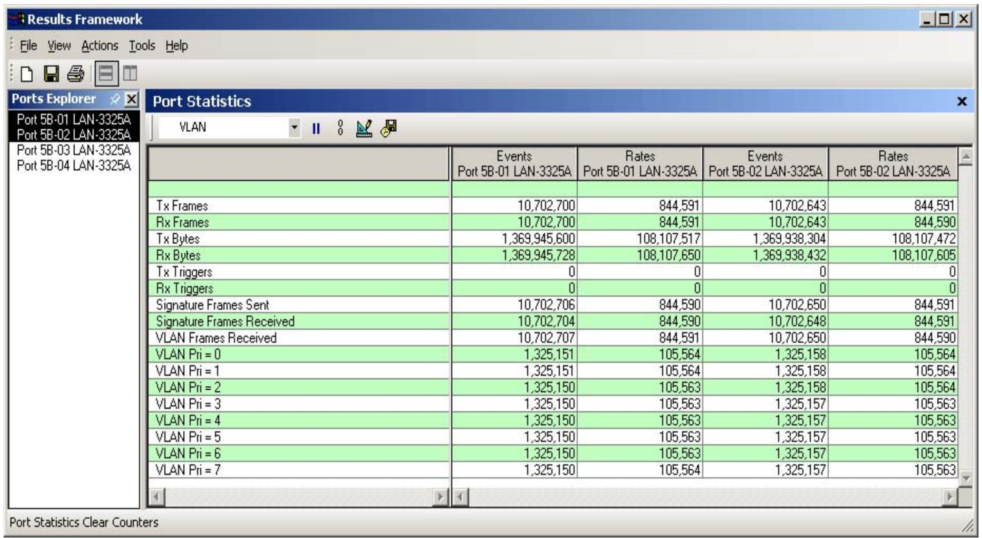


Figure 8-78. VLAN Counters in the Port Statistics Window

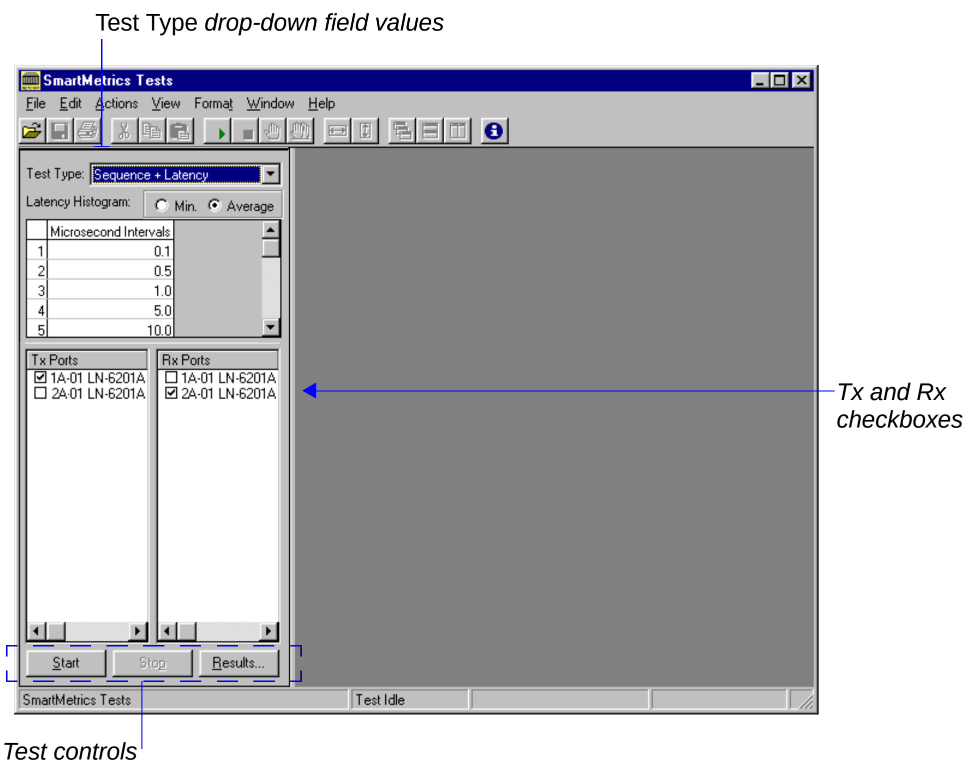
The VLAN priority counters provide the capability to identify counts per VLAN priority assignment (0-7). The VLAN counter is 32 bits.

Running the Sequence and Latency Test

The Sequence and Latency test provides information such as latency, latency distribution, frame loss, and frame sequencing.

To run this test:

1. If not connected, connect to the SmartBits 6000x chassis and reserve two ports for the test.
2. Choose **Options** > **SmartMetrics Tests**.
   The SmartMetrics window appears.

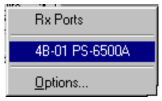


3. From the *Test Type* drop-down menu, choose **Sequence & Latency**.
   Notice that results can be shown as minimum or average latency values.
4. Select the transmitting port and the receiving port.
5. Click the **Start** button.
6. Make SmartCounters the active window to view statistics while the test is running. (Refer to *"Configuring Transmit Streams on TeraMetrics Modules" on page 392* for a complete description of how to configure and display SmartCounters.)

Important: The test can be run in *Single Burst* mode. Choosing this mode enables you to control the exact number of frames sent during the test.

7. Click the **Stop** button to stop the test.

8 Click the **Results** button, and choose the receiving card from the drop-down menu.



The SmartMetrics spreadsheet appears.(See *Figure 8-79*.)

The Stream *column lists streams by number.*

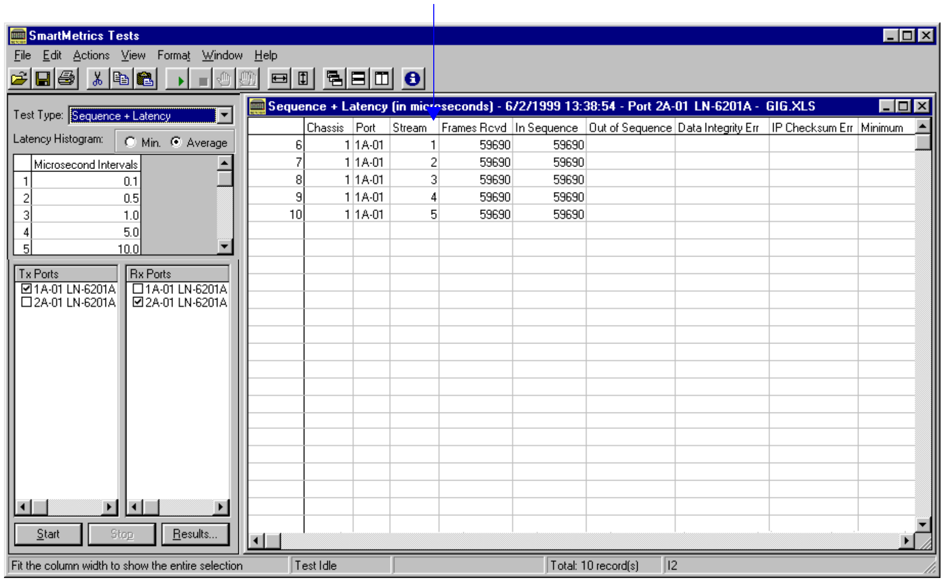
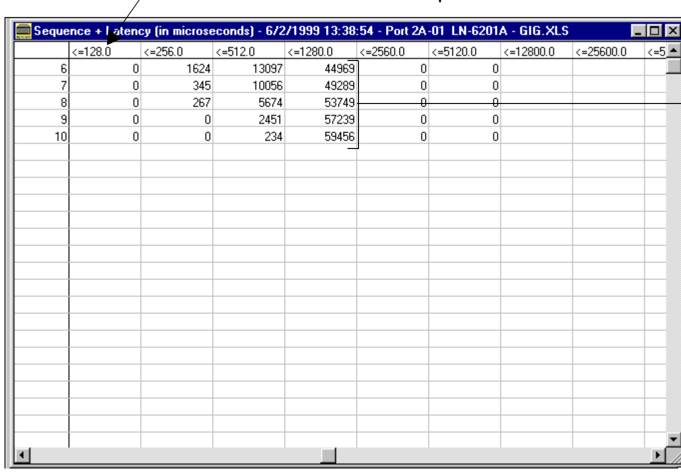


Figure 8-79. SmartMetrics Spreadsheet

9 Scroll to the right to view the latency distribution buckets. (See *Figure 8-80*.)

Buckets are incremented in µs.



The frame count in SmartCounters should equal the total number of frames for all buckets when the test is finished.

Figure 8-80. Buckets View

10 To save the results in Excel format, choose **File** > **Save As**, name the file, and select `.xls`.

11 Double-click the saved Excel file to open it, and then graph the results.

Each data series represents one of the QOS streams that was created. (See *Figure 8-81*.)

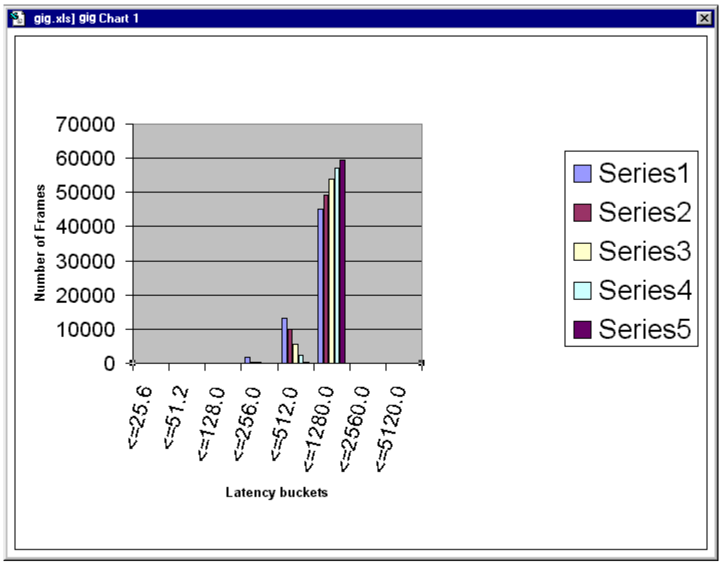


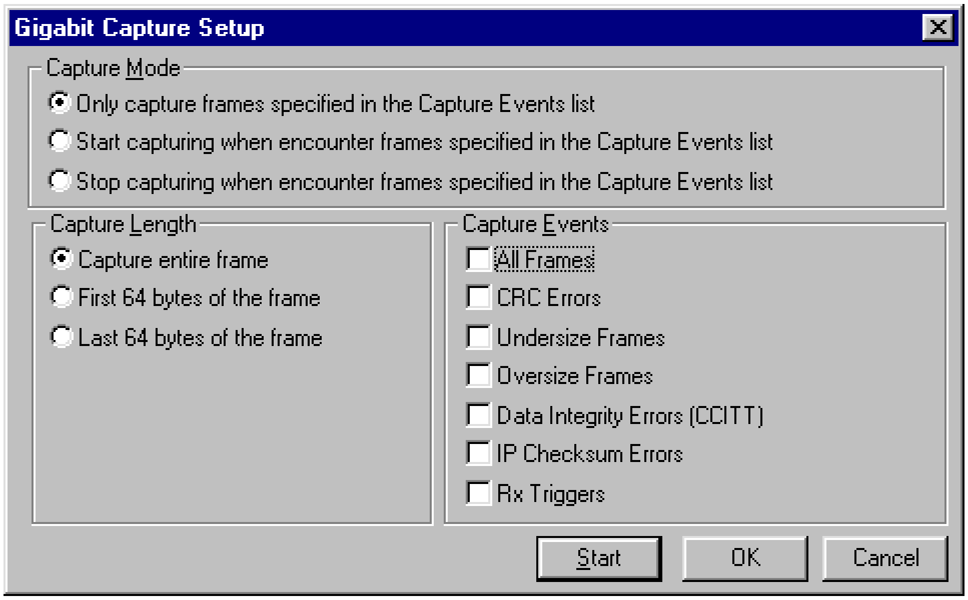
Figure 8-81. Excel File

Capture vs. SmartMetrics

The capture buffer may be used as an additional debugging tool, independent of the SmartMetrics capabilities. Although more practical performance metrics may be obtained without the use of the capture buffer, it is a useful tool if certain error conditions need to be analyzed. For standard performance analysis, SmartMetrics provides the same capabilities without the need for a capture buffer.

SmartWindow captures each frame, not just a sample of frames. The capture buffer is a single-triggered 1Mb RAM. Once triggered, the buffer is filled to capacity, and no more data can be captured until triggered again.

The capture buffer can be set to trigger on the following events.


Gigabit Capture Setup
Capture Mode
Only capture frames specified in the Capture Events list
Start capturing when encounter frames specified in the Capture Events list
Stop capturing when encounter frames specified in the Capture Events list
Capture Length
Capture entire frame
First 64 bytes of the frame
Last 64 bytes of the frame
Capture Events
All Frames
CRC Errors
Undersize Frames
Oversize Frames
Data Integrity Errors (CCITT)
IP Checksum Errors
Rx Triggers
Start
OK
Cancel

Additional Feature for the LAN-3710AL/AE/AS

Operation/Administration/Management (OAM) is an additional SmartBits feature that applies to the LAN-3710AL/AE/AS GbE modules.

Defining OAM Patterns

The *Streams Setup* window for the LAN-3710AL/AE/AS modules includes options to enable the sending and receiving of frames with a customized OAM preamble.

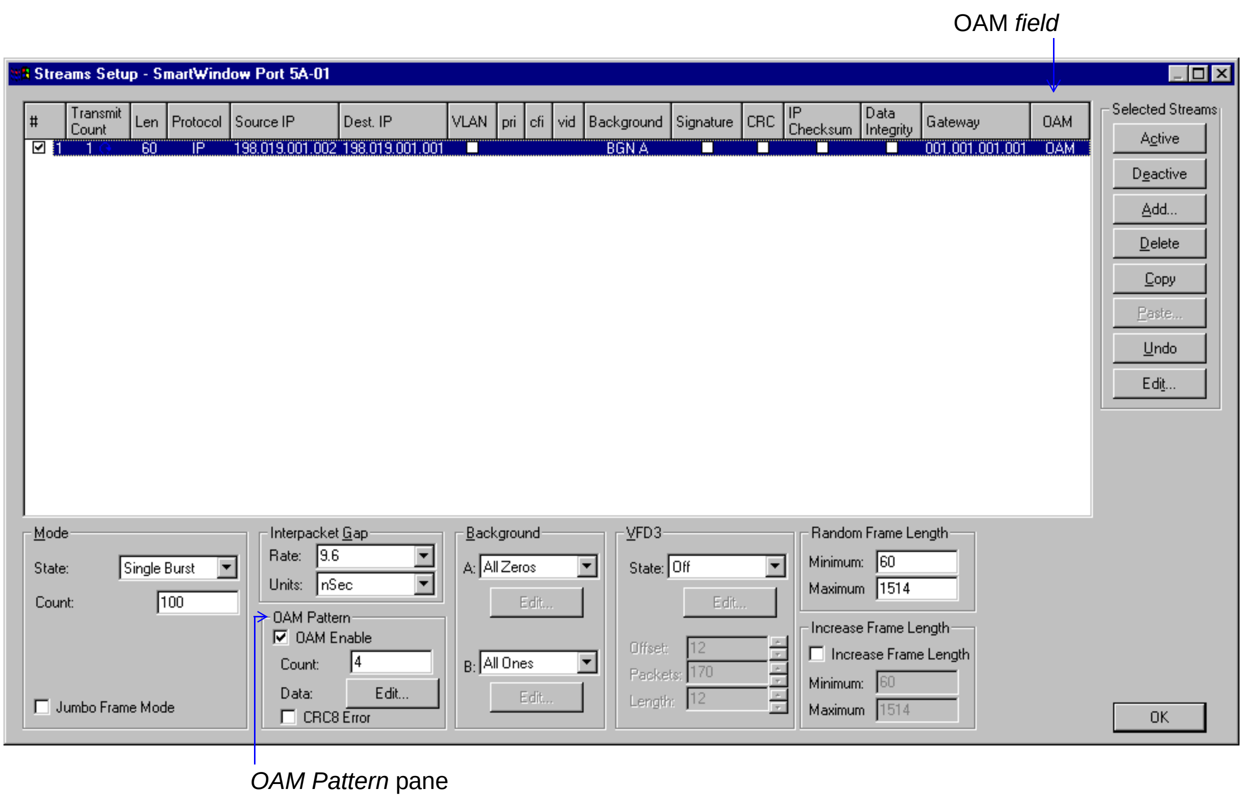


Figure 8-82. OAM Options in the Streams Setup Window (LAN-3710AL/AE/AS)

When selected, the *OAM Enable* checkbox configures the port to send or receive OAM frames. When this option is enabled, the port can receive OAM frames at any time.

The port generates OAM frames for a stream when the *OAM* field in the stream template is set to either **OAM** or **Idle.** (See *Figure 8-82*.) If the OAM field is set to **Normal**, the port generates non-OAM frames for that stream template, regardless if the *OAM Pattern* checkbox is selected.

Count — The *Count* field specifies how many OAM patterns should be prepended to each frame that is transmitted for a stream template. Each OAM pattern is 6 bytes long. The maximum count is 128.

Figure 8-83 shows the Custom Editor display for an OAM stream with a count of **4**. (Click the **Edit** button in the *OAM Pattern* pane to open the Custom Editor.) Each pattern appears in an alternating black and green font. In this example, the SmartBits port generates test frames for this OAM stream by sending the first frame with the first pattern, the second frame with the second pattern, etc.

```
FF FF FF FF FF FFFirst frame
EE EE EE EE EE 66Second frame
66 66 67 77 77 77Third frame
89 88 89 88 99 99Fourth frame
```

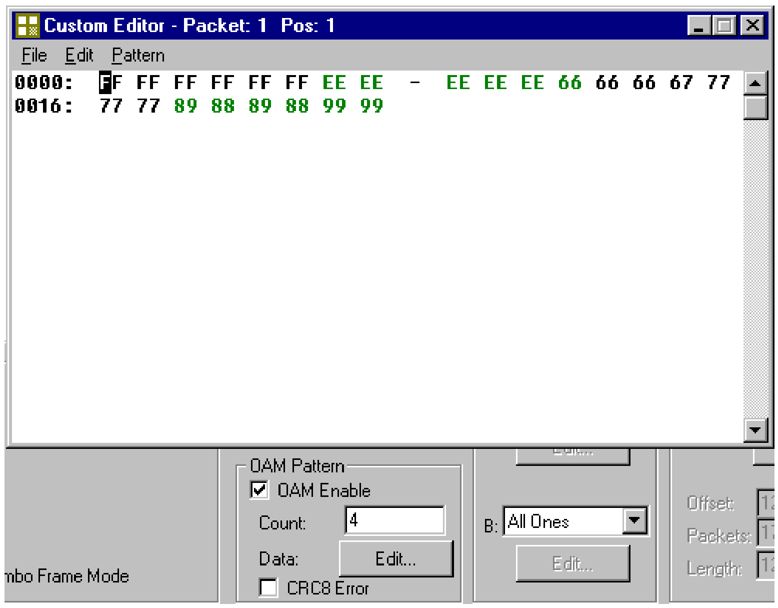


Figure 8-83. Four OAM Patterns

Data: Edit field and button — Click the **Edit** button to open the Custom Editor, which enables you to edit the OAM pattern(s).

CRC8 Error checkbox — When selected, all OAM frames have a CRC8 error.

Multiple Streams and Transmit Count

With multiple streams, the SmartBits port generates the frames for each stream following the stream order and the transmit count per stream (if specified). Multiple OAM patterns are applied in order within this sequence.

For example, in *Figure 8-84*, stream 1 is an OAM stream and has a transmit count of 10.

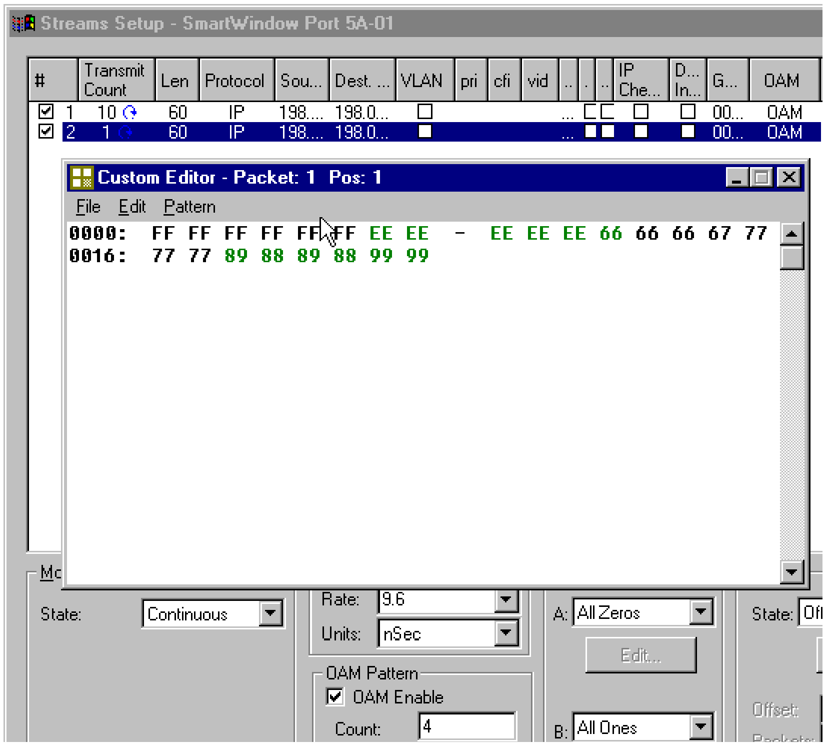


Figure 8-84. OAM Patterns with Multiple Streams

The stream scheduler sends 10 frames for stream 1 before it sends one frame for stream 2. The four defined OAM patterns are inserted into the 10 frames of stream 1 in sequence, as shown below.

PatternFrame	Stream
FF FF FF FF FF FF1	1
EE EE EE EE EE 662	1
66 66 67 77 77 773	1
89 88 89 88 99 994	1
FF FF FF FF FF FF5	1
EE EE EE EE EE 666	1
66 66 67 77 77 777	1
89 88 89 88 99 998	1
FF FF FF FF FF FF9	1
EE EE EE EE EE 6610	1

After the 10 frames for stream 1 have been sent, the port sends a frame for stream 2. This stream is also an OAM stream, and it is sent with the next OAM pattern in the four-pattern sequence.

PatternFrame	Stream
66 66 67 77 77 7711	2

Counters for OAM Frames

When the OAM pattern is enabled for a LAN-3710AL/AE/AS port, the port counters include results related to OAM frames, OAM idle frames, OAM frames with CRC8 errors, and normal (non-OAM) frames sent and received by the port.

These counters appear at the bottom of the SmartCounters list.

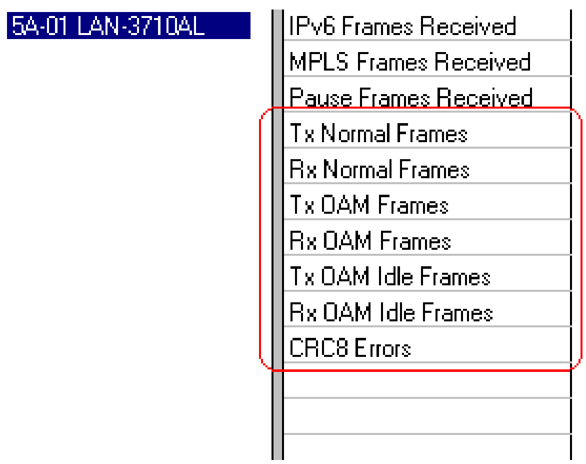


Figure 8-85. Counters for OAM Streams

Capture on OAM Frames

To set up capture of OAM frames:

1. Select **Capture** from the *Port* menu.
2. In the *10 Gigabit Capture Setup* dialog box, select **OAM Only** (located at the bottom of the *Capture Events* list).

   Selecting capture of OAM frames is exclusive. No other filtering can be done, and only OAM frames are captured. All OAM frames (both OAM and OAM idle) are tagged with **A** (for OAM frame).

Important: All normal and OAM frames (but not OAM idle frames) are tagged as CRC errored frames.

Chapter 9

Testing Frame Relay Switches

This chapter describes how to use SmartWindow and the frame relay family of WAN SmartCards to evaluate the performance of frame relay devices. It includes two setup procedures for:

- The WN-3445A Channelized DS3 SmartCard. (Refer to *"Test Using the WN-3445A Channelized DS3 SmartCard" on page 454*.)
- The WN-3405 Fractional T1 SmartCard. (Refer to *"Test Using WN-3405 T1 SmartCards" on page 492*.)

See also *"Additional Features for WAN Cards"* for capabilities and options not covered by the setup examples. These sections include:

- *"Duplicate PVCs Easily" on page 508*
- *"Adjust Incorrect Number of PVCs" on page 509*
- *"Use Different Transmit Modes" on page 510*
- *"Perform SmartMetrics Tests" on page 512*
- *"Define a Frame Distribution Method" on page 513*
- *"Set up IGMP Streams on WAN Cards" on page 514*.

In this chapter...

About T1/DS3 Data Networking

T1 digital transmission technology was developed for use in telephone voice communications. In digital form, one voice signal requires 64,000 bits per second (64 Kbps). This basic channel unit was designated Digital Signal Level 0 (DS0). When 24 DS0 channels are multiplexed, the aggregate data rate is 1,536,000 bps. An additional 8,000 bps is used to keep the multiplexers synchronized at each end of the link. This brings the total data rate to 1,544,000 bps or 1.544 Mbps, the standard T1 rate.

Data Signal Level Three (DS3) was developed as carriers of major routes realized the need for a faster rate than T1. The DS3 rate of 44.736 Mbps is equivalent to the capacity of 28 T1s, plus additional overhead.

Fractional, Channelized, and Clear Channel Transmission

Fractional The earlier WAN T1 SmartCard (the WN-3415) is fractional: it provides a channel over over one port (line), and it enables you to select and transmit using a subset of the DS0s available in the T1 line.

Channelized The channelized T1 and DS3 SmartCards (the WN-3441A or WN-3445A) enable you to create multiple individual channels within a T1 line, assigning one or more DS0s to each channel.

Clear channel The WN-3445A DS3 SmartCard is also capable of clear channel transmission. The DS3 line then carries a single channel that is allocated all the available bandwidth. The single channel can be assigned multiple PVCs or one PPP connection. There is no T1 line in clear channel mode.

T1/E1 Digital Hierarchy

Table 9-1 outlines the digital hierarchy that includes T1, E1, and DS3.

Table 9-1. T1/E1/DS3 Digital Hierarchies

	Signal Level	Digital Bit Rate	Equivalent Voice Circuits	Carrier System	Usual Medium
North America	DS-0	64 Kbps	1	*None*	Wire or Cable
	DS-1	1.544 Mbps	24	T-1	
	DS-1C	3.152 Mbps	48	T-1C	
	DS-2	6.312 Mbps	96	T-2	
	DS-3	44.736 Mbps	672	T-3	Coaxial Cable
	DS-4	274.176 Mbps	4032	T-4	
Europe and Other CCITT Nations	**Signal Level**	**Digital Bit Rate**	**Equivalent Voice Circuits**	**Carrier System**	**Usual Medium**
	0	64 Kbps	1	*None*	Wire or Cable
	1	2.048 Mbps	31*	E-1	
	2	8.488 Mbps	120	E-2	
	3	34.368 Mbps	380	E-3	Coaxial Cable
	4	139.264 Mbps	1920	E-4	
	5	565.148 Mbps	7680	E-5	

*A reserved signaling channel cannot be used to carry user data.

Characteristics of a Frame Relay Switch

A frame relay switch is designed to support data in bursts and at high speeds in a bi-directional, conversational method of communication. The switch operates primarily at Layers 1 and 2 of the network model. It works by providing virtual circuit connections, in which dynamic links act like a pipe for moving traffic.

Service fees for frame relay connections are based on the Committed Information Rate (CIR), which is equal to the bandwidth available from one end to another. The minimum frame size is 32 bytes; the maximum is 8,191 bytes.

The local address for each link on a frame relay switch is the DLCI.

Types of Virtual Circuits

As noted above, a frame relay switch works by providing virtual circuit connections. There are three types of Virtual Circuits (VCs):

Switched (SVC)
The SVC is similar to a voice connection made through the telephone network. When the network receives a connection request, it sets up a connection, data is sent, and then the connection is terminated.

Permanent (PVC)
The PVC is a point-to-point connection that is similar to a leased data line. It is dedicated and used over long periods of time.

Multicast (MVC)
The MVC is a connection between groups of users, who can use both SVCs and PVCs.

Note: Currently, SmartBits tests support only the PVC type of frame relay circuit.

Testing for Throughput Capacity

Use the test procedures described in this chapter to determine the throughput capacity of a frame relay switch with a T1 (1.544 Mb) interface.

SmartWindow can be used to perform three basic tests in this area:. (See *Table 9-2*.)

Table 9-2. Frame Relay Test Methodology

Test	Used by	Objective
1	End user	To see that the switch does not set the DE bit before the CIR is exceeded.
2	Developer	To see at which point the switch starts to drop frames, i.e., where frames received are less than frames transmitted.
3	Developer	To see how well the Link Management Protocol (LMI Rev.1/ ITU Q.933 Annex A/ T1.617 Annex D) operates.

Test Objectives with a Frame Relay Device

A frame relay device is designed to support bursty data at high speeds in a bi-directional, conversational communication mode. The switch operates primarily at Layers 1 and 2 of the network model. It works by providing virtual circuit connections, in which dynamic links act like a pipe for moving traffic.

The frame relay link consists of one or more virtual channels used for allocating dedicated bandwidth resources for multiplexed devices across the link. These logical channels are identified using the Data Link Connection Identifier (DLCI).

Note: The DLCI must be the same at the SmartCard port as it is for the DUT.

To perform this test:

The typical test sequence is as follows:

1. Configure the PVC.
2. Send increasingly heavy traffic streams.
3. Observe the line rates at which DE frames are tagged and dropped.
4. Check and troubleshoot the PVCs to confirm switch performance.

Test follow-up

Configure multiple PVCs with varied frame rates to confirm the results of the single PVC. Verify that the link management protocol is working properly.

Test Using the WN-3445A Channelized DS3 SmartCard

Use the WN-3445A SmartCard to perform frame-level testing, up to full line-rate, for WAN and broadband access devices, LAN routers, and switches. The card can interoperate with other SmartBits cards to test high-performance internetworking between frame relay/PPP, WAN and LAN, ATM, and other frame relay or PPP devices, running Layer 2 and Layer 3 tests.

Clear channel operation

The WN-3445A can be configured for clear channel transmission (one data channel with full bandwidth). (See *"Configuring the WN-3445A for Clear Channel Transmission" on page 490* for guidelines.)

Notes:

- For a procedure with the same test objectives but using the WN-3405 T1 SmartCard, see *"Test Using WN-3405 T1 SmartCards" on page 492*.
- The WN-3441A can be substituted for the WN-3445A in tests related to throughput capacity of a frame relay switch.

Summary of Specifications

Feature/Function	WN-3445A
Ports per card	1
Maximum cards per chassis (SmartBits 2000)	10 (Each card uses two slots.)
Line rate	DS3 (44.736 Mbps)
Signaling and channelization	Channelized mode: up to 672 data channels Clear channel mode: 1 channel
Loopback	Remote or disable
Network connection	Dual 75-ohm BNC connector
Line framing	C-bit or M13
Line encoding	B3ZS
Transmit clock	Internal or loop-timed

Latency Measurements

The WN-3445A card can perform Layer 2 latency measurements using the trigger mechanism, with tests running between it and all compatible SmartCards.

For Layer 3 latency tests, the card interoperates with other WN-34xx cards, as well as other cards that support SmartMetrics testing using the transmit time signature field.

These other (non-WAN) cards include the following:

Ethernet LAN	POS
ML-5710/A	POS-3500B/Bs
ML-7710	POS-3502A/As
LAN-3101A/B	POS-3505A

Layer 3 Test Functionality

Layer 3 tests that can be performed using the WN-3445A card are as follows:

- Latency Over Time
- Latency Distribution
- Raw Packet Tags
- Sequence Tracking
- Sequence Tracking + Latency.

Interoperation with Other WAN Cards

The WN-3445A card can fully interoperate with other SmartBits WAN cards when their characteristics and configurations are properly matched. This matching is in respect to the DUT interface that is communicating with both cards.

Observe the following guidelines:

- The general port configuration for each SmartCard interface—such as encoding and framing—must match the configuration at the DUT interface.
- Clocking should be internal at one interface and loop-timed at the other.
- DS0 selection must also match at the SmartCard interface and the DUT interface. However, on the two SmartCards, these configuration parameters can differ; they must only match the configuration of the terminating DUT interface.

Figure 9-1 on page 456 shows an example of appropriate matching between interface configurations.

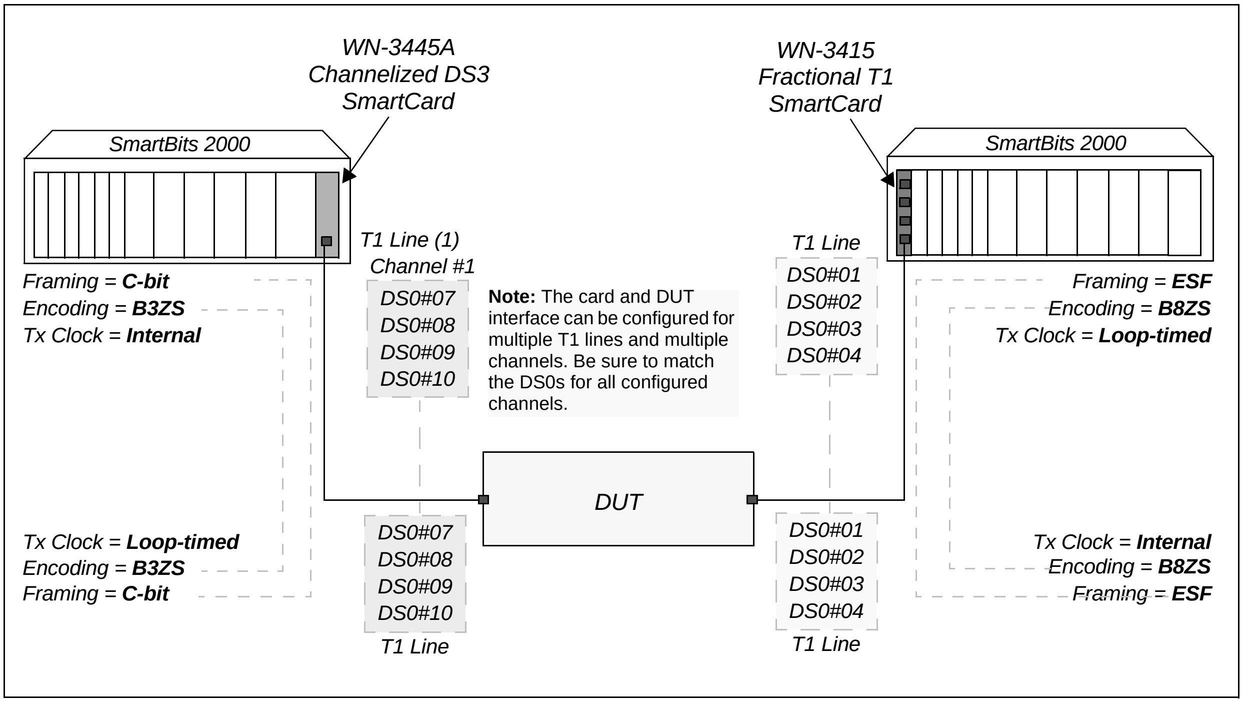
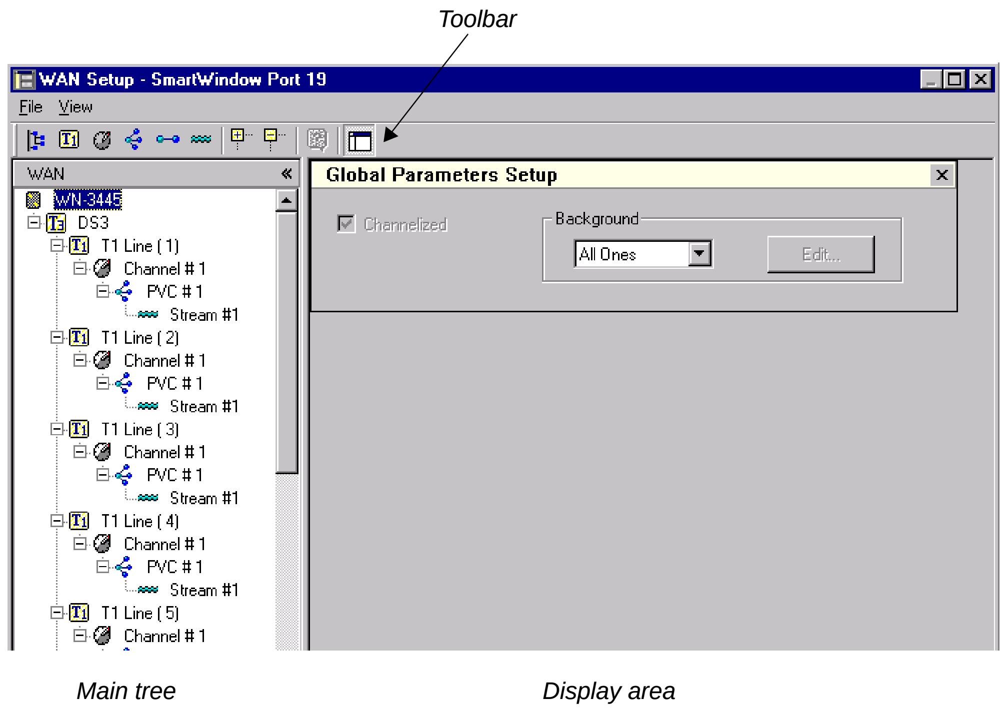


Figure 9-1. Configuration Matching between SmartCards and DUT Interfaces

SmartWindow Interface for WN-3445A

SmartWindow screens and dialog boxes for the new WN-3445A card employ a split-pane format. The left pane shows a main tree that organizes card functionality into a hierarchy. Use the tree to control what information and options are displayed in the right pane, which is the display area.



Right-clicking or left-clicking over entries in the main tree results in the following actions:

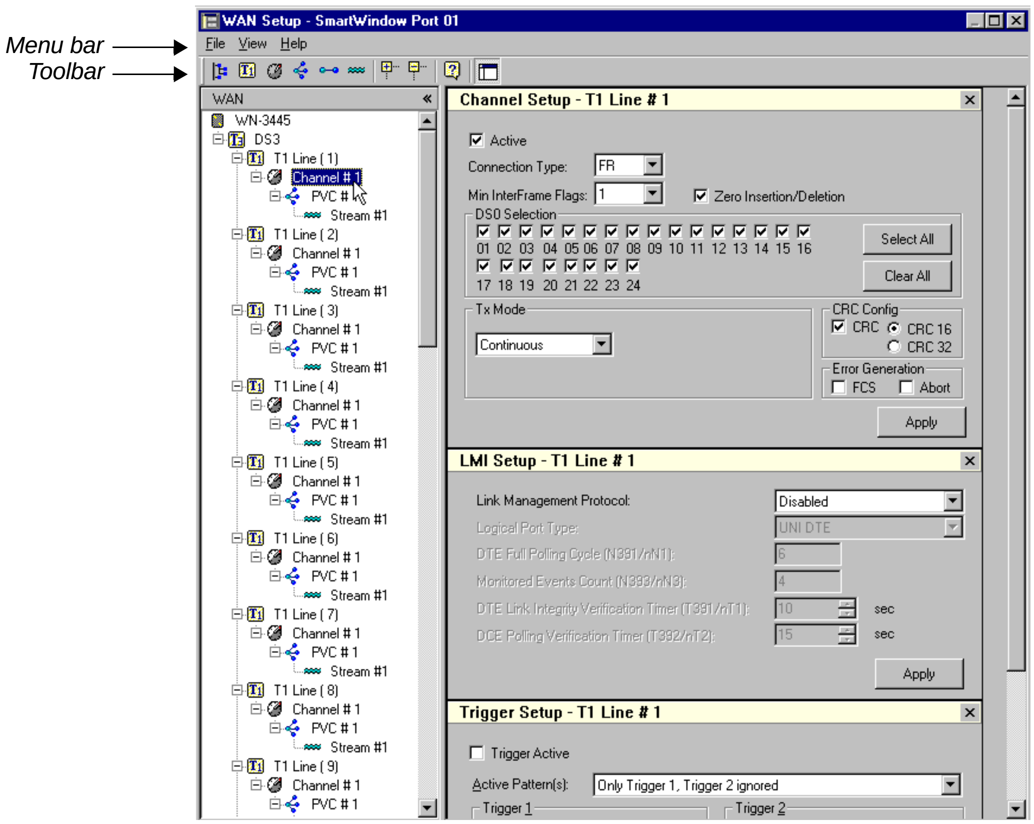
- **Right-click**
  Opens a pop-up menu with options to:
  - Add T1 lines, channels, PVCs, or streams (depending on tree item)
  - Hide or show individual panes in the display area
  - Perform editing operations (cut, copy, paste, or delete).
- **Left-click**
  Fills the display area with the associated setup pane. For example, left-click **Channel #1** under one of the T1 line entries in the tree to open the *Channel Setup* pane.

Multiple Setup Panes per View

For most entries in the main tree, the display area shows two or more individual setup or information panes. However, it might display a primary setup pane from which you can enable additional information panes (status and statistics) by right-clicking the entry in the main tree, then selecting from the pop-up menu. Two examples are provided.

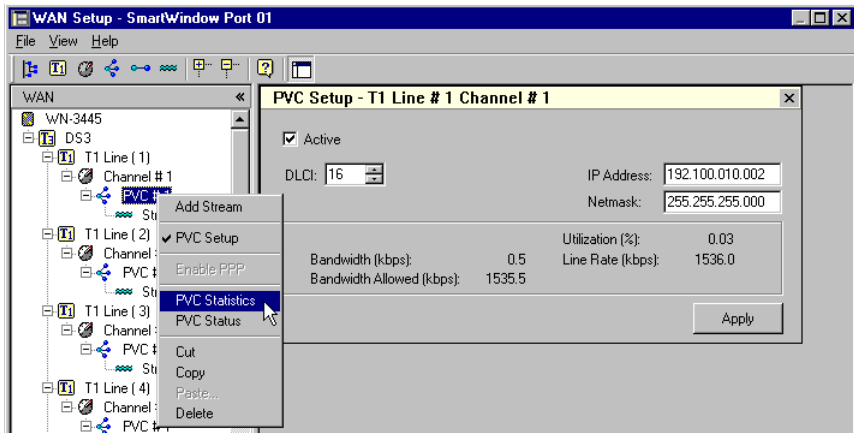
Example 1

Left-click **Channel #n** in the main tree, and three individual setup panes appear in the display area: *Channel Setup*, *LMI Setup*, and *Trigger Setup*. Use the scroll bars to move bottom setup panes into view.



Example 2

Left-click **PVC#n** in the main tree, and only the *PVC Setup* pane is shown. Add the *PVC Statistics* and *PVC Status* panes by right-clicking **PVC#n** in the main tree and enabling these views.



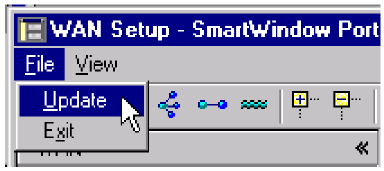
Toolbar and Menu Bar

A toolbar offers many of the options and controls that are available by using the main tree. All tool buttons self-identify when the cursor is held over them. The *View* option on the menu bar can be used to navigate among information and setup panes in the display area.

Using File › Update to Refresh SmartWindow Dialog Boxes

The *File* option on the *WAN Setup* menu bar includes an *Update* option. Use the *Update* option to refresh the information displayed in the SmartWindow interface. *The card configuration is not updated*. If you add channels in the *WAN Setup* window and need the new channels to appear in the *SmartCounters* window immediately, use the *File* > *Update* option.

Important: To update the card configuration completely, click the card image in SmartWindow and select **Update this Port** from the card menu. (For this option to appear, SmartWindow must be connected to the chassis, and the card must have been reserved.)



Select **File > Update** *from the* WAN Setup *menu bar to refresh SmartWindow dialog boxes. This option does not update the card onboard configuration.*

Select **Update This Port** *from the card menu to send the SmartWindow configuration to the card and activate the changes.*

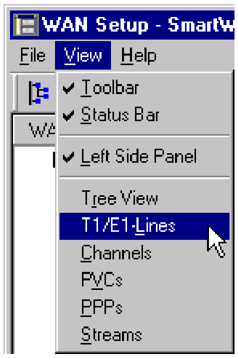
Using the View List to Modify Multiple Instances

The *View* option on the *WAN Setup* menu bar also provides a powerful way to modify a selected parameter in multiple instances of T1 lines, channels, PVCs, PPP connections, and streams.

When you select the *View* option and click any of these options, the display pane lists all the current instances. (See *Figure 9-2 on page 461*.) Select one or more instances in the following ways:

- Hold the left mouse button down and drag across entries.
- Hold the **Shift** key down to select a range of entries.
- Hold the **Ctrl** key down and click over multiple individual entries.

To modify a field value, right-click over the field and select from the pop-up menu. (See *Figure 9-2 on page 461*.)



Use the View *option on the* WAN Setup *menu bar to list all current instances of T1 lines, channels, PVCs, PPPs, or streams in the display pane.*

Select one or more instances to modify individual parameters globally. Drag across entries to select them, use the Ctrl *key and mouse to select individual entries, or use the* Shift *key and mouse to select a range of entries.*

To modify a field value, right-click the field and select from the pop-up menu.

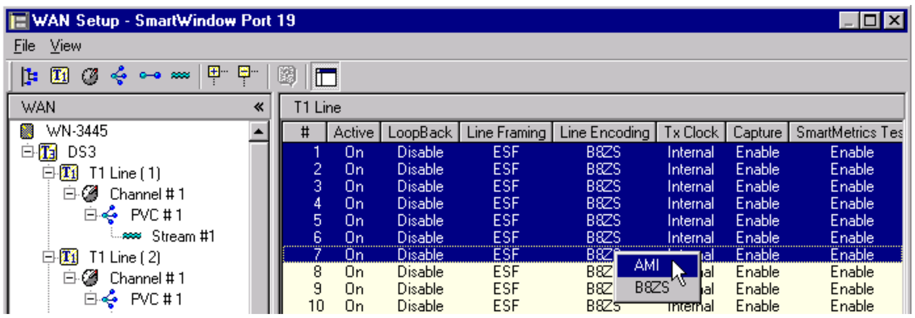


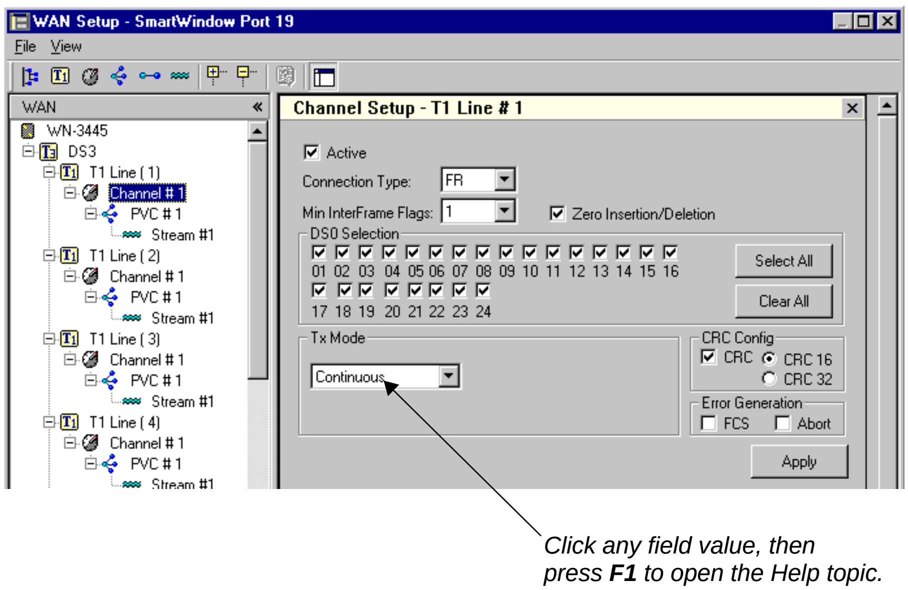
Figure 9-2. Using the View Option to Configure Multiple Instances

SmartWindow Help for WN-3445A

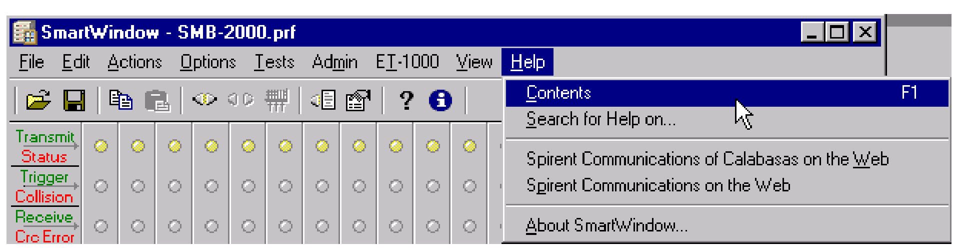
SmartWindow online Help includes detailed information for the WN-3445A SmartCard. Find Help information in two ways:

- Use context-sensitive (F1) Help to open the topic for a specific window or setup pane.

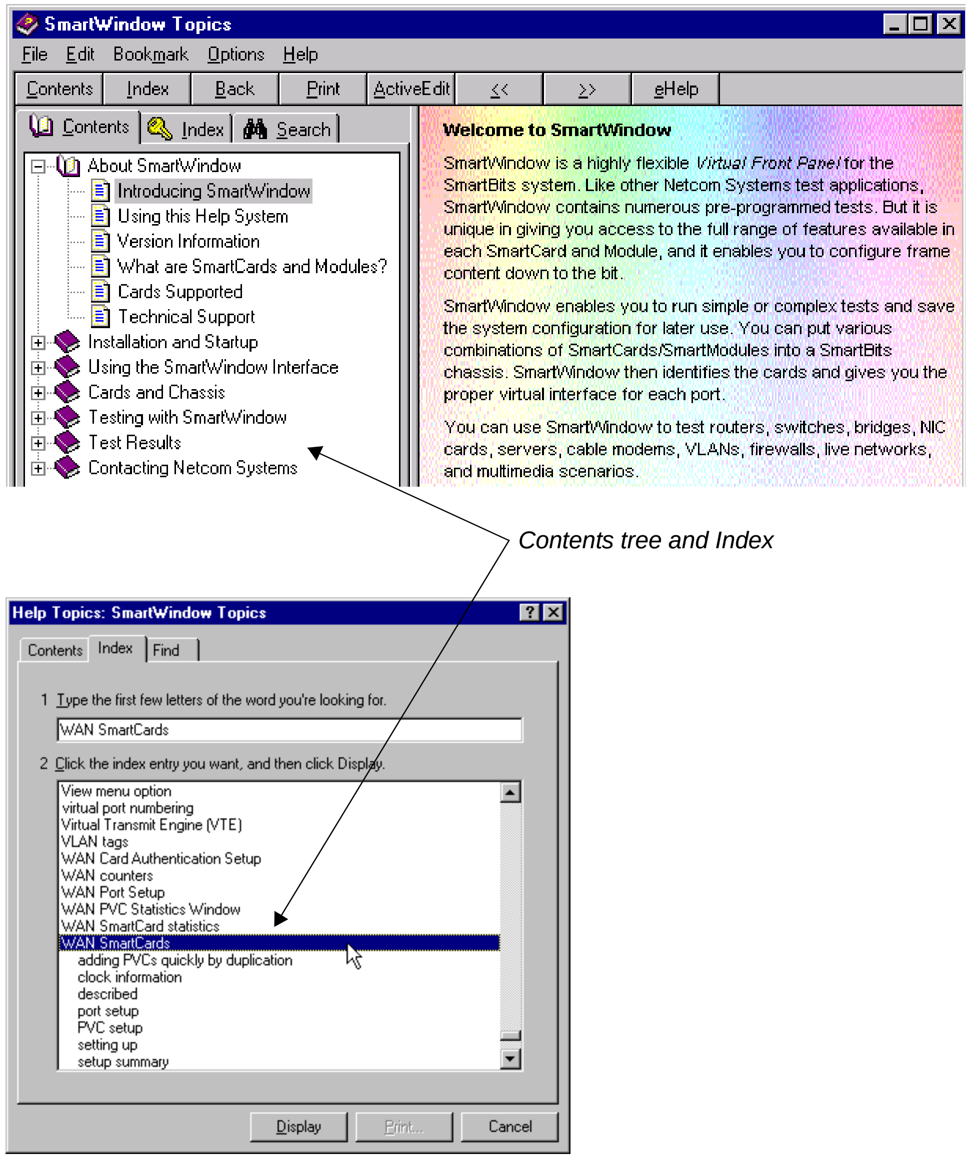
  Important: Click a field value in the window, then press **F1** for the Help topic to display.



- Use the Help contents and Index. Select **Help** > **Contents** from the SmartWindow main menu.



Use the Contents tree, Index, and Search functions to locate topics.



Setting up Tests with the Channelized WN-3445A

The WN-3445A SmartCard provides one port interface (T3), with an option of configuring from 1 to 28 T1 lines, each 1.544 Mbps and with 24 DS0s (data channels) per line.

Note: Set up the WN-3445A for clear channel transmission, in which the DS3 line carries one channel with full bandwidth. (See *"Configuring the WN-3445A for Clear Channel Transmission" on page 490*.)

Review the Default Configuration

When you first begin to set up the WN-3445A card, the default configuration provides the following:

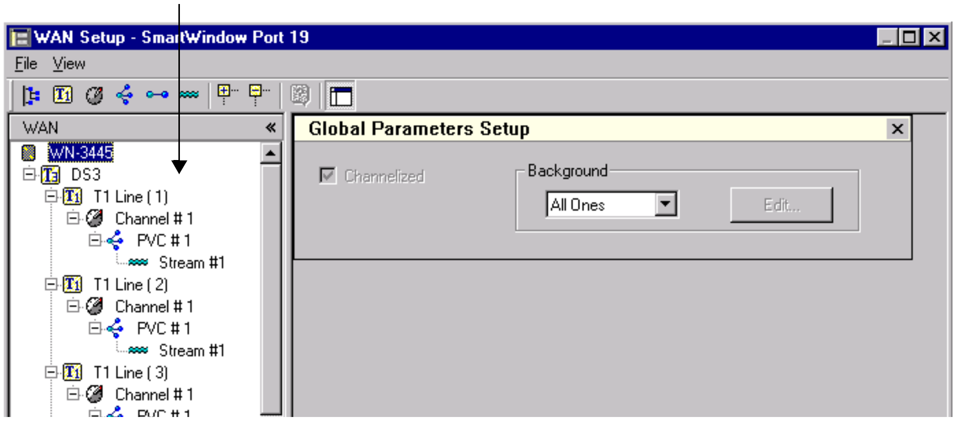
- One DS3 line
- 28 T1 lines
- One channel per T1 line
- Frame relay data link type for each T1 line
- One PVC per T1 line
- One stream per T1 line.

Note: Default transmission is at a frame rate of one frame per second.

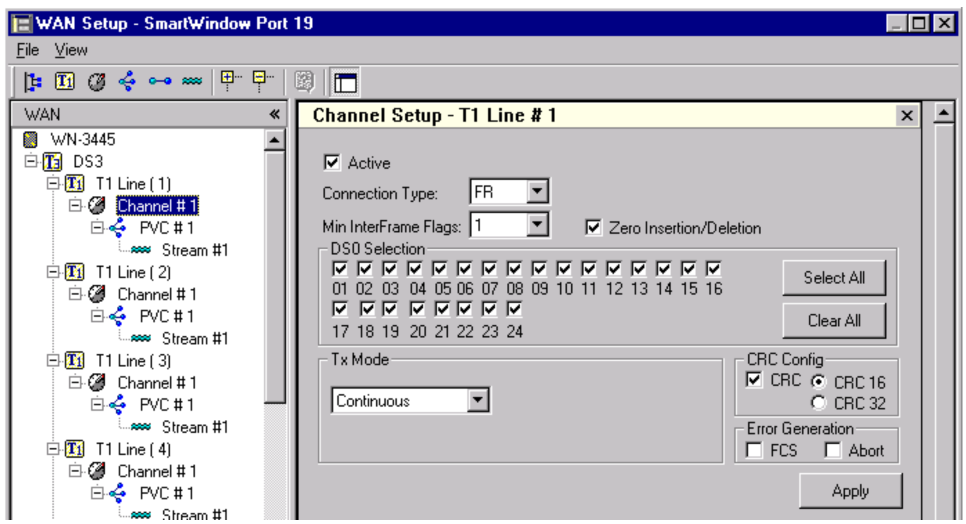
To see the default configuration and add channels:

1 Click the WN-3445A card image to open the card menu and select **Transmit Setup**. The main tree (i.e., the left side of *WAN Setup* window) shows the DS3 line and the T1 lines, each with one channel, PVC, and stream.

Main tree shows one DS3 line and 28 T1 lines.



2 Left-click **Channel #1** to open the *Channel Setup* pane for line #1.

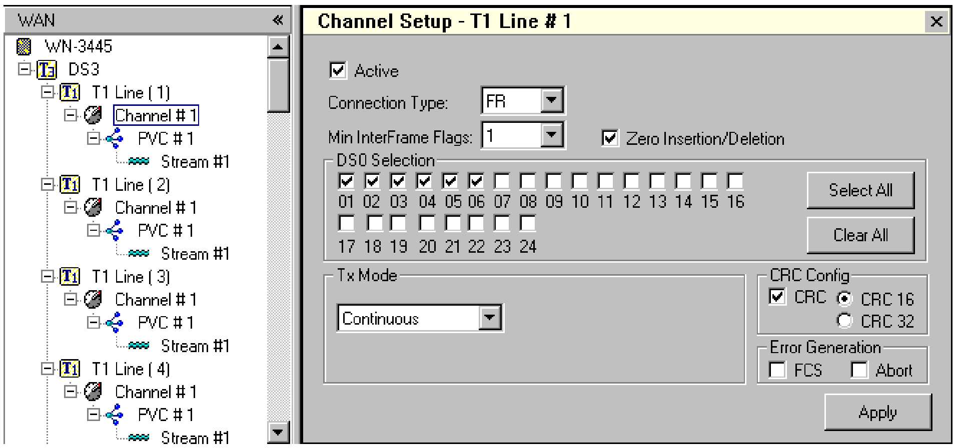


In the *DS0 Selection* field, all DS0s are selected, indicating that all the available bandwidth for line #1 has been assigned to channel #1.

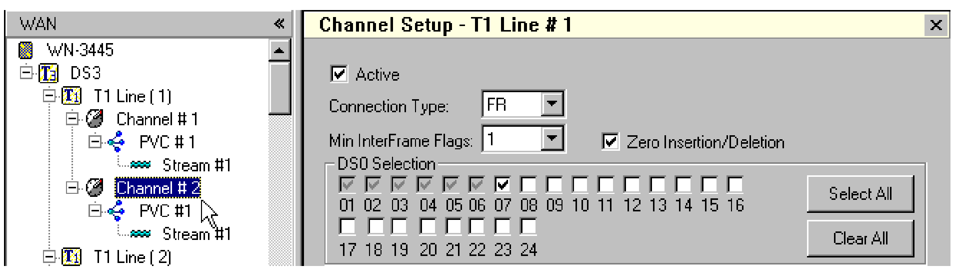
If you right-click on **T1 Line (1)** in the main tree and select **Add Channels...**, an error message appears.

3 To add channels to line #1, deselect/delete one or more DS0s in channel #1 to make them available for use with a second channel (or additional channels).

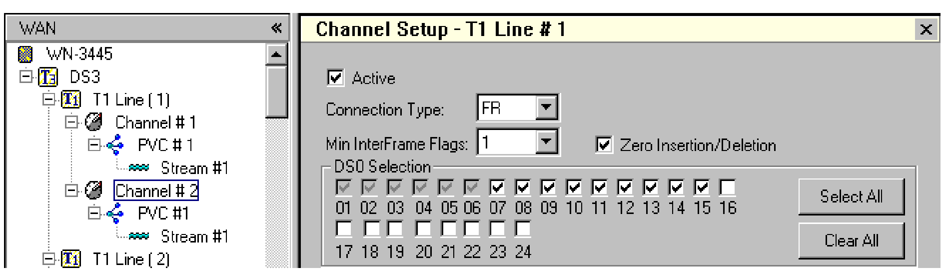
4 Click **Clear All** to clear/delete all DS0s. This action clears almost every DS0 checkbox. A warning message indicates that DS0#01 cannot be cleared/deleted. At least one DS0 must be selected for each channel. Use the checkboxes to select only DS0#02 through DS0#06.



5 Right-click **T1 Line (1)** in the main tree, select **Add Channels...,** and add one channel. The tree expands to add **Channel #2**. Left-click the **Channel #2** entry to display the *Channel Setup* pane.



In Channel #2, one DS0 is selected by default (DS0#07). Each channel must contain at least one DS0. DS0#01 through #06 are already assigned to channel #1 and are unavailable. All remaining DS0s (#08 through #31) are available and can be assigned to this channel or to other channels (if added). For this example, assign DS0#08 through DS0#15 to channel #2.



Global Parameters in the Channel Setup Pane

Other fields in the *Channel Setup* pane set global parameters that apply to the channel and its assigned DS0s generally. (Refer to the online Help for detailed descriptions of these options.)

Data Link Type

The channel *Data Link Type* field can be set to either *FR* (frame relay) or *PPP*. This selection determines how the next level in the main tree displays. (It shows *PVC* or *PPP*.) The related setup pane then displays options appropriate for the selected data link type.

Note: This document mainly uses a frame relay data link type in its examples, referencing setup of PVCs rather than PPPs. For details on the parameters that need to be configured if you set up PPP connections, refer to *"PPP Setup Pane"* or to the SmartWindow online Help.

PPP Setup Pane

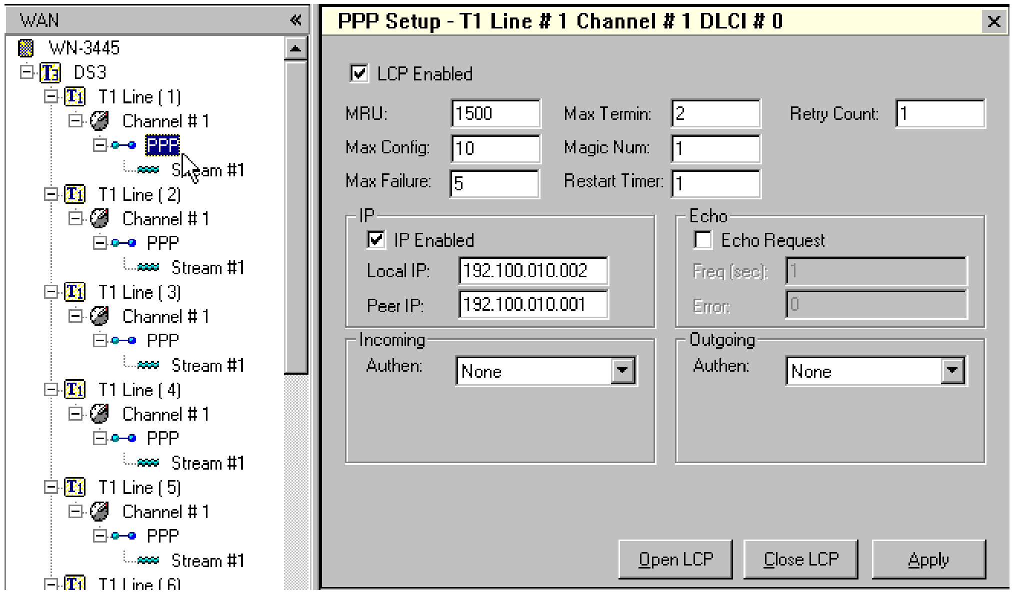
To check or modify the PPP setup options, click **PPP** under *Channel #1* in the main tree. Use this window to configure parameters for the Link Control Protocol (LCP) negotiation, such as IP Network Control Protocol (IP NCP), local and peer IP addresses, and authentication.

Transmitting frames with IP NCP disabled

The port can still transmit frames even when the *IP Enabled* checkbox is cleared, i.e., even when the IP NCP is disabled. This feature allows you to test protocol reject in PPP, if needed.

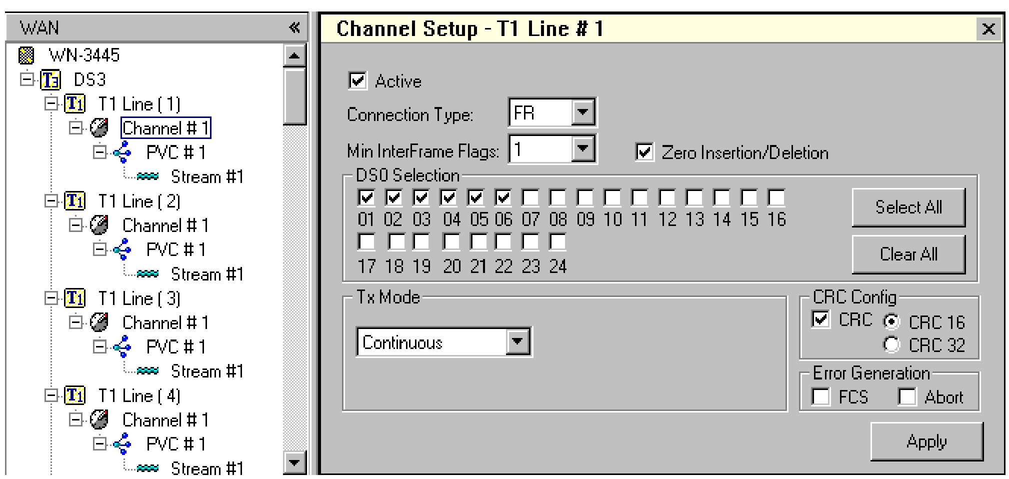
Note: When changes are complete, click the **Apply** button to start the PPP link actions that have been enabled. For example, if echo-request frames are enabled, the port begins sending them only when the **Apply** button is clicked.

A PPP session is automatically established when it is configured, but you can use the *Open LCP* and *Close LCP* buttons to later re-establish or close an LCP session.

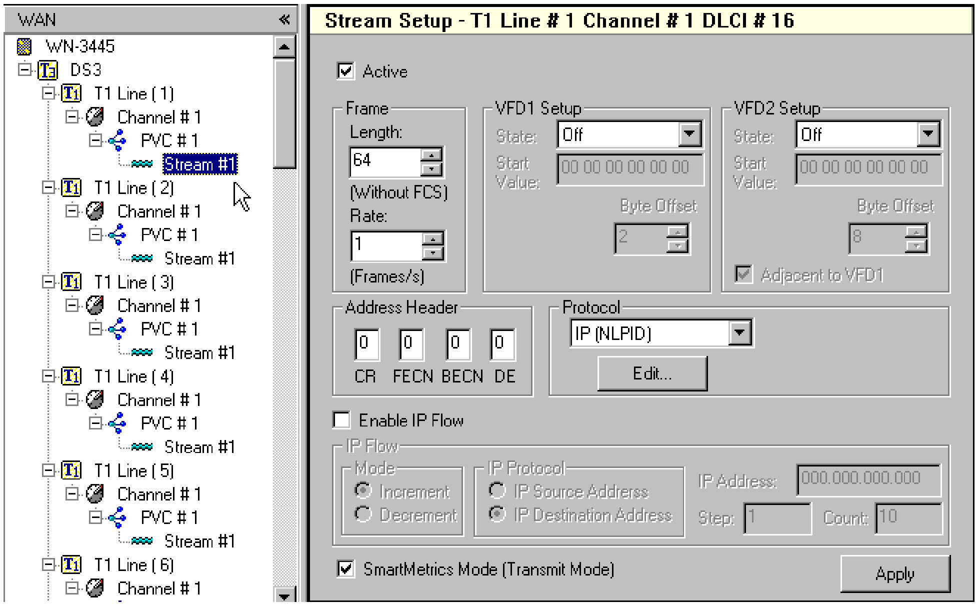


Configuring Streams

Stream setup is the same with either data link type. Once the number of DS0s to be assigned to a channel has been selected, its overall bandwidth is fixed at *number of DS0s x 64Kbps*. In this example, shown in the following figure, six DS0s have been assigned to channel #1. As a result, its available bandwidth is 6 x 64Kbps or 384Kbps. This is the bandwidth available to the streams that were set up for either frame relay PVCs or PPP connections.



To look at the stream setup options, click **Stream #1** under *Channel #1 / PVC #1* in the main tree.



Default field values for *Frame Length (Without FCS)* [(of *64* bytes)] and *Rate* (of *1* frame per second) are supplied. These default values are small enough to allow for upward adjustment within overall channel bandwidth.

Example: Increase the *Rate* field value to 1200 frames per second and click the **Apply** button. An error message displays (*Figure 9-3 on page 470*).

The rate exceeds the available capacity (bandwidth) of the channel. With a frame rate of 64 bytes, the bit rate is *8 x 64* = 512 bps.

Multiply this value by the requested number of frames per second (1,200). The result is a stream bit rate of 614,000 bps.

This value is much higher than the available channel bandwidth (of 384,000 bps) as calculated on *page 468*, even without including the Frame Check Sequence (FCS).

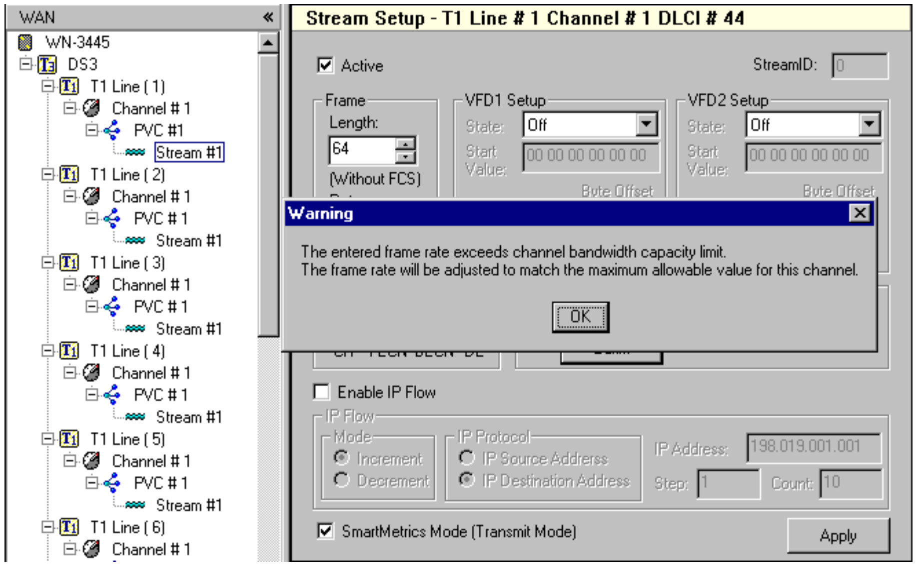
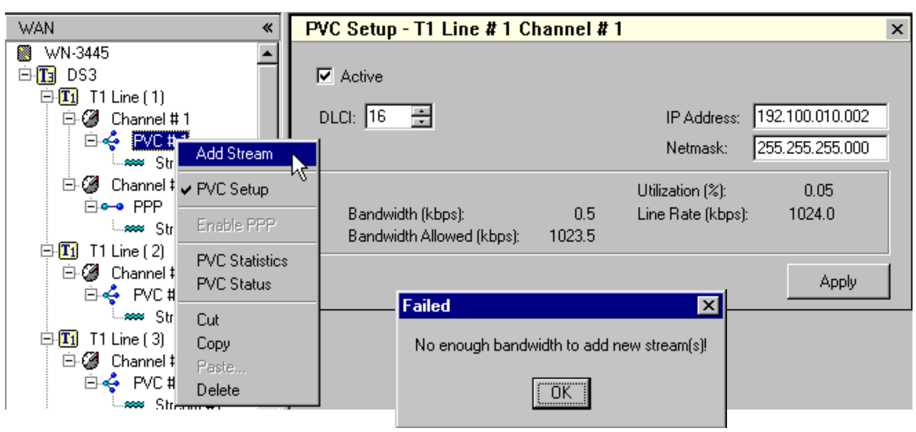


Figure 9-3. When Frame Rate Exceeds Channel Bandwidth

In response to this situation, the card automatically adjusts the frame rate to the highest acceptable value. In this case, it is 761 frames per second, which results in a bit rate of 365,280 bps.

However, this action assigns all the available bandwidth to the one stream. If you right-click **PVC#1** in the main tree and select **Add Streams...**, an error message appears that indicates there is not enough bandwidth to add another stream. Reduce the frame rate value for stream #1 (or the frame length) to make bandwidth available for stream #2.

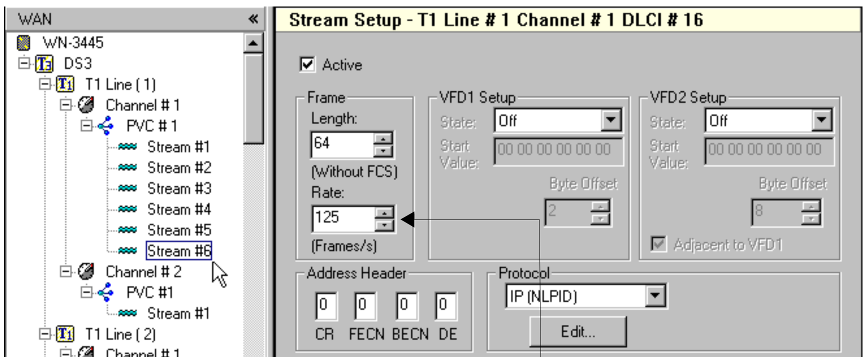


If the *Rate* field value is reduced to 300 frames per second for stream #1 (i.e., half the former rate), you can then copy the stream and paste it with all the same attributes while still remaining within the available bandwidth.

Estimating Frame Rate for Streams

Estimate the highest possible frame rate for the streams to be created for a PVC or PPP connection. Find the highest permitted rate for the first stream, then divide that value by the desired number of streams. In the example above, the highest allowed value for stream #1 was 761 frames per second. To create a total of six streams, divide this rate by six (761 / 6 = 126.83). Assign a frame rate of about 125 frames per second to each of the six streams in channel #1.

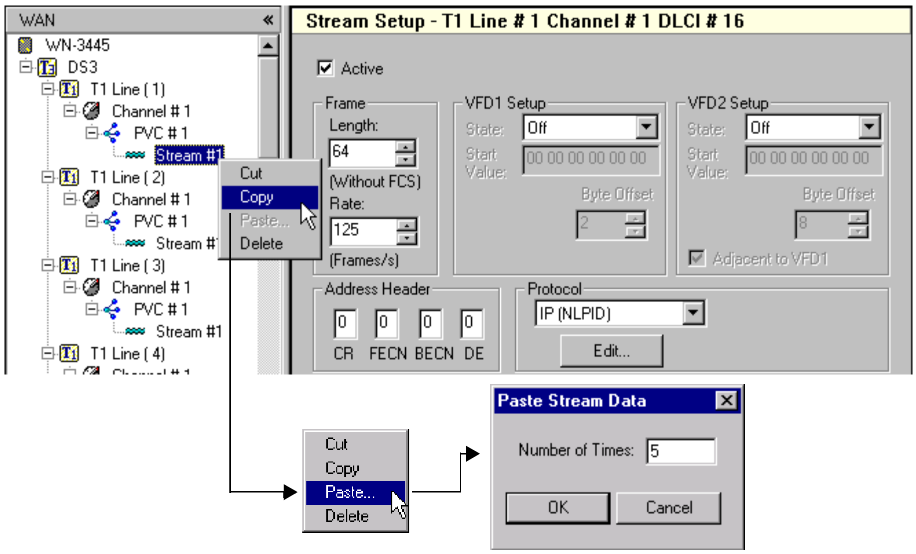
Note: Remember that the bandwidth available to a channel always depends on the number of DS0s that have been assigned to it.



To evenly distribute a maximum frame rate for each stream, divide the maximum number of frames per second allowed for one stream only (761 frames per second in this example) by the total number of streams (six) to derive the maximum for each stream (761/6 = 125).

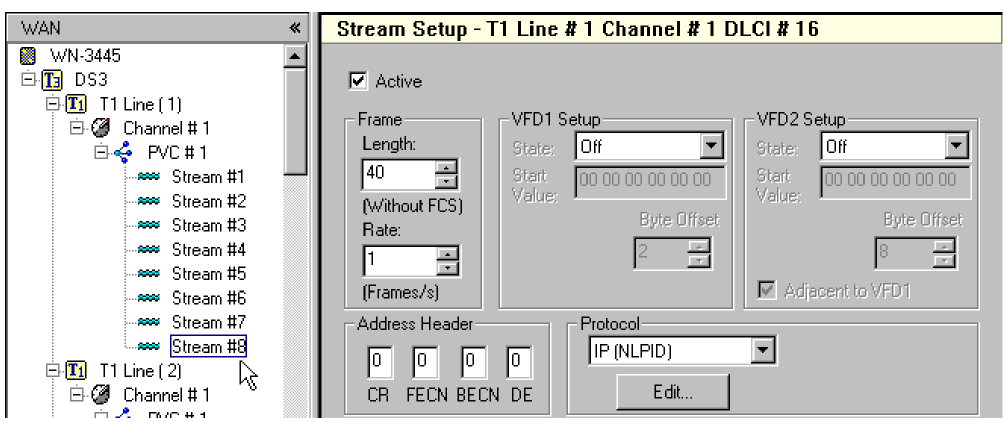
Copying and Pasting Streams

To quickly duplicate a stream one or more times, right-click the template stream, then select **Copy** from the pop-up menu. Right-click again and select **Paste**. Enter the number of times to copy the stream in the pop-up dialog box, and click **OK**.



Recovering Bandwidth by Reducing Frame Size

Similarly, increase the number of possible streams by adjusting the frame size. In this example, reducing the *Length (without FCS)* field value from 60 to 40 makes possible two additional streams at the same frame rate.



Configuring Streams for Cisco HDLC Frames

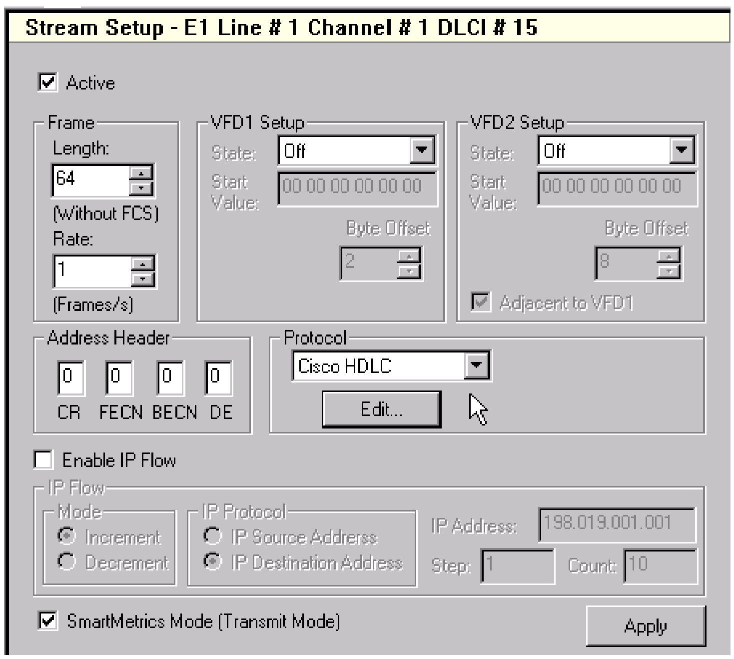
To transmit Cisco HDLC frames:

1 Set the **Data Link Type** to frame relay PVC.

2 Select **Cisco HDLC** in the *Protocol* field of the *Stream Setup* pane.

To set the protocol:

1 Left-click the **Stream#*n*** entry to open the *Stream Setup* pane.



2 Set the **Protocol** field to **Cisco HDLC**.

3 Click the **Apply** button.

Configure the DUT

The DUT is typically configured as the Data Circuit-terminating Equipment (DCE). As a minimum, its configuration includes setting values for the following parameters:

- Line rate
- Committed Information Rate (CIR)
- Flow control mechanisms: FECN, BECN, and DE
- Link Management Protocol: LMI, Q.933 Annex A, or T1.617 Annex D.

These DUT configuration settings must be duplicated in the SmartBits system. If the settings are not duplicated, the DUT may not accept SmartBits traffic during the test.

Set up Physical Connections

Once the DUT configuration is completed, set up the physical connections. In this example, two WAN cards are used. A DS3 port is configured on one card as the transmit port, and another DS3 port is configured on the other card as the receive port.

To set up the physical connection:

1. Install a WN-3445A SmartCard in the SmartBits 2000 chassis.
2. Attach a connecting cable between the BNC port interface connector on each Smart-Card and ports on the DUT.

Set up the SmartCard Ports

The SmartCard ports are set up using SmartWindow. The following steps apply to one of the two ports needed for this test example, and these steps can generally be repeated for the second port.

How to Apply the Configuration on the Card

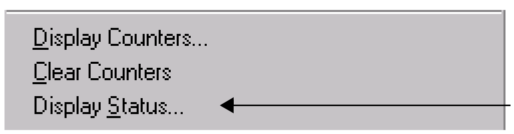
To ensure that configuration settings are sent to the card, always stop test traffic before modifying the SmartCard configuration. After modifying parameter values, click the **Apply** button in the setup dialog box.

To completely update the card configuration, click the card image in SmartWindow and select **Update this Port** from the card menu. (SmartWindow must be connected to the chassis, and the card must be reserved for this option to appear.)

*To completely update a card configuration, select **Update This Port** from the card menu. (The card must be reserved for this option to appear in the card menu.)*

Caution: Check Channel Status Before Sending or Receiving Test Traffic

After the card configuration is updated, be sure to allow time for all channels to come up before test traffic is started. After updating, select **Display Status** to open the *Port Status* window. Watch the status for all channels until all channels are up, then start test traffic. If channel status is not verified, test results may be inaccurate.



*Select **Display Status** to view channel status. Wait until all channels are up before starting test traffic.*

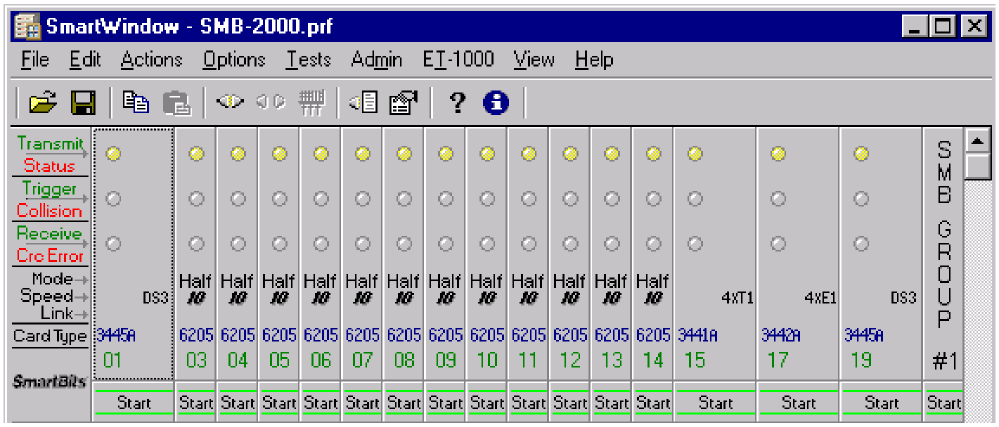
Use Online Help for Detailed Field Descriptions

In regards to the following steps, refer to the SmartWindow online Help for complete descriptions of parameters and options.

Note: See *"SmartWindow Help for WN-3445A" on page 462* for important information on using context-sensitive (F1) Help with this card.

Launch SmartWindow

Start SmartWindow, and the card image appears. (Slot 01 is shown in the following example.)

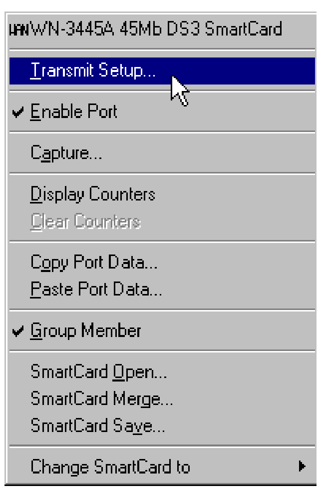


Set up the WAN Port and Channel #1

It is usually not necessary to change the default SmartCard port parameters. However, the clock source or polarity may need to be reconfigured, depending on the DUT characteristics.

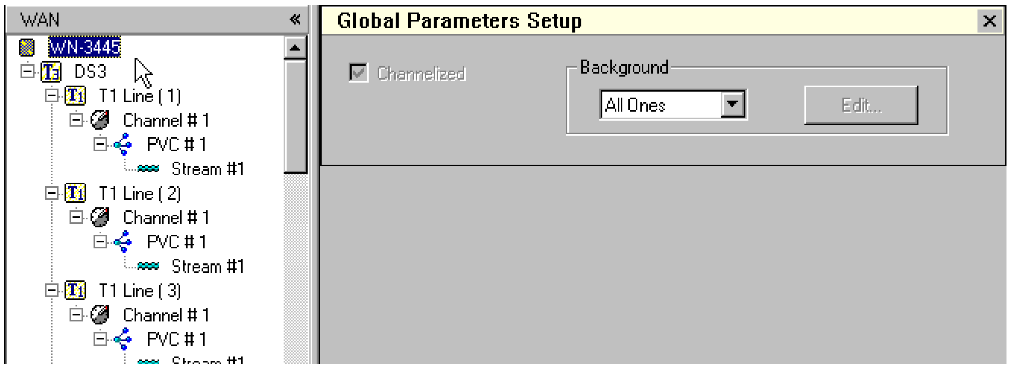
To set up the port and channel:

1. Click the card image to open the card menu.
2. Select the **Transmit Setup** option.



To set the global background:

1 Left-click **WN-3445A** at the top of the tree to display the *Global Parameters Setup* pane. The *Global Parameters Setup* pane is used to set the background pattern for all streams sent through the port.



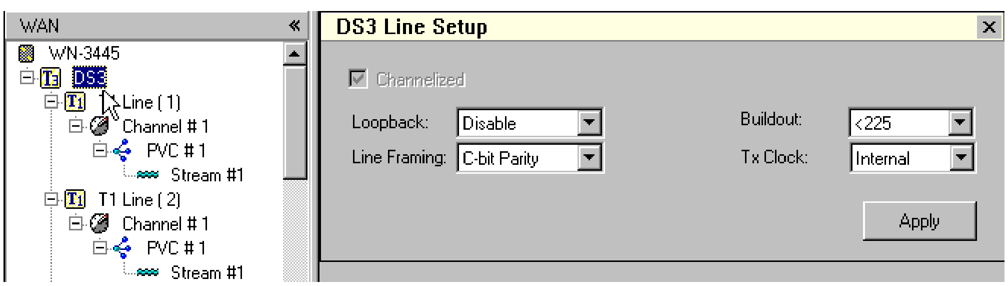
2 Change the **Background** field value, as need.

To set the DS3 line setup:

1 Left-click the **DS3** entry in the main tree to review the DS3 line parameters.

With the exception of the *Tx Clock* field, the parameters on this pane should reflect the same values for this SmartCard as for the DUT interface. The *Tx Clock* field should be set to **Internal** at one side of the DS3 line and **Loop-timed** at the other side. (See *Figure 9-1 on page 456* for an illustration of this concept.)

2 When the settings in this pane are correct, click the **Apply** button.



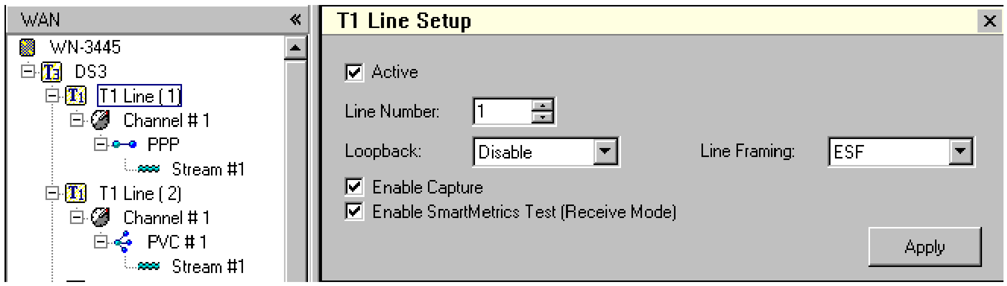
To set up the T1 line:

1 Left-click the **T1 Line (1)** entry in the main tree to review the T1 line parameters.

2 Select the **Enable Capture** checkbox to use the card data capture capability. The capture buffer can hold up to 8,000 frames.

3 Select the **Enable SmartMetrics Test (Receive Mode)** checkbox to generate histogram test information and results.

4 When the settings in this pane are correct, click the **Apply** button.



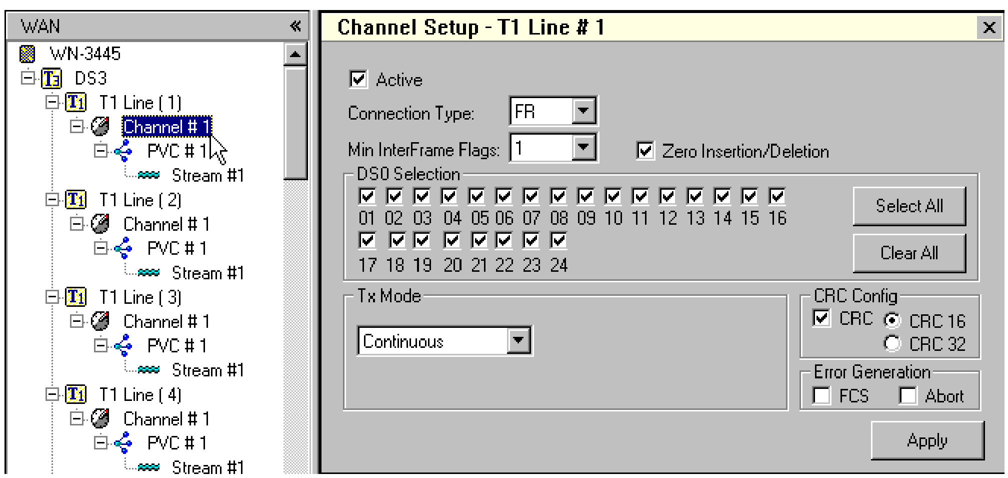
To set up the channel:

1 Left-click the **Channel #1** entry under T1 Line (1) to display the *Channel Setup* pane.

2 Verify that the *Connection Type* field value is **FR** in the *Channel Setup* pane. (This is the default value.)

3 Review other parameter values.

4 When the settings in this pane are correct, click the **Apply** button.



To set up the Link Management Interface (LMI):

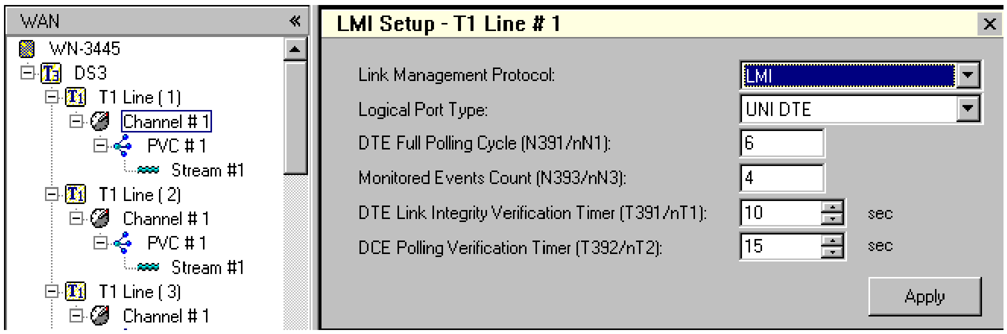
1 Scroll down and review the settings for the Link Management Interface (LMI) in the *LMI Setup* pane.

The Link Management Protocol (LMP) manages the PVC connection between the SmartCard port and the frame relay switch. You can choose from the following protocol types: LMI, T1.617 Annex D, Q.933 Annex A, and Disabled.

When an LMI type other than *Disabled* is selected, the other parameters become enabled. These parameters include logical port type (UNI DTE/UNI DCE) plus various counts and timers. These parameters may be left at the default values or set as appropriate for the test.

2 Change parameters, as necessary.

3 When the settings in this pane are correct, click the **Apply** button.



To set up the trigger:

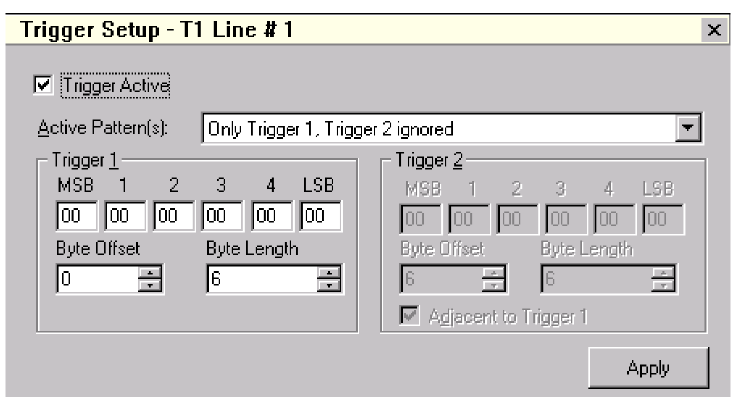
Use the values in the *Trigger Setup* pane to specify a unique pattern to detect and trigger in a frame. The trigger allows ports (on which the trigger pattern is defined) to count the number of packets with the specified trigger pattern, and then to update the transmit and receive trigger counters.

1 Select the **Trigger Active** checkbox to enable trigger.

2 Verify that the other trigger parameters, such as byte patterns, offset, and length are set appropriately.

3 Select the **Adjacent to Trigger 1** checkbox to place trigger 2 immediately next to trigger 1.

4 When the settings in this pane are correct, click the **Apply** button.

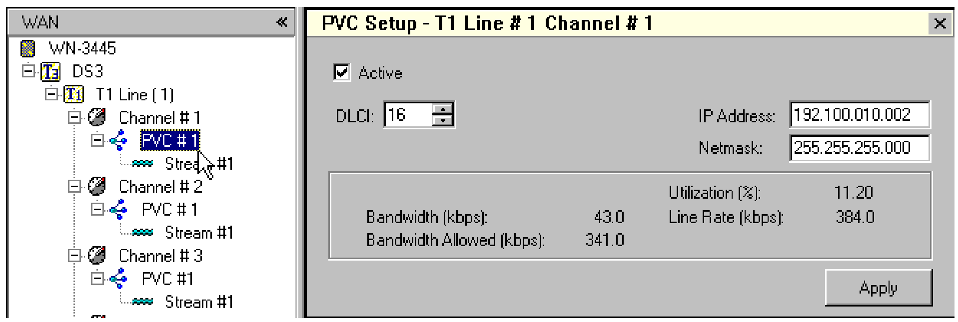


Set up the PVC

All fields in the *PVC Setup* pane contain default values that can be used, if appropriate for the test requirements.

To set up the PVC:

1 Left-click the **PVC #1** entry to open the *PVC Setup* pane.



2 Ensure that the **Active** checkbox is selected. At least one PVC must be configured to transmit and/or receive traffic.

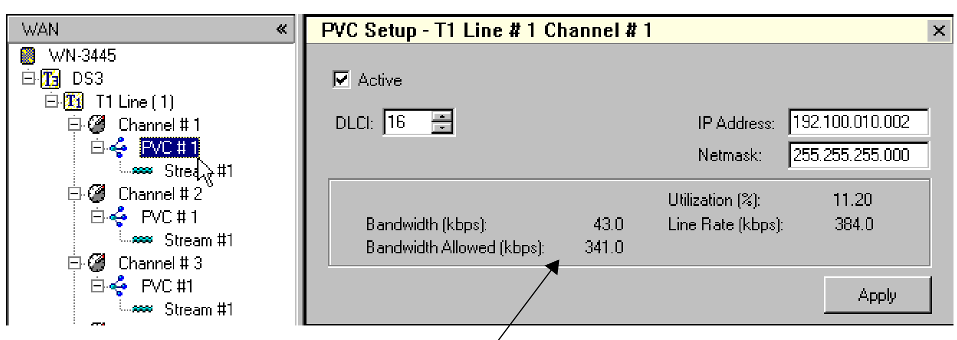
3 Set the **DLCI** field value to match the DLCI setting in the DUT, and verify that each channel is configured with a unique DLCI. By default, the *DLCI* field value is set to the lowest non-reserved default value (16).

4 Enter the **IP Address** and **Netmask** values for this PVC. The IP address is what the IP network and all connected routers will recognize as the endpoint for this PVC.

5 When the settings in this pane are correct, click the **Apply** button.

The information area of this pane shows calculated values for bandwidth, line utilization, and aggregate line rate.

Note: Ensure that the same line rate is configured on the frame relay DUT.



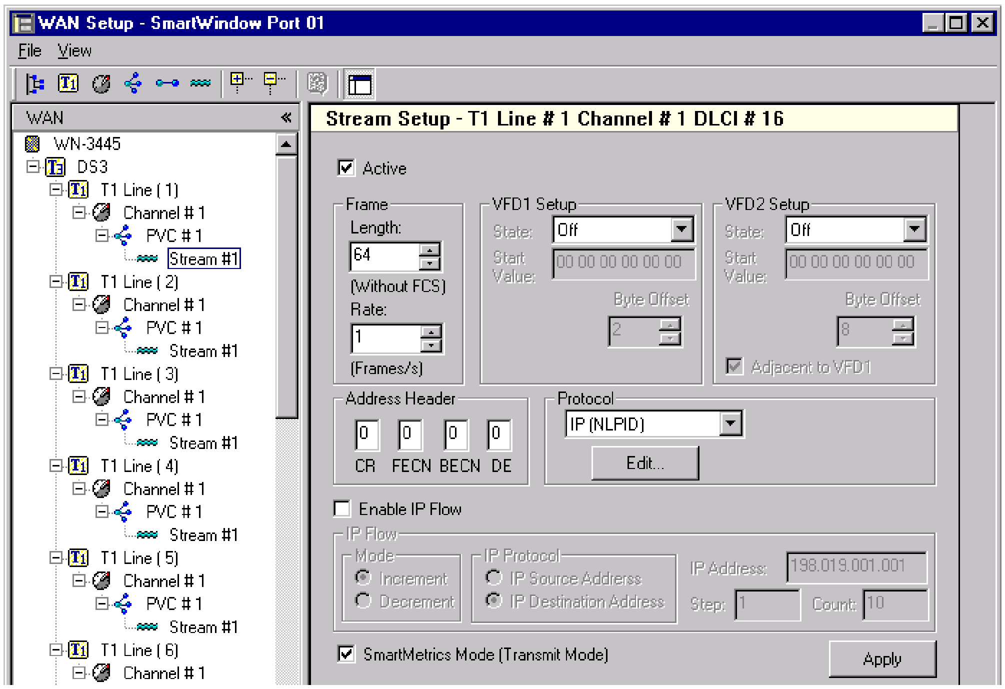
Information area

Set up the Stream

Only frame size is important to the DUT. For switch tests, upper layer protocols do not matter unless the DUT is Layer 3 aware. In this pane, the primary options of interest are frame size and address header (CR /FECN /BECN /DE).

To set up the stream:

1 Left-click **Stream #1** in the main tree to display the *Stream Setup* pane.



Note: The specified frame rate does not include bit stuffing, which affects the actual frame rate. When running a test, if the actual frame rate exceeds the maximum throughput on the line, the measured receive frame rate (as shown by the counters on the receiving card) fluctuates. To achieve a steady receive frame rate, gradually lower the frame rate on the transmitting card until the fluctuations disappear.

Use the following formula to calculate the frame rate:

Frame Rate = Channel Bandwidth / (Frame Size + Minimum Flag Separation + Number of CRC Bytes)

The number of CRC bytes can be either two or four, as specified in the *Channel Setup* pane.

Important: Remember that channel bandwidth is stated in different units (bits per second) than frame rate (frames per second). Be careful to convert to the correct units when performing calculations.

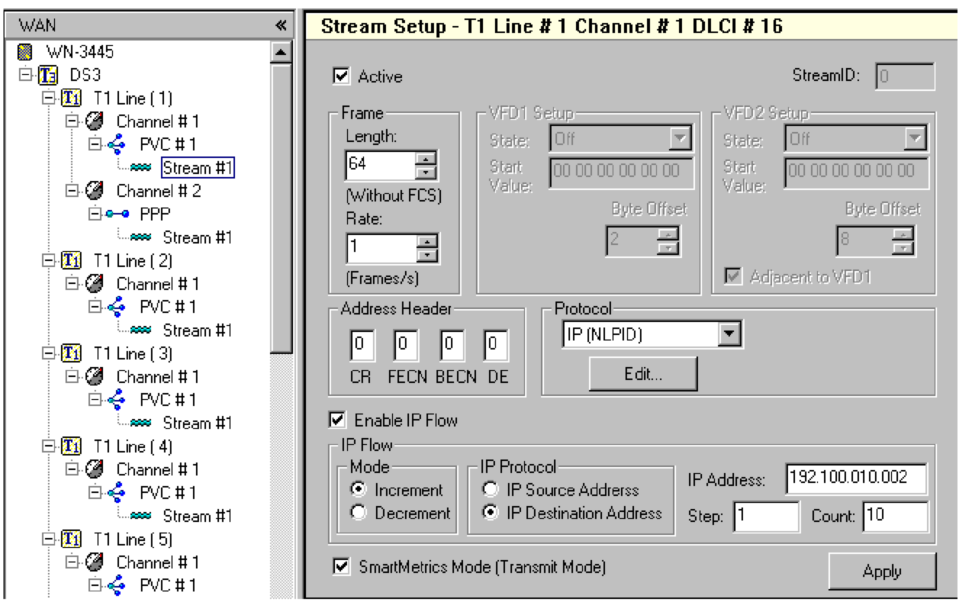
2 When the settings in this pane are correct, click the **Apply** button.

Set up IP Flows

Use the *IP Flow* pane at the bottom of the *Stream Setup* pane to configure IP flows.

To set up IP flows:

1. Select the **Enable IP Flow** checkbox to activate the other fields. These fields control how the flows associated with the stream are configured and handled in transmission.
2. Click the appropriate *Mode* button to select whether the ID field in the IP header increments or decrements in the IP address.
3. Click the appropriate *IP Protocol* button to specify whether the IP source address or IP destination address should be modified according to the *Mode* selection.
4. Enter the starting **IP Address** field value.
5. Enter the **Step** and **Count** field values that indicate how the address should change and how many flows are cycled through when changing the address.



Note: The WN-3445A can support up to 64,000 flows per IP stream by using the VFD fields to alter the source and destination IP addresses. However, IP flow and VFD cannot be run concurrently. To use the VFD fields, clear the **Enable IP Flow** checkbox.

Run the Test and Review Statistics

After the necessary setup and configuration steps have been completed, the test can be initiated and the initial data reviewed.

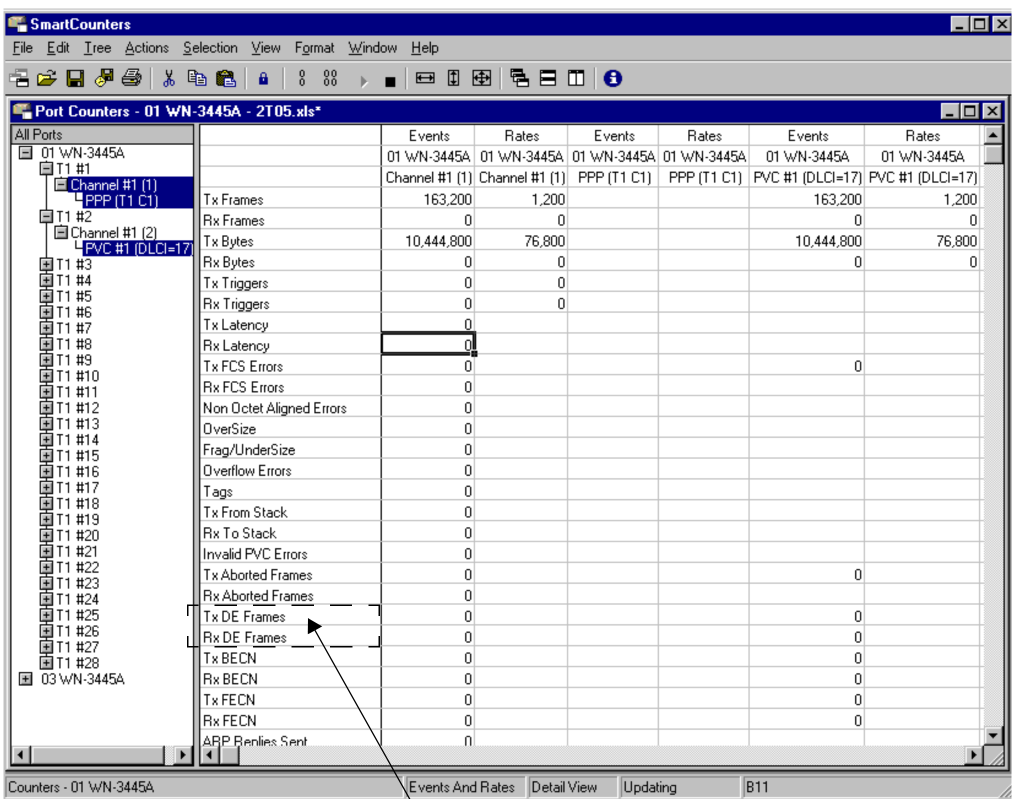
Note: Refer to *"How to Apply the Configuration on the Card"* and *"Check Channel Status Before Sending or Receiving Test Traffic" on page 475*.

As the test is run on the receive card, watch the counters. The higher the Committed Information Rate (CIR), the more the customer pays for the guaranteed service at that level.

It is important to confirm that the traffic performs to the subscription rates promised, so the actual limits of the switch need to be determined.

To run the test and review statistics:

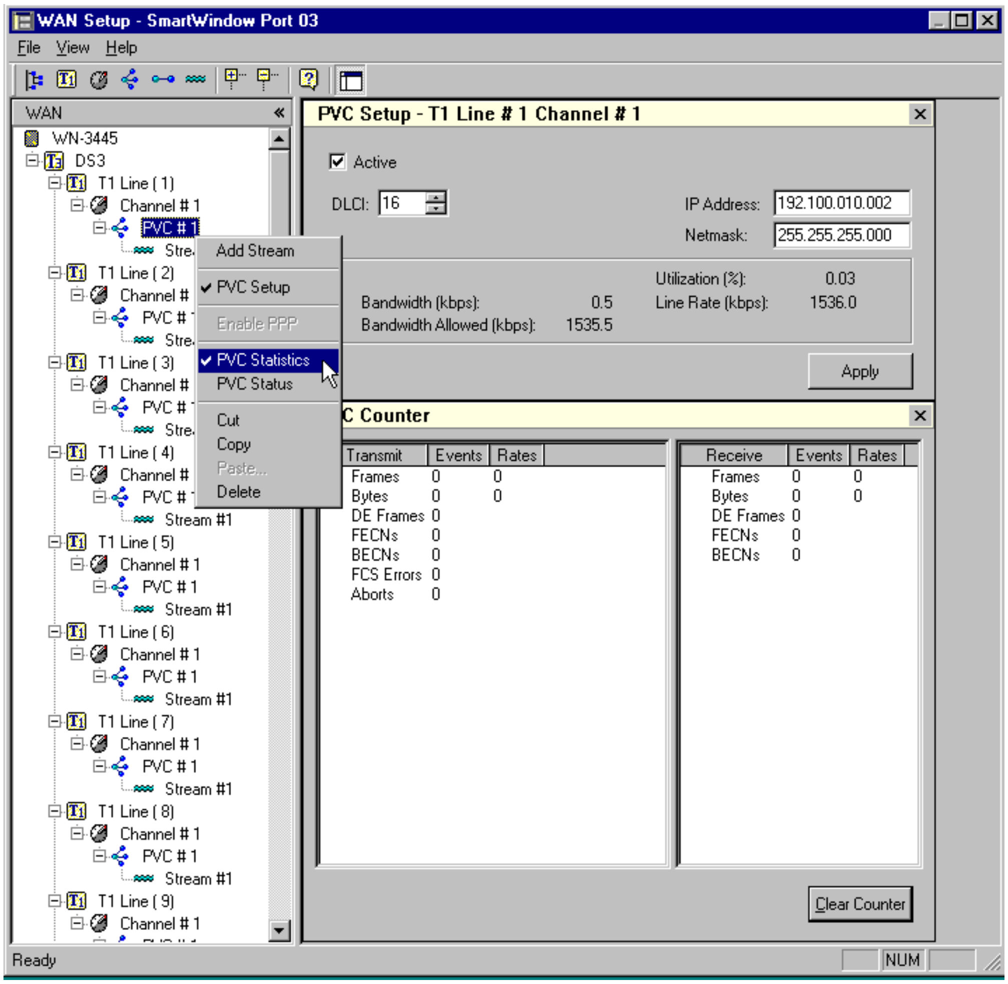
1. To begin transmission in the SmartWindow front panel, click the **Start** button on the transmitting WAN card.
2. To view statistics on the receiving card, right-click the card image and select **Display Counters** from the menu. The *SmartCounters* window appears.



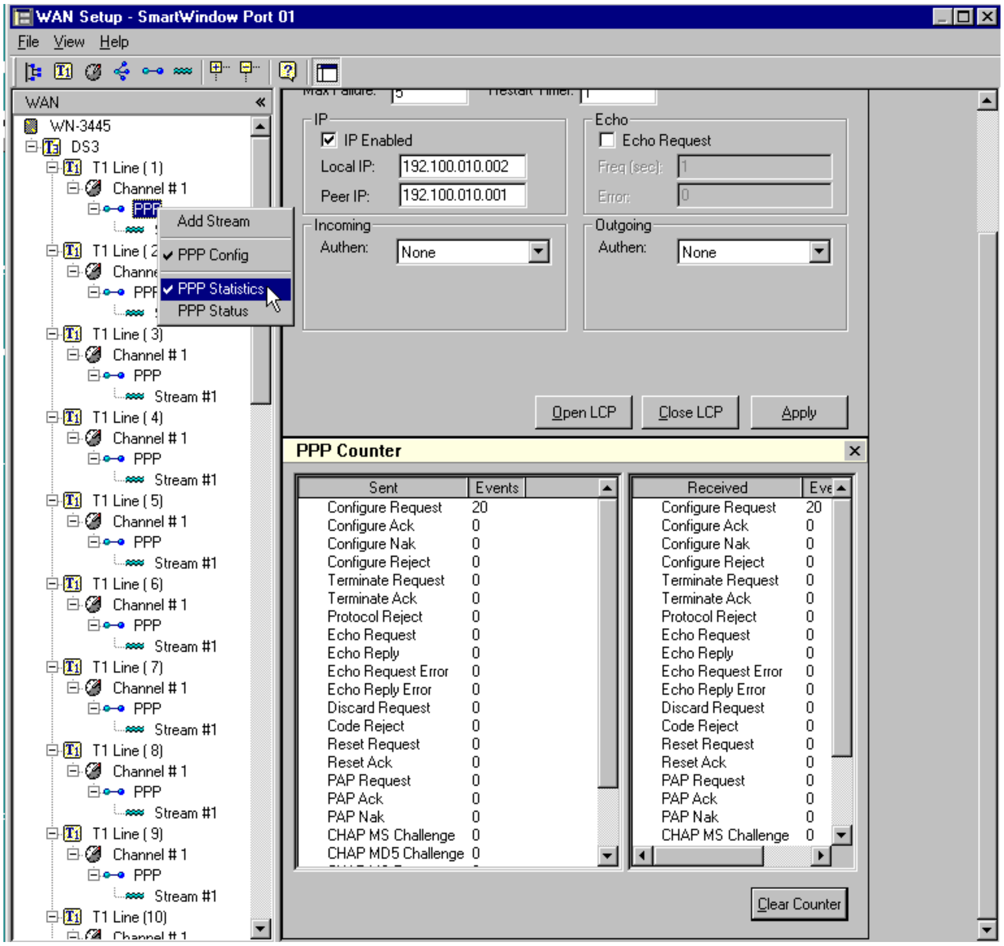
Check for DE frames in the Port Counters *window.*

3 Check for Discard Eligible (DE) frames in the counters window. When DE frames occur, the frames either have already been dropped or have been tagged as *not guaranteed*, and therefore are candidates to be dropped if there is network congestion.

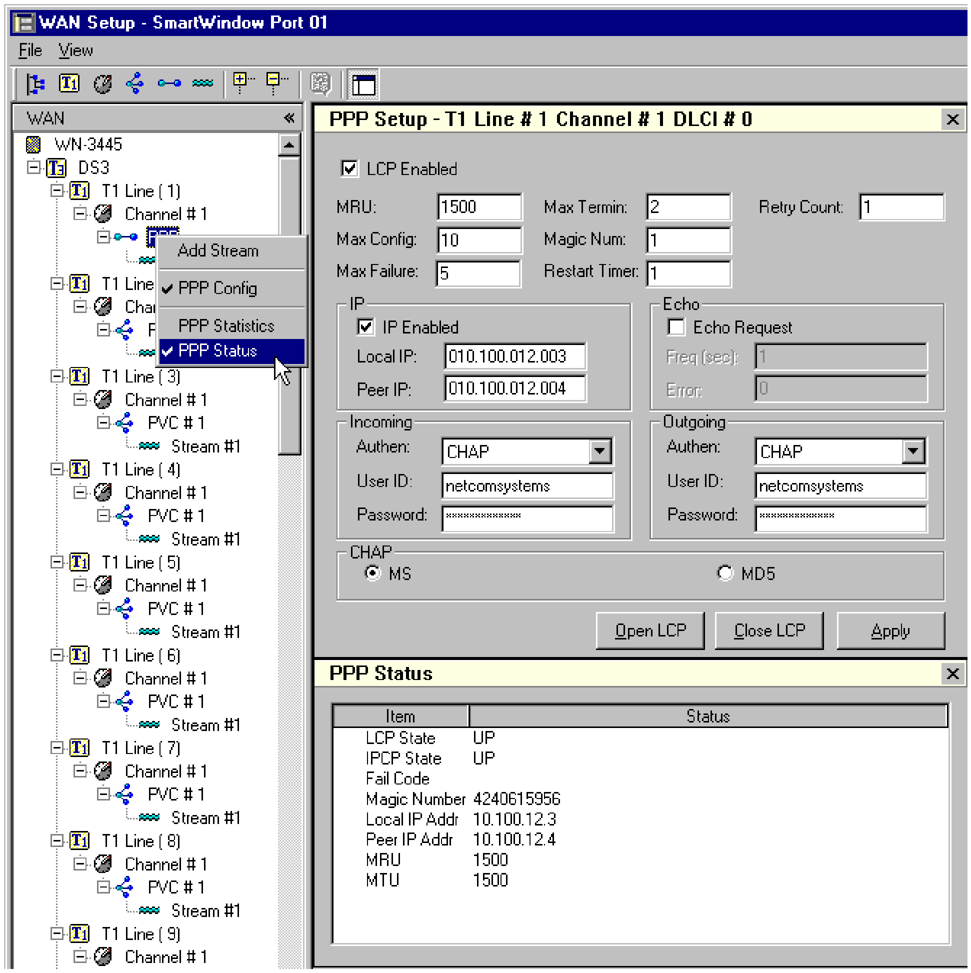
4 View frames and other statistics by opening the *PVC Statistics* pane. From the main tree in the *WAN Setup* window, right-click **PVC #1** and select **PVC Statistics** to add this pane to the display.



5 View the *PPP Statistics* pane. From the main tree in the *WAN Setup* window, right-click **PPP** and select **PPP Statistics** to add the following pane to the display.



6 View the *PPP Status* pane. From the main tree in the *WAN Setup* window, right-click **PPP** and select **PPP Status** to add the following pane to the display.


WAN Setup - SmartWindow Port 01
File View
WAN
WN-3445
DS3
T1 Line (1)
Channel # 1
Add Stream
PPP Config
PPP Statistics
PPP Status
PPP Setup - T1 Line # 1 Channel # 1 DLCI # 0
LCP Enabled
MRU: 1500
Max Termin: 2
Retry Count: 1
Max Config: 10
Magic Num: 1
Max Failure: 5
Restart Timer: 1
IP
IP Enabled
Local IP: 010.100.012.003
Peer IP: 010.100.012.004
Echo
Echo Request
Freq (sec): 1
Error: 0
Incoming
Authen: CHAP
User ID: netcomsystems
Password:
Outgoing
Authen: CHAP
User ID: netcomsystems
Password:
CHAP
MS
MD5
Open LCP
Close LCP
Apply
PPP Status
Item Status
LCP State UP
IPCP State UP
Fail Code
Magic Number 4240615956
Local IP Addr 10.100.12.3
Peer IP Addr 10.100.12.4
MRU 1500
MTU 1500
T1 Line (3)
PVC # 1
Stream #1
T1 Line (4)
T1 Line (5)
T1 Line (6)
T1 Line (7)
T1 Line (8)
T1 Line (9)

Using SmartCounters

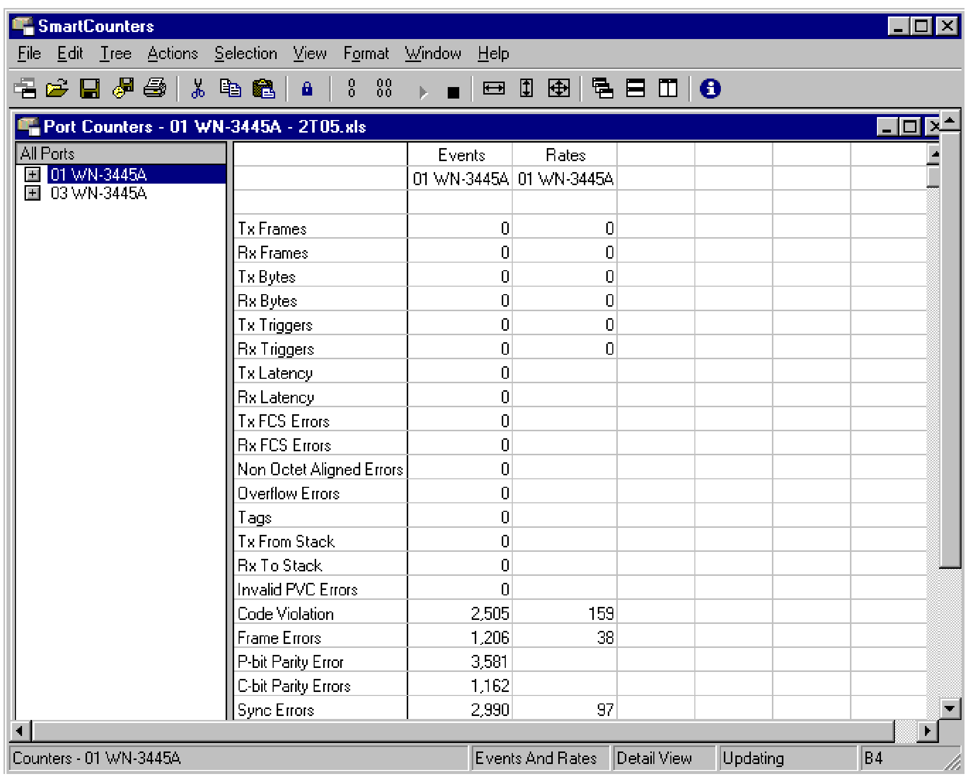
Use SmartCounters to save statistics and to see data on a specific port.

To use SmartCounters:

1. Choose **Actions** > **SmartCounters**.
2. Select **File** > **New** to open a new counter window.
3. To save the statistical data available at that moment for the highlighted port, choose **File** > **Save As** from the *SmartCounters* menu. The data is saved to an Excel spreadsheet (see the figure below).
4. Choose **View** > **Counter Only** to see only the data on a specific port.

Note: The WN-3445A can require additional time to clear counters and display new counts. Allow from 10 to 15 seconds.

For complete information on SmartCounters, refer to *"Set up IGMP for SmartBits 600x/6000x Modules" on page 120* in *Chapter 5, "Advanced Operational Theory."*



Data Capture

Perform data capture using the WN-3445A SmartCard, including capture on test traffic generated by other compatible cards such as the WN-3415 and WN-3441A.

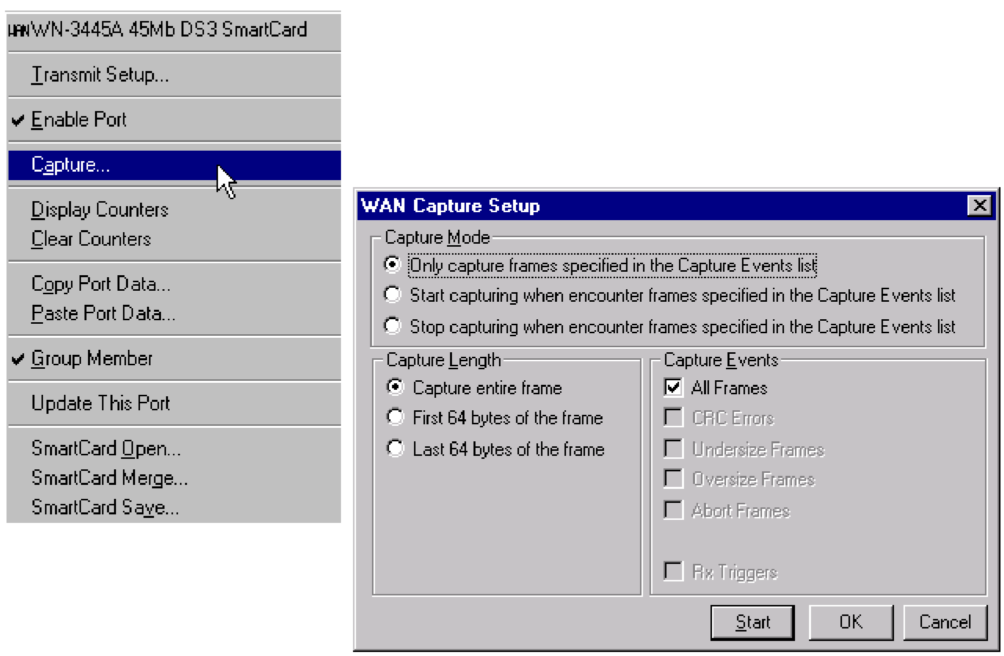
Note: For complete information about setting up and using data capture, refer to *"Using Triggers and Capture" on page 145* in *Chapter 5, "Advanced Operational Theory."*

To capture data:

1. Select the **Capture...** option from the card menu.
2. Specify the capture parameters in the *WAN Capture Setup* dialog box.

   The WN-3445A can display up to 512 bytes of each captured frame. The capture buffer holds up to 8,000 frames.

Note: The 2-byte or 4-byte CRC is included in the total frame length field (without FCS), but it is displayed in the capture only if it fits within the 512-byte limit of the WN-3445A capture display length.



The captured data is then displayed as shown in *Figure 9-4 on page 489*.

3. Edit each frame line by double-clicking on it.

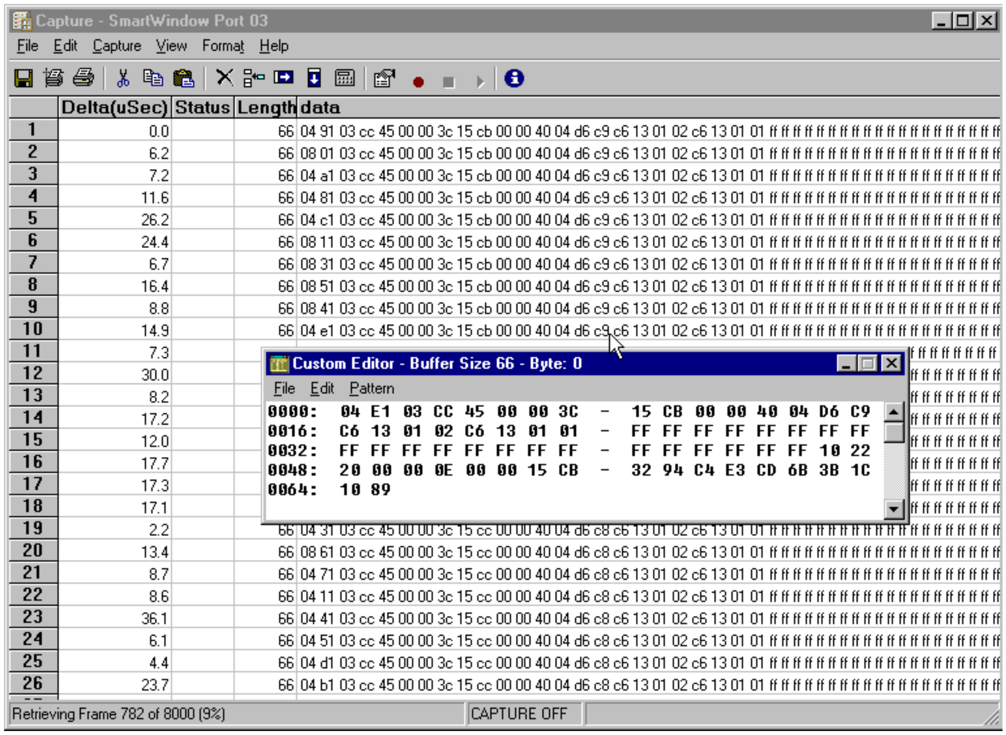


Figure 9-4. Data Capture with the WN-3445A

Configuring the WN-3445A for Clear Channel Transmission

Set up the WN-3445A DS3 SmartCard for clear channel transmission. The DS3 line (port) then carries one channel, which may carry multiple frame relay PVCs or one PPP connection. There is no T1 line in clear channel mode.

To enable clear channel:

Important: When the card mode is changed from channelized to clear channel, any on-going channelized configuration data is lost. Be careful to save the channelized configuration before enabling clear channel.

1. Click the card image to open the card menu
2. Select the **Clear Channel** option (*Figure 9-5*).

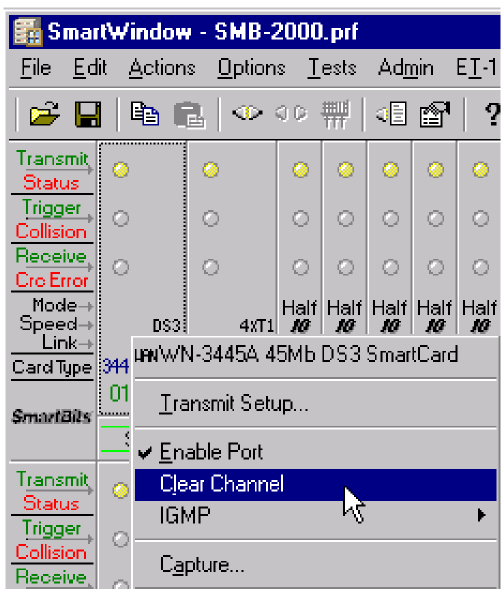
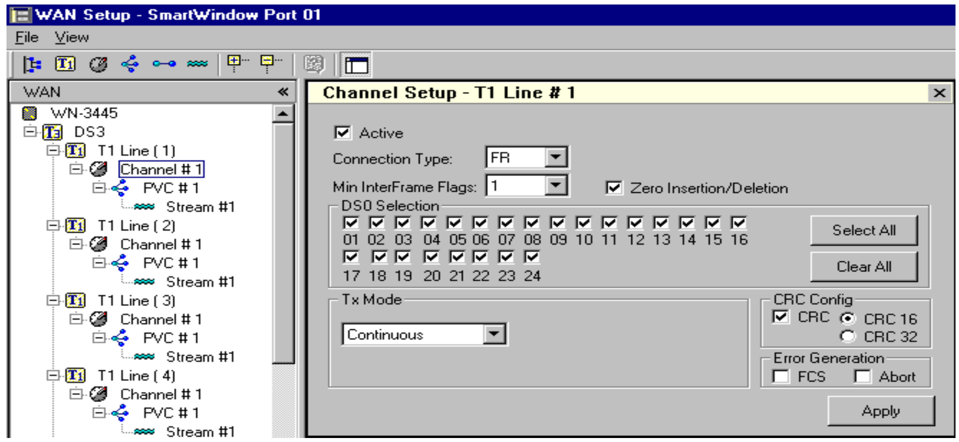


Figure 9-5. Enabling Clear Channel Operation

3. Select the **Transmit Setup** option from the card menu.

   The *WAN Setup* tree contains just one channel.
4. Select the channel, and use the *Channel Setup* pane to configure the data link type as frame relay or PPP.

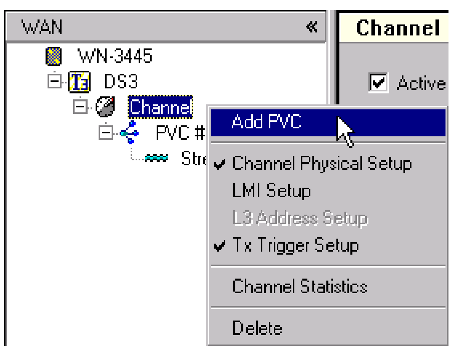


Frame relay data link type

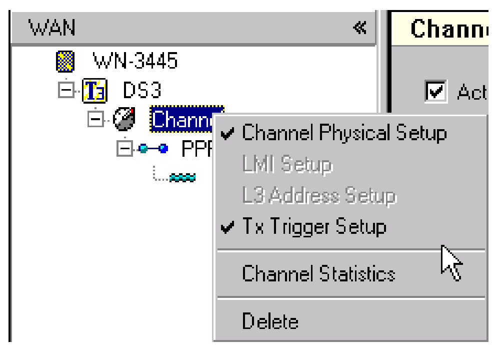
5 When the data link type is frame relay (FR), multiple PVCs can be added. Right-click **Channel** in the tree, then select the **Add PVC** option from the menu.

PPP data link type

When the data link type is PPP, one PPP connection is available.



With frame relay data link type, multiple PVCs can be added to the channel.



With PPP data link type, one PPP session is available.

Test Using WN-3405 T1 SmartCards

This section outlines the procedure for frame relay throughput testing using the WN-3405 fractional T1 SmartCard.

Notes:

- See *"Test Using the WN-3445A Channelized DS3 SmartCard" on page 454* for a procedure with the same test objectives but using the WN-3445A Channelized DS3 SmartCard.
- The WN-3415, WN-3420, or WN-3441A can be substituted for the WN-3405 when testing the throughput capacity of a frame relay switch.

Configure the Switch as DCE

First, configure the frame relay switch. It is typically configured as the Data Circuit-terminating Equipment (DCE). As a minimum, its configuration includes setting values for the following parameters:

- Line rate
- Committed Information Rate (CIR)
- Quality of Service parameters: FECN, BECN or DE
- Link Management Protocol: LMI, Annex A, or Annex D.

These configuration settings in the DUT must be duplicated in the SmartBits system. If the settings are not duplicated, the switch may not accept SmartBits traffic during the test.

Important: SmartWindow does not support split-clocking. Although SmartWindow does auto-detect, in DTE mode the line rate must be specified and must match the line rate of the DUT.

Set up Physical Connections

Once the switch configuration has been completed, set up the physical connections. This test example assumes a two-port test, although SmartBits can accommodate tests with more than two ports if necessary. In this example, configure port 14 as the transmit port and port 15 as the receive port.

This example uses the WN-3405 SmartCard. By default, it is set for Data Terminal Equipment (DTE).

To set up the physical connection:

1. Install two WN-3405 SmartCards in the SmartBits chassis. Each WN-3405 supports 128 PVCs per port.
2. Connect the provided V.35 Winchester cable between one WN-3405 SmartCard and to the switch to be tested. (An additional cable might be needed, depending on the type of connector on the switch. This cable can be obtained from the switch manufacturer.)

Set up the WAN Cards

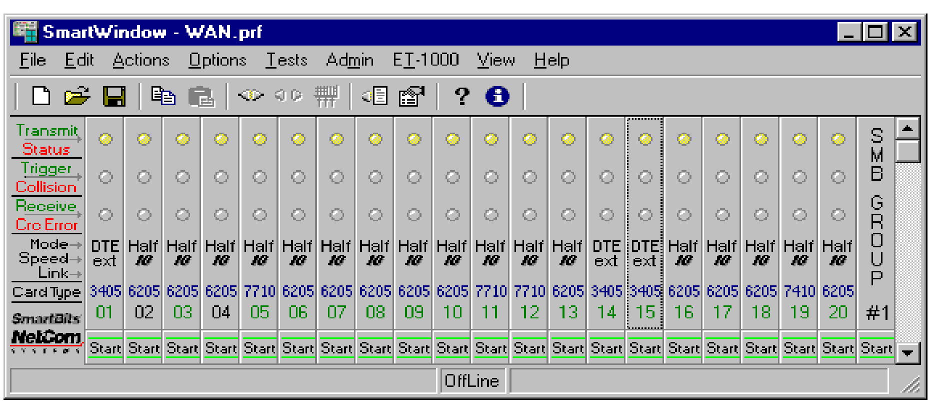
Now set up the WAN cards using SmartWindow.

Note: Confirm that SmartWindow is installed on a PC that is connected to SmartBits. See *"Installing SmartWindow" on page 28* for additional information.

Launch SmartWindow

To start SmartWindow:

1. Click the SmartWindow icon.
2. Confirm the card interface by right-clicking the card (V.35). The card image shows *DTE ext.*



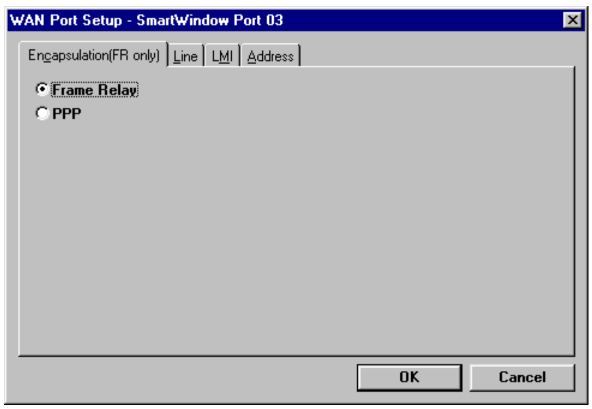
Set up the WAN Port

It is usually not necessary to change the default WAN port parameters. However, the clock source or polarity might need to be reconfigured, depending on the characteristics of the frame relay switch.

To set up the port:

1 Click the WAN card in slot 14 to view the main menu.

2 Choose **WAN Port Setup**.
The *WAN Port Setup* window opens.

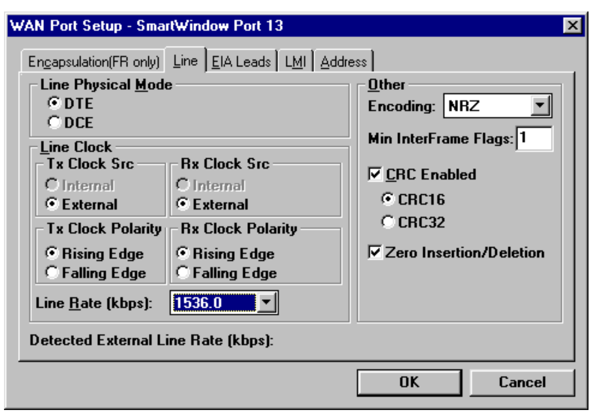


Encapsulation tab

3 On the *Encapsulation* tab, click the **Frame Relay** button to select frame relay.

Line tab

4 Choose the **Line** tab to review the default settings for line parameters. (Generally, these defaults do not need to be changed. However, because SmartBits is set as a DTE, enter the line rate for T1.) Enter (or verify) the value **1536 kbps** in the *Line Rate (kbps)* field.



Additionally, the *Line* tab contains:

- Line physical mode (DTE or DCE):
  - Switch is usually set as DCE.
  - SmartBits must be set to DTE to complement the switch.
- Clock type (external or internal):
  - DTE setting automatically defaults to external clock.
- Transmit polarity:
  - Rising edge accommodates 90% of switches.
- Line rate (19.2 to 8192 Kbps in increments of 64 bytes).
- Encoding (NRZ/NRZI), CRC (16/32 bit), and flags between frames.

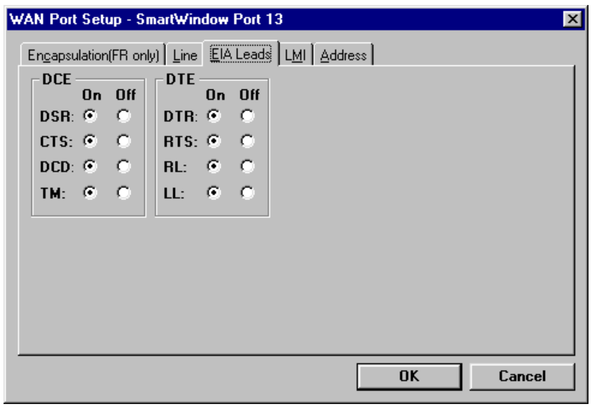
5 Select the **Zero Insertion/Deletion** checkbox.

EIA Leads tab

6 To verify the EIA leads, choose the **EIA Leads** tab. Generally, use the defaults for the EIA leads, which are as follows:

- DCE: Data Set Ready, Clear To Send, Data Carrier Detect
- DTE: Data Terminal Ready, Request To Send.

Note: Test Mode (TM), Remote Loopback (RL), and Local Loopback (LL) are currently unsupported.



7 Click **OK**.

LMI tab

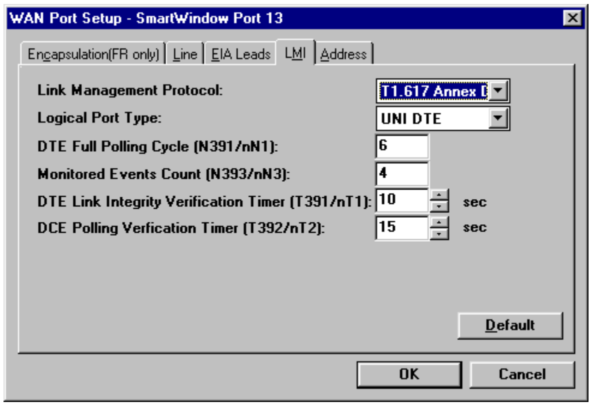
8 Choose the **LMI** tab to review the settings for Link Management Protocol (LMP).

LMP manages the connection (PVCs) between the SmartBits and the switch. It includes:

- Link Management Protocol. This may be one of the following:
  – LMI
  – T1.617 Annex D
  – Q.933 Annex A
  – Disabled.

When an LMI type (other than *Disabled*) is selected, the other parameters become enabled. These include:

- Logical port type (logical DTE/DCE). This is similar to a master-slave protocol handshake.
- Various counts and timers (which should remain at default values).



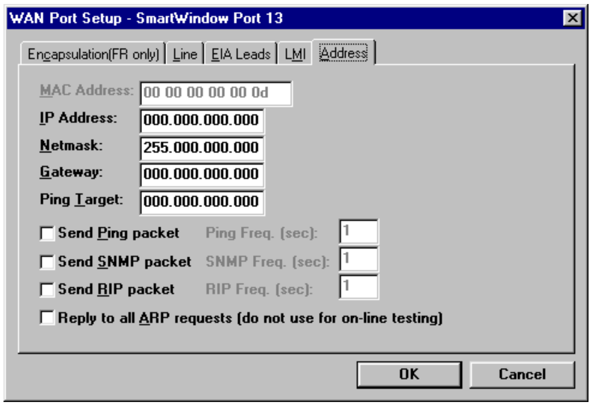
9 Select **Annex D** as the *Link Management Protocol* field value.

Address tab

10 Choose the **Address** tab. Use these values to inject Layer 3 traffic on top of a stream, or to look at Layer 3 traffic without streams or PVCs.

Frame relay switches are usually unaware of Layer 3 traffic. This dialog box is used primarily to test routers with frame relay interfaces, as well as high-end switches that support routing. In this window, turn on Layer 3 traffic: SNMP, ARP, and ping packets. With ping packets, specify source and destination addresses plus gateway, depending on the test needed.

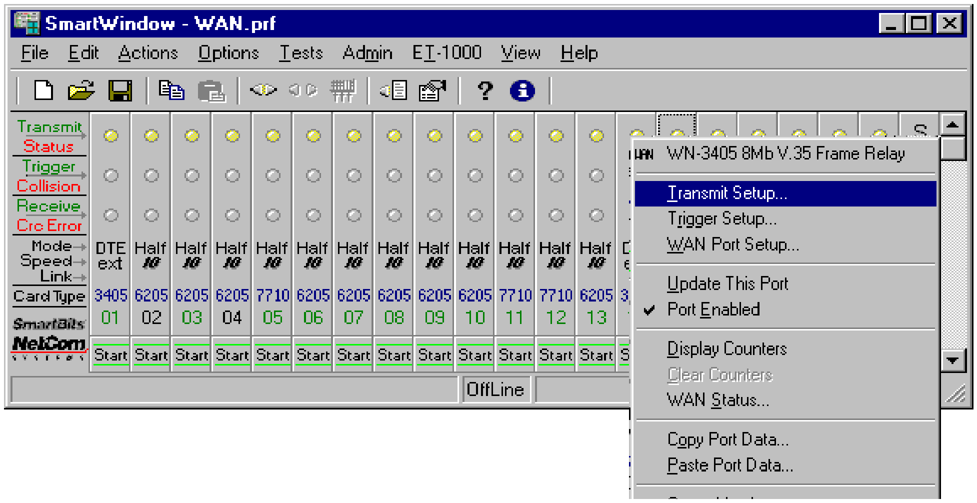
11 To look at Layer 3 traffic, enter the necessary addresses.



12 Click **OK**.

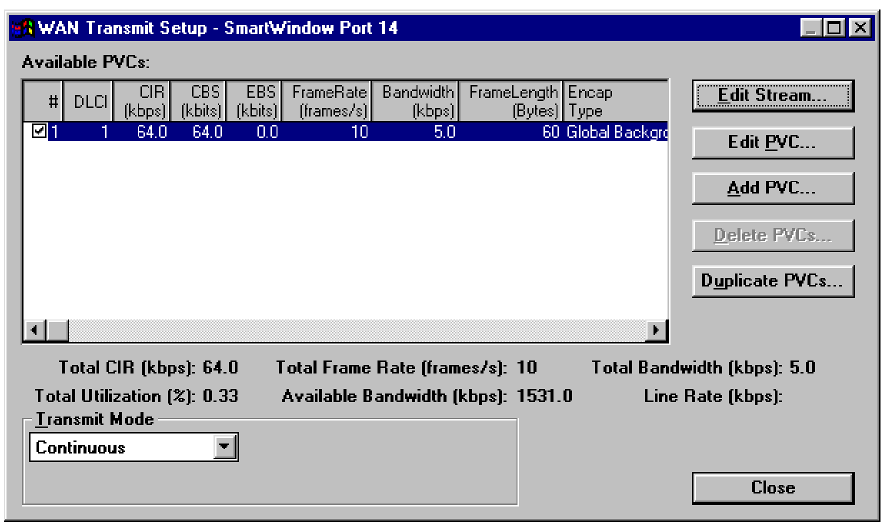
Transmit Setup

Use the *Transmit Setup* window to configure PVCs and define streams of traffic. Click the *WAN* card, and choose **Transmit Setup**.



The *Transmit Setup* window offers several options:

- *Edit Stream* is used to specify frame length (without FCS), triggers, and errors.
- *Add PVC* is used to add the new PVC and its DLCI number.
- *Edit PVC* is used to edit the PVC for FR parameters.



Typically, first set up the stream with the frame length (without FCS), then edit the PVC and its frame rate to accommodate the frame size. Currently, each PVC supports only one stream.

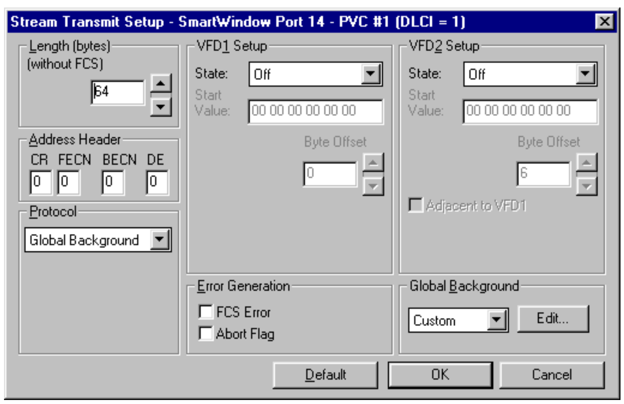
Defining Frame Length (without FCS) for Streams

The frame relay switch deals only with the frame size. Upper layer protocols do not matter for switch tests unless the switch is Layer 3 aware. The following options apply:

- *Address Header* (CR /FECN /BECN /DE)
- *Encapsulation Type* (none, bridged, routed) for Layer 3 devices primarily
- *Error Generation* (FCS and Abort Flag errors).

To set the frame length:

1 Click the **Edit Stream** button.
The *Stream Transmit Setup* window opens.



2 In this example, enter **64** in the *Length (bytes) (without FCS)* field for frame length (without FCS) in bytes. (Default is 60.) Retain all the other defaults.

Note: Be sure to add overhead to frame length (without FCS) when calculating frame rate, so 67 bytes minus 3 bytes is the actual frame size.

3 Click **OK** to return to the *Transmit Setup* window.

Configure a WAN SmartCard to Overwrite the FR/PPP Header

Two options exist for creating IP (or other) streams that start immediately after the HDLC flag at the beginning of a frame, thus overwriting the FR/PPP header normally generated by the WAN SmartCard.

Option 1: Use Custom Frames

The first option uses custom frames and is outlined below.

Advantage: Full utilization of the PVC (or channel) is maintained. No "wasted" HDLC flags.

Disadvantage: User needs to manually construct IP frames.

Option 1: Use custom frames to manually generate IP streams.

1. In the *WAN Transmit Setup* window, click **Edit Stream**.
2. Choose **Custom** from the **Protocol** drop-down menu.
3. Set the **Offset** to 0.
   This ensures that the custom frame is placed immediately after the HDLC flag (7E) at the beginning of the frame.
4. Click the **Edit** button.
   The *Frame Editor* window appears. Manually create an IP (or other frame). See *"Editing Frames" on page 157* for information on constructing frames that include CRC or checksum calculations.
5. Verify that **VFD1 Setup** is set to **State** and **VFD2 Setup** is set to **Off.**
   These settings ensure that VFD1 or VFD2 do not overwrite the custom frame created.

<table>
<tr><th colspan="3">0 … 15</th><th colspan="3">16 … 31</th></tr>
<tr><td colspan="5">End of previous frame</td><td>7E</td></tr>
<tr><td>Version</td><td>Header length</td><td>TOS</td><td colspan="3">Total length</td></tr>
<tr><td colspan="3">ID</td><td>Flags (3 bits)</td><td colspan="2">Fragment offset (13 bits)</td></tr>
<tr><td colspan="2">TTL</td><td>Protocol</td><td colspan="3">Header checksum</td></tr>
<tr><td colspan="6">Source IP</td></tr>
<tr><td colspan="6">Destination IP</td></tr>
<tr><td colspan="6">Data</td></tr>
</table>

Figure 9-6. Frame Created Using Option 1

Option 2: Overwrite the Header Using VFD1

The second option uses VFD1 to overwrite the FR/PPP header that is normally generated by the WAN SmartCard.

Advantage: IP frames are automatically created by SmartBits.
Disadvantage: Line utilization drops as six unnecessary HDLC flags are inserted between every two frames

Option 2: Use VFD1 to overwrite FR/ PPP header.

1. In the *WAN Transmit Setup* window, click **Edit Stream**.
2. Choose **Routed** and **IP (NLPID)** from the **Protocol** drop-down menus.
3. Set **VFD1** to **Static**, the **Start Value** to 7E 7E 7E 7E 7E 7E, and the **Byte Offset** to 0.
   These settings ensure that VFD1 overwrites the FR/PPP header and places six additional HDLC flags (7E) before the start of the IP header.
4. In the **Protocol** drop-down box, click the **Edit** button.
   The *Frame Editor* window appears.
5. Edit the IP header, as needed.
   SmartBits automatically generates all CRC calculations.

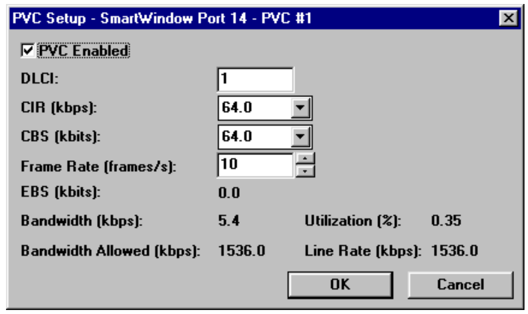
0			***15***	***16***			***31***
End of previous frame							*7E*
7E	*7E*	*7E*	*7E*	*7E*	*7E*	*Version*	*Header length*
TOS		*Total length*				*ID*	
ID (continued)		*Flags (3 bits)*	*Fragment offset (13 bits)*			*TTL*	
Protocol		*Header checksum*				*Source IP*	
Source IP (continued)						*Destination IP*	
Destination IP (continued)							
Data							

Figure 9-7. Frame Created Using Option 2

Edit and Configure a PVC

To edit and configure a PVC:

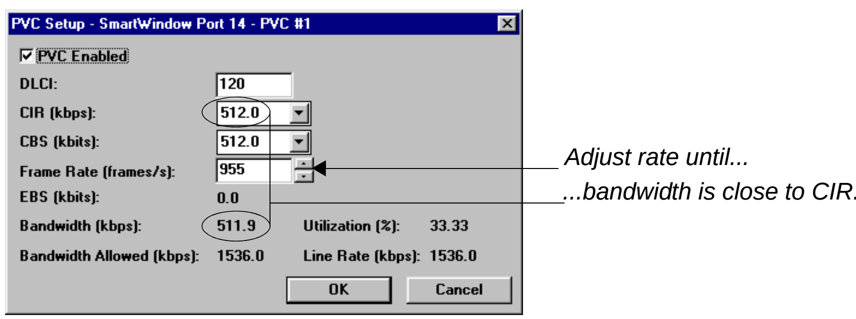
1. From the *Transmit Setup* window, click the **Edit PVC** button.
   The *PVC Setup* window opens.



2 Enter a **DLCI** field value to match the valid DLCI number in the switch. [DLCI (Data Link Connection Identifier: 1 to 1022)]

3 Enter a **CIR (kbps)** field value to match the switch. [CIR (Committed Information Rate: 19.2 to 8192 Kbps)]

4 In the *CBS (kbits)* field, enter a value that either is identical to the *CIR (kbps)* field value or is a multiple of that value.



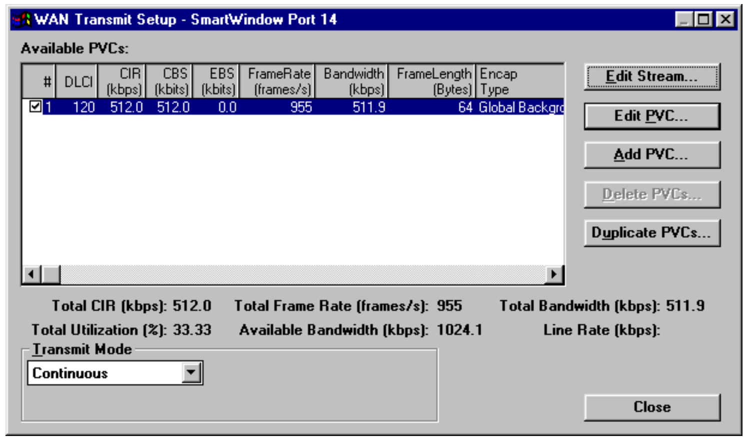
5 Starting with a sample frame rate of 100 frames/sec, increase the rate until the *Bandwidth (kbps)* value is close to the CIR value.[1]

6 Verify that the **PVC Enabled** checkbox is selected.

Note: SmartBits uses the frame rate value to calculate the CIR, CBS, and EBS at this time.

1. Frame rate = CIR/(frame size Kb + 3 bytes)*(8 bits)

7 Click **OK** to return to the *Transmit Setup* window.



Duplicate PVCs

Once a PVC is created, you can duplicate it and create up to 128 PVCs per card with a few entries.

To duplicate PVCs:

1 From the *Transmit Setup* window, click the **Duplicate PVCs** button.

2 Identify the number of PVCs to set up and the DLCI numbers.

3 Click **OK** to return to the *Transmit Setup* window.

Note: If too many PVCs are specified for the available bandwidth, an error message appears, and the program automatically configures the maximum number possible.

Configure the Second WAN SmartCard

For this example, repeat the setup procedure described in *"Transmit Setup" on page 497* for WAN port 15 (using the *Transmit Setup* window field values), but with the following exceptions:

- Click port 15 WN-3405, not port 14.
- Do not duplicate the previous DLCIs or a duplicate DLCI error is generated.

Run the Test and Review Statistics

After the necessary setup and configuration steps have been completed, the test can be initiated and the initial data reviewed.

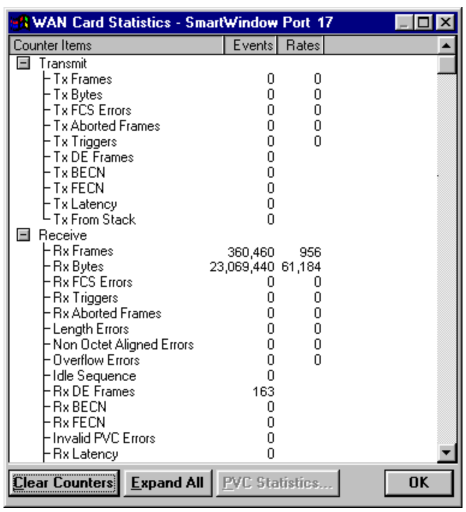
As the test is run on the receive card, watch the counters. The higher the Committed Information Rate (CIR), the more the customer pays for the guaranteed service at that level.

It is important to confirm that the traffic performs to the subscription rates promised, so the actual limits of the switch need to be determined.

To run the test and review statistics:

1. To begin transmission in the SmartWindow front panel, click the **Start** button on the transmitting WAN card (port 14).
2. To view statistics on a particular card, right-click the card image, and select **Display Counters** from the menu.

   The *WAN Card Statistics* window appears. In these statistics, all frames are successfully moving through the switch at the 956 frames per second rate.

3. Check for Discard Eligible (DE) frames in the *Counters* window or in the individual *PVC Statistics* window.

   When DE frames occur, the frames either have already been dropped or have been tagged as *not guaranteed*, and therefore are candidates to be dropped if there is network congestion.
4. Scroll down the *Counters* window to check LMI statistics.

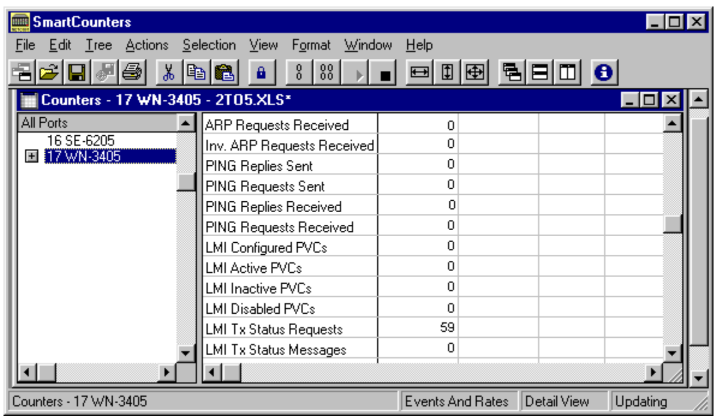
Use SmartCounters

Use SmartCounters to save statistics and to see data on a specific port.

To use SmartCounters:

1. Choose **Actions** > **SmartCounters**.
2. Select **File** > **New** to open a new counter window.
3. To save the statistical data available at that moment, choose **File** > **Save As** from the *SmartCounters* menu. The data is saved to an Excel spreadsheet.
4. Choose **View** > **Counter Only** to see data on a specific port.

Note: Refer to *"Set up IGMP for SmartBits 600x/6000x Modules" on page 120* for more complete information.



Determine the Traffic Breakpoint and Frame Rate Impact

The line rate stays the same for all PVCs, but each PVC may be configured for different throughput (56 Kbps, 64 Kbps, etc.). If you subscribe to 512 Kbps, be sure to verify the rate.

Sometimes older frame relay switches contain a T1 circuit/interface, but do not have the physical capability to run at that rate. Therefore, if you are paying for a T1 circuit, but the switch can only transmit at 56 Kbps, the WAN circuit is never saturated so you are not operating in a cost effective manner.

Determine the Traffic Breakpoint

To determine the frame rate at which frames are lost or about to be discarded:

1. In the *Transmit Setup* window, change the frame rate and/or the frame length (without FCS) to higher values.

2 To clear the counters, click the **Clear Counters** button.

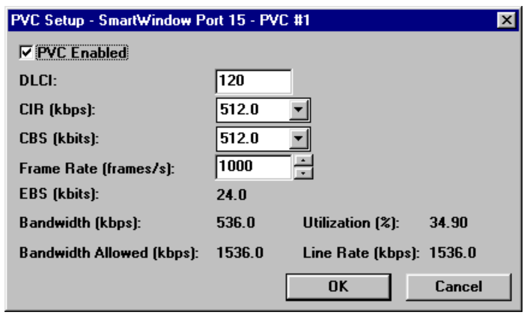
3 Run the transmission and watch the new counters for DE frames.

4 Increase the frame rate and repeat the above steps until the breakpoint is discovered.

5 Increment frame rates.

Note: Increase the frame rate, and monitor the effect.

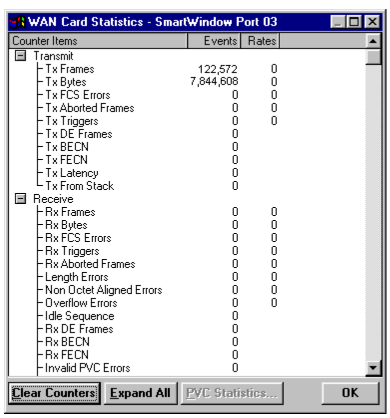
6 Increase the frame rate from 955 to 1000. The utilization rate increases from 33.33 to 34.90%.

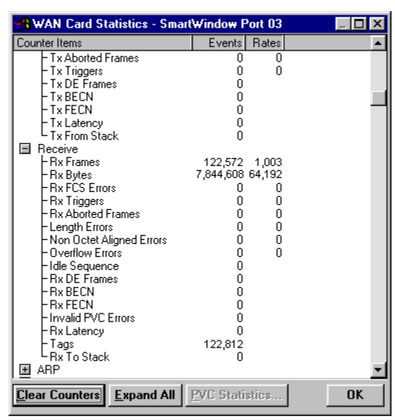


7 Inspect a new set of counters.

A new set of counters can be viewed easily. (To create a new set of counters, click the **Clear Counters** button on the *Counters* window, and run traffic.)

Note: In this example, all frames are successful in transmit and receive, but DE frames are tagged and may be discarded before reaching an end station.

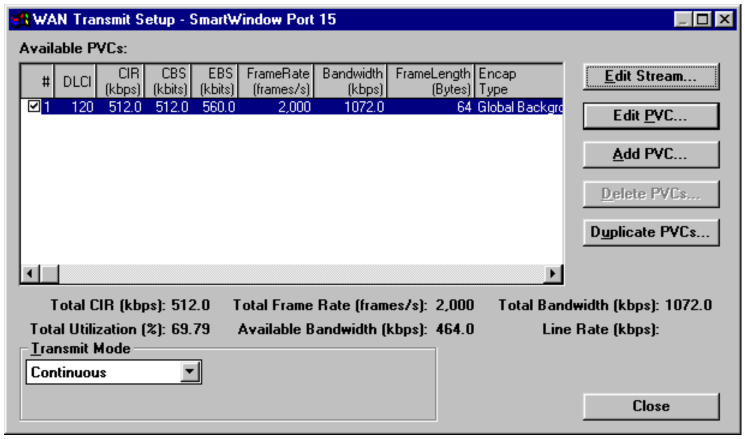




8 Increment further.

A frame relay switch may only support 70% of the line rate, which is why testing of network components is necessary to determine actual performance and the limitations of a network. When either the frame rate or the frame size is increased, the bandwidth goes down.

9 Increase the frame rate to find where the switch runs out of resources and discards frames in order to show physical capability and traffic capacity of the switch as well as to exercise an end-to-end test of the WAN. With this switch, a frame rate of 2000 and utilization rate of 69% demonstrates the upper limit.

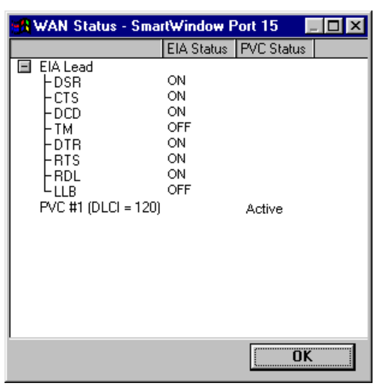


Troubleshooting Test Results

Before troubleshooting, carefully inspect the physical connections and PVCs.

To effectively troubleshoot the test:

1 Right-click the card, and select **WAN Port Setup** > **EIA Leads** or Right-click the card, and select **WAN Status.**
The following display appears.



Note: To promote accuracy, perform the following troubleshooting actions as well.

2 Check link LED on WN-3405 card.

- If red, link is down.
- If off, link is up.

3 Check DTR and RTS LEDs on the *WAN Status* window.
   - Should be on. (If off, DTR and RTS are not configured on the SmartBits).

4 Check DLCI on the *WAN Status* window.
   - Active (desired)
   - Inactive (Either LMP has not registered with switch, it depends on timer, or there is a problem.)
   - Not configured (Check configuration.)

5 Right-click the card and choose **WAN Port Setup**.
   - The card should be set to DTE if switch is set as DCE.
   - Line rate must match switch.
   - Under LMP, the link management protocol must match the switch settings.
     – LMI, annex A, or annex D
     – Card should show UNI on front; if not, it is disabled.
   - EIA leads must be on.

6 Check WAN transmit setup.
   - The **PVC** checkbox must be selected.
   - DLCI number must be valid and match switch port.
   - Correct CIR.
   - Frame rate must be set. Zero (the default) does not work.

Additional Features for WAN Cards

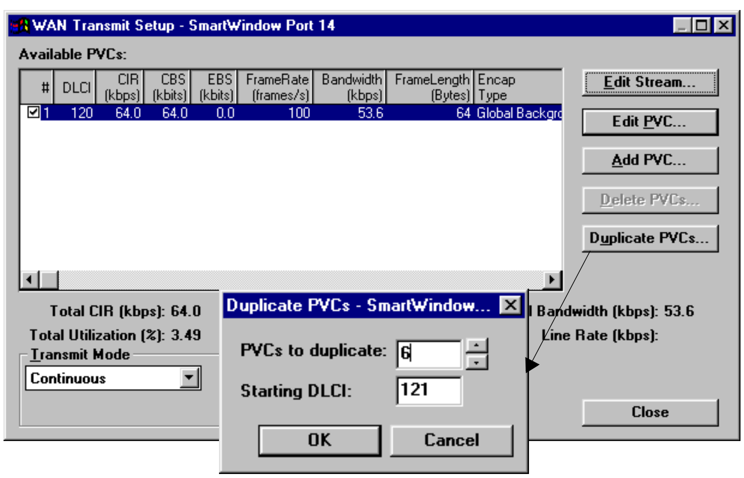
These are additional SmartBits features that apply to the WN-3405 and similar WAN SmartCards (WN-3415 and WN-3420):

- *"Duplicate PVCs Easily" on page 508*
- *"Adjust Incorrect Number of PVCs" on page 509*
- *"Use Different Transmit Modes" on page 510*
- *"Perform SmartMetrics Tests" on page 512*
- *"Define a Frame Distribution Method" on page 513*
- *"Set up IGMP Streams on WAN Cards" on page 514*.

Duplicate PVCs Easily

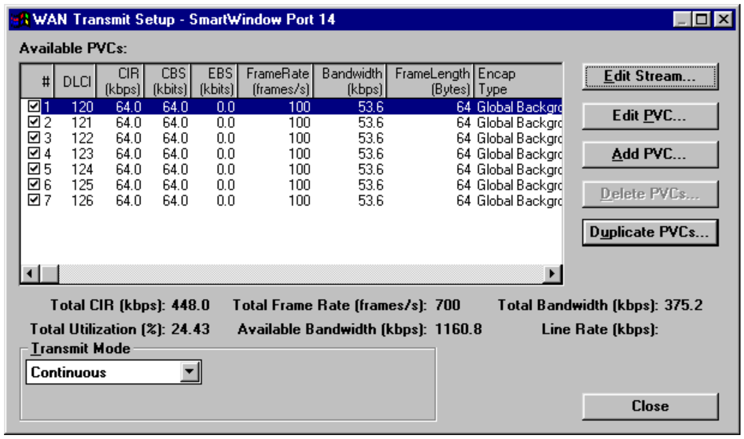
To duplicate PVCs:

1. First highlight the PVC to be duplicated.
2. Click the **Duplicate PVC** button, and then click **OK**.
3. Create six more PVCs with the same settings as PVC #1, and start the new PVCs at DLCI 121.



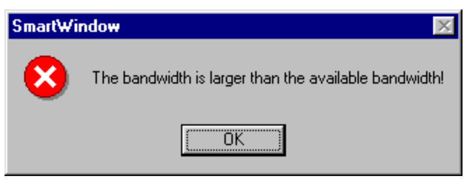
4 Click **OK**.

The duplicated PVCs appear, starting with PVC #2. The duplicated PVCs have the same settings as PVC #1.



Adjust Incorrect Number of PVCs

If the frame rate or the number of PVCs requested cannot fit into the available bandwidth, the following message appears:

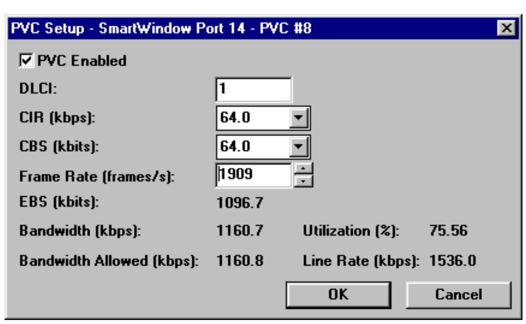


To correct and accept a frame rate:

1 To correct the frame rate, click **OK**. The *PVC Setup* dialog box appears with a corrected frame rate so that the bandwidth is not oversubscribed.

When the frame rate has been set appropriately by SmartBits to 126 frames per second, the bandwidth does not get oversubscribed.

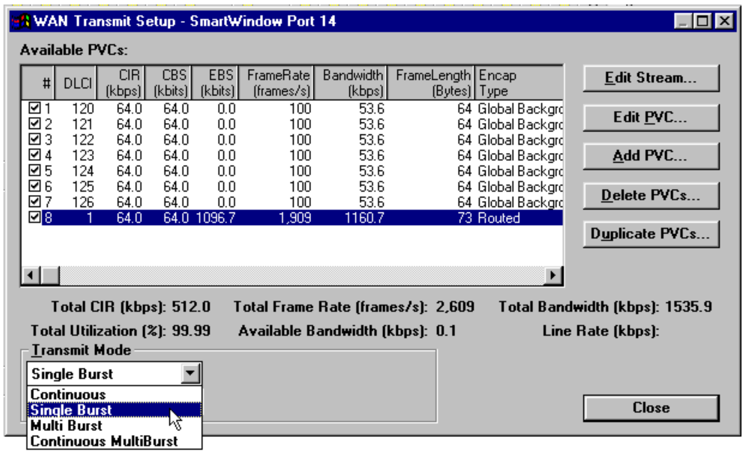
2 To accept the correct frame rate and return to the *Transmit Setup* dialog box, click **OK**.



Use Different Transmit Modes

The transmit modes are:

- Continuous
- Single burst
- Multiburst
- Continuous multiburst.

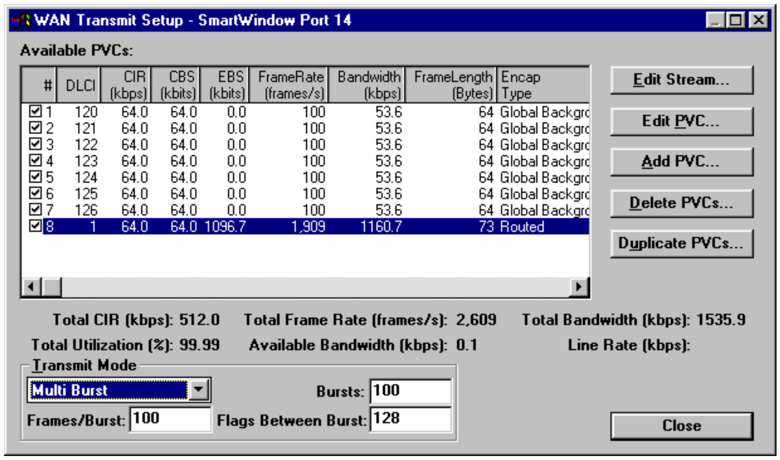


To select a transmit mode:

1. In the *Transmit Setup* dialog box, click the **Transmit Mode** field drop-down list to display available transmit modes.
2. Select the appropriate transmit mode.
3. Click the **Close** button to return to the *WAN Transmit Setup* window.

Single Burst Transmit Mode

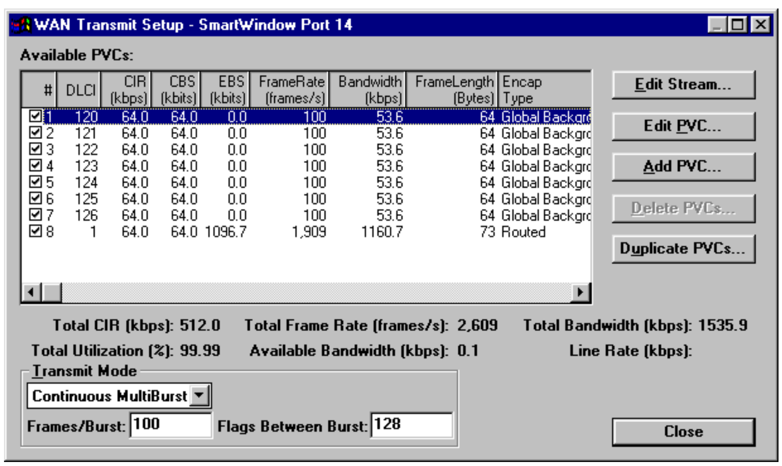
Single burst mode transmits a single burst of frames for each configured PVC.



Here the burst size is 100 frames per burst. PVC #1 sends the 100-frame burst over 1 second. PVC #8 sends the 100-frame burst over 0.0523 second.

Multiburst Transmit Mode

Multiburst mode transmits a pre-defined number of bursts with a defined interval between each burst for each active PVC.



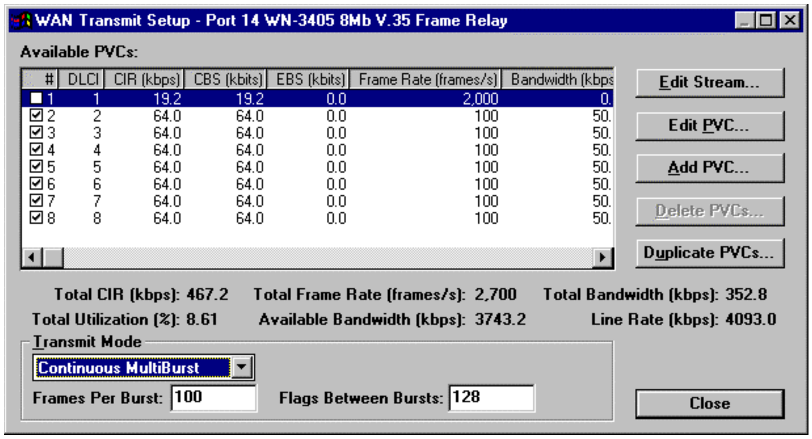
Both PVC #1 and PVC #2 send 100 bursts consisting of 100 frames per burst with spacing of 128 flags between each burst.

Note: A flag is a 7E 8-bit pattern inserted into the bit stream to delineate frames.

Continuous Multiburst Transmit Mode

Continuous multiburst mode transmits bursts continuously, with a defined interval between each burst, for each active PVC.

Select **Continuous MultiBurst** mode to transmit continuously without bursts.



PVCs #1 through 8 send bursts of 100 frames with spacing of 128 flags between bursts.

Perform SmartMetrics Tests

SmartMetrics tests are selected by choosing *Options* > *SmartMetrics Tests* from the SmartWindow main menu. The transit time analysis tests can be performed on Layer 2 and Layer 3 switches to generate performance data for:

- Latency over time
- Latency distribution
- Frame variation
- Sequence tracking
- Raw packet tags.

For more details, see *Chapter 7, "SmartMetrics Testing"* and SmartWindow online Help.

Define a Frame Distribution Method

On the WN-3415 and WN-3420 SmartCards, you can set one of two frame distribution modes. The modes determine how test frames are distributed in the stream.

This functionality is normally disabled. To enable it, modify the smartbit.ini file. Once you have enabled the functionality, the *WAN Transmit Setup* dialog box changes to include a *Frame Distribution* pane with radio buttons to select the mode.

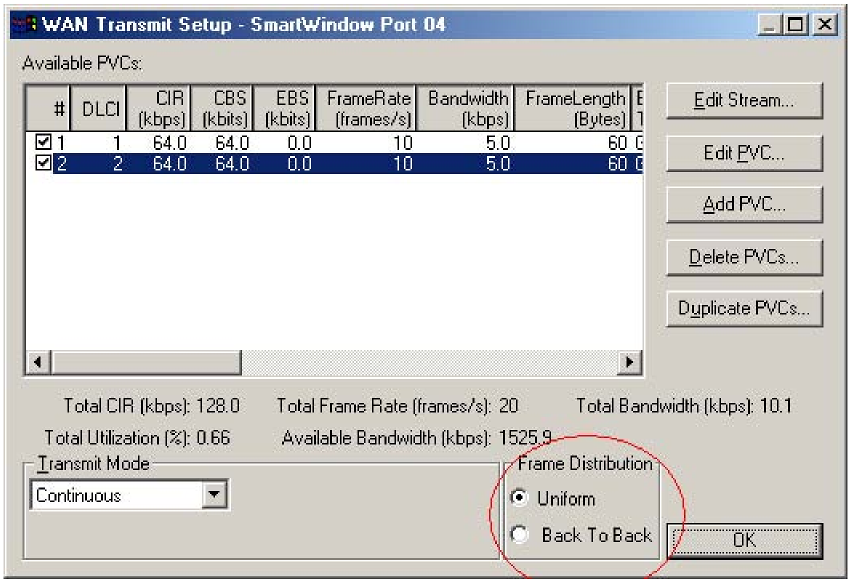


Figure 9-8. Frame Distribution Option

To enable the frame distribution functionality, edit the smartbit.ini file. Add the following entry under `[WAN Card Settings]`:

```
WAN Transmit Dlg Frame Distribution=1
```

The two frame distribution modes are uniform and back-to-back.

In the uniform mode, traffic is distributed evenly across the entire time slot. This mode appears continuous, in that frames are equally spaced.

In back-to-back mode, the card transmits data at full wire rate until all data is transmitted. Then it idles until the next time slot. As a result, the back-to-back mode can appear bursty.

Set up IGMP Streams on WAN Cards

The WN-3441A, WN-3442A, and WN-3445A SmartCards can be configured to handle IGMP multicast streams.

Important: Refer to *"Setting up IP Multicast Groups" on page 112* (in *Chapter 5, "Advanced Operational Theory"*) for an overview of IGMP and multicast. That section applies to Ethernet cards, but it provides background information on multicast operation.

To set up multicast addresses for WAN cards:

1 Assign the Layer 3 addresses, if needed.

- **a** Click the card image to open the card menu.
- **b** Select **Transmit Setup**, then use the navigation tree to select the PVC or PPP instance.
- **c** Use the address fields in the *PVC Setup* or *PPP Setup* dialog box to set the local IP address (*Figure 9-9*).
- **d** Specify an **IP Address** field value to be used in streams, as well as a subnet mask (**Netmask**) field value, if necessary.

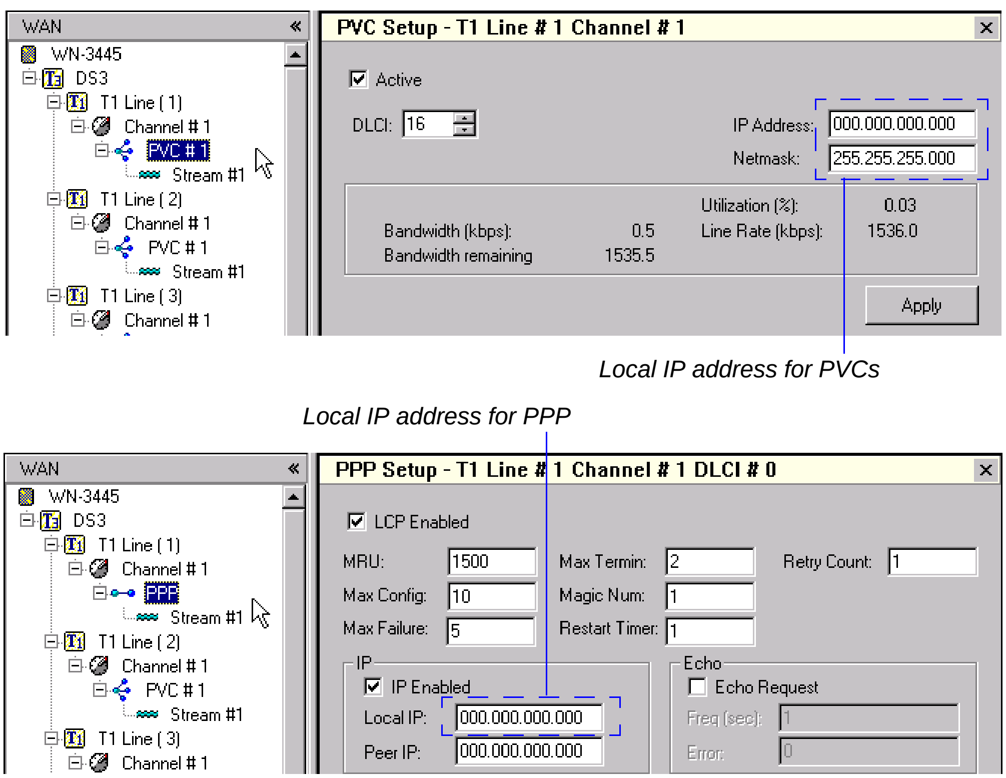
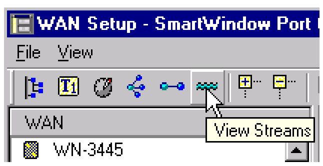


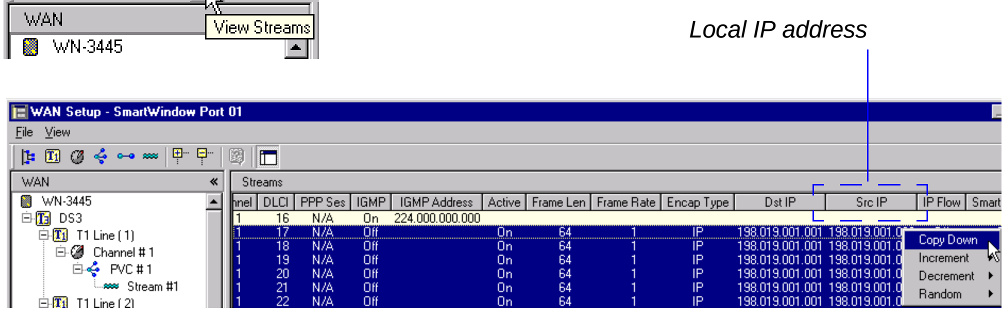
Figure 9-9. Setting Local IP Addresses on WAN Cards

Use the *View Streams* function to set local IP addresses.

To set the IP address using the View Streams icon:

1. Click the *View Streams* icon on the toolbar.
2. Use the *Streams* list to set the destination IP address *(Dst IP)* field.
3. Use the *Copy Down* option by performing the following steps:
   - **a** Select a range of streams to copy to.
   - **b** Highlight the stream with the address to duplicate.
   - **c** Right-click to retrieve the menu.
   - **d** Select **Copy Down**.





To configure the individual streams:

This procedure applies to existing streams or to new streams that are added.

1. Click the card to open the card menu.

   Notice that the IGMP menu options are disabled (*Figure 9-10*). SmartWindow enables these options either:

   - After you configure at least one multicast stream (*"Option 1: To use the Protocol Editor" on page 516*) or
   - When you select *Set up IGMP Group* in the *Streams Setup* window (*"Option 2: To set up a global IGMP group" on page 518*).

   A multicast stream is identified by having an IP destination address in the range `224.0.0.0` through `239.255.255.255`. (**Note:** The "All Hosts Group" address 224.0.0.1 and "All Routers Group" address 224.0.0.2 should not be used in test streams; see *"How IP and MAC Addresses Identify Multicast Traffic" on page 115* for a detailed explanation.)

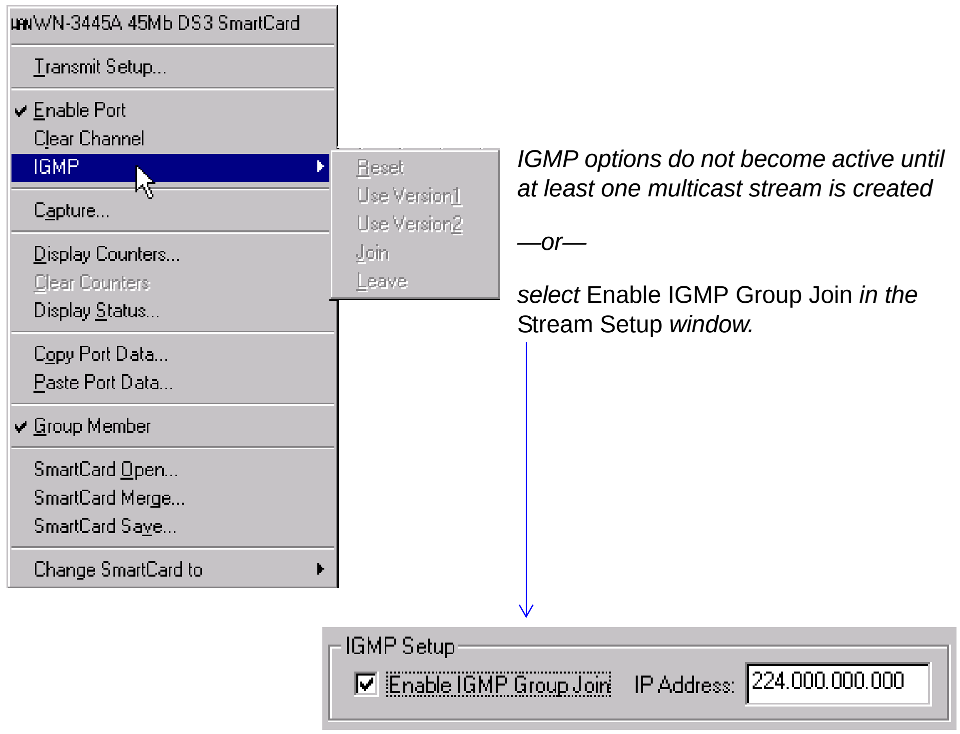


Figure 9-10. IGMP Menu Options Before Streams Are Set Up

2 Select the **Transmit Setup** option to open the *WAN Setup* window.

3 Click a stream in the navigation tree to open the *Stream Setup* window (*Figure 9-12 on page 518*).

Set the multicast address for the stream.

To designate the stream as multicast, set a destination IP address in the multicast range of 224.0.x.x through 239.255.255.255.

Note: Avoid using the "All Hosts Group" address 224.0.0.1 and "All Routers Group" address 224.0.0.2. (See *"How IP and MAC Addresses Identify Multicast Traffic" on page 115* for a detailed explanation.)

You can set the address in two ways, either by using the Protocol Editor or setting up a global IGMP group.

Option 1: To use the Protocol Editor

This option enables the port to transmit multicast streams as well as to receive them.

The *Enable IGMP Group Join* checkbox (located in the bottom of *Stream Setup* window) must not be selected.

1 Click the **Edit** button in the *Protocol* pane.

2 Use the Protocol Editor to set the IP destination address (*DestIP* field) as shown in *Figure 9-11*.

Enter an IP address in the range of `224.0.0.0` through `239.255.255.255`.

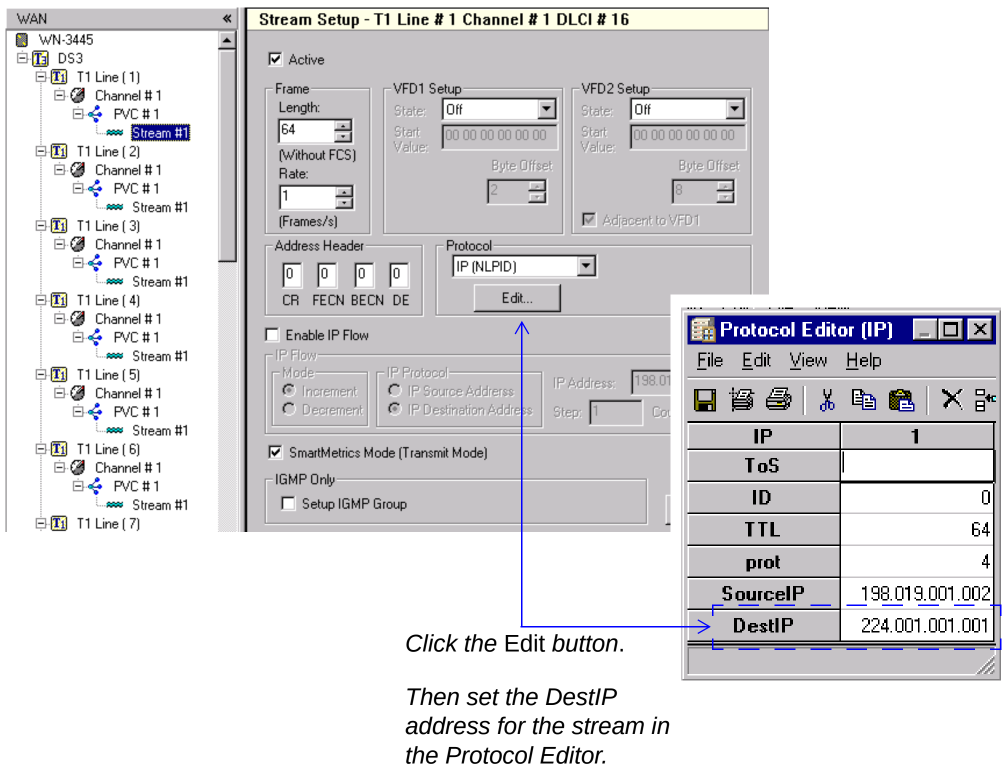


Figure 9-11. Setting the Multicast Address in the Protocol Editor

Option 2: To set up a global IGMP group

This option enables participation in multicast group membership through join and leave actions, but it does not allow multicast streams to be transmitted.

1 Select the **Enable IGMP Group Join** checkbox in the *IGMP Setup* pane (*Figure 9-12*).

2 In the **Group Address** pane, enter an IP address in the range of `224.0.0.0` through `239.255.255.255`.

SmartWindow proposes a default group address of `224.0.0.0`, the lowest possible address in the multicast range.

Note: Selecting the *Enable IGMP Group Join* checkbox disables all other options in the *Stream Setup* window.

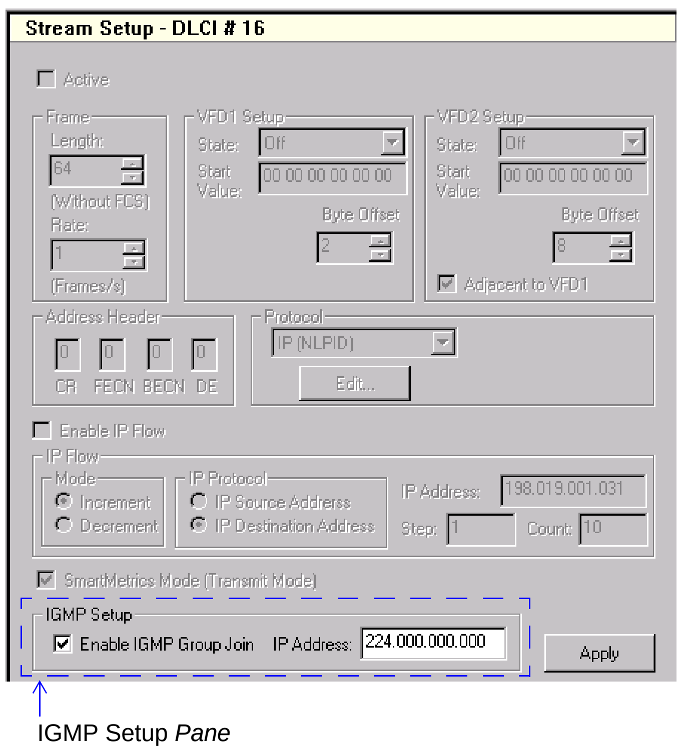


Figure 9-12. Stream Setup Window and IGMP Setup Pane

Select the IGMP Version and Actions

Once IGMP streams have been set up, SmartWindow enables its IGMP menus and options. You can then select the IGMP version, reset the IGMP stack when changing versions, and perform join and leave actions for multicast streams that have been set up.

IGMP version

IGMP Version 2 is the default. Select the version that is supported by the DUT. You must set the IGMP version before a join will take effect. If the IGMP version is changed, you must reset the IGMP stack. To do this, use the *Reset* option.

If Version 2 is used, no leaves are sent automatically when you reset. For this reason, it is recommended that leave commands are issued for all joined groups before selecting the *Reset* option in order to reset the internal IGMP stack. The port may continue to receive frames from previously joined multicast groups for some time.

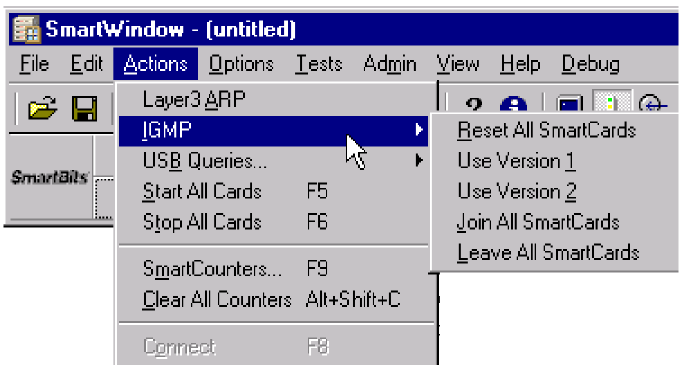
Joins and leaves affect only active streams.

Remember that join and leave actions apply only to streams that are enabled. For some test situations, use the *Active* checkbox to include or exclude a multicast stream from IGMP actions.

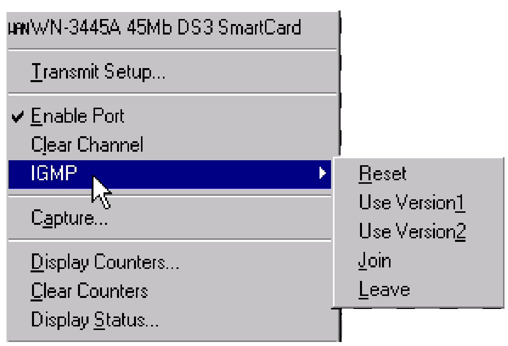
How to select IGMP options

IGMP options are selected in two ways:

- Use the SmartWindow global options. Select **Actions** > **IGMP** from the main menu.



- Select **IGMP** from the card menu. All of these options apply to all multicast streams that have been set up for the port.



Chapter 10

Testing ATM

The SmartBits chassis, ATM SmartCards, and SmartWindow provide a highly effective test methodology when seeking critical data to evaluate ATM devices.

This chapter presents a detailed set of procedures for testing ATM device performance.

In this chapter...

Testing ATM

Asynchronous Transfer Mode (ATM) is a connection-based technology. It requires that a specific path be established between two endpoints before data can be transferred between them.

The ATM series of SmartCards can be used to generate and monitor ATM network traffic. Applications include testing:

- ATM-to-LAN internet working devices
- Very high-performance ATM backbones
- LAN-to-ATM edge devices.

Among the significant capabilities of these low cost/high performance ATM cards are:

- Frame-level testing at full-duplex, full-wire rate on edge devices and switches
- Switch testing at full-cell rate
- High-rate signaling testing for edge devices.

SmartWindow uses the concept of *streams* as a transmission engine. When a stream is created, you define what to transmit, how and where to transmit it, and how fast to transmit it.

The *what to transmit* is the frame that a stream will use. Each time a stream is created, you must define a frame template (a data pattern) that the card can use to create and transmit test traffic. When the *Start* button is clicked, the stream transmits that data pattern repeatedly in its assigned turn.

The *how* and *where to transmit* depend greatly on stream type and encapsulation. The two stream types are Permanent Virtual Connections (PVC) and Switched Virtual Connections (SVC). In ATM, one physical pipe is used to transmit and receive all data, but the pipe can be divided into channels (as in television transmission). When a data cell is transmitted, its data channel is indicated by two fields in the cell header that is included in each cell. These are the Virtual Path Identifier (VPI) and Virtual Channel Identifier (VCI) fields.

PVCs

For PVCs, specify the VPI/VCI on which the stream is supposed to transmit the frame. The card verifies that the specified VPI/VCI is not already used by another stream on the card. In addition, it verifies that there is enough system memory to send and receive data on the VPI/VCI associated with that stream.

SVCs

For SVCs, the network to which the ATM card is connected selects the VPI/VCI; thus, do not specify a VPI/VCI. However, specify certain signaling parameters that indicate to the network what data to transmit, its destination, how the network should handle it, and how fast to send it. The card sends these signaling parameters to the network and waits for the network to assign a VPI/VCI to use in sending the data frames of the stream. If the network switch agrees with the requested signaling parameters, it assigns a VPI/VCI. The card then ensures that enough resources are available for using the assigned VPI/VCI.

This procedure is much the same for both PVCs and SVCs, although the setup for an SVC can be more complex and varied, depending on the encapsulation type. Once the setup process has completed for either a PVC or SVC, the stream is said to be in a connected state. A connection index number is assigned by the card as a reference number for the connection. (The term *connection index* is nearly interchangeable with the term *VPI/VCI*. However, the value of the connection index has no relation to the value of the VPI/VCI or to the stream number which is using the VPI/VCI. It is simply a value used to identify a VPI/VCI when retrieving statistics.)

Note: Refer to the *"ATM Glossary" on page 524* for definitions of key terms.

Understanding Variations in Cell Rates

ATM cell transmission follows a generic cell rate algorithm, which attempts to regulate output for optimal speed and efficiency. In some test setups, the algorithm can produce an actual cell rate that differs from requested rate. This occurs when you set up multiple streams with multiple stream sizes, with the result that the first stream starts to reduce throughput.

ATM is able to multiplex cells from different virtual connections onto a single physical interface. Any time more than one VC has been configured, it becomes possible that the two VCs may try to send a cell during a given cell time. (This is true of any ATM implementation.) When this happens, the cell of one VC is pushed to a later transmit time. Because of the generic cell rate algorithm, which defines the conformance of cell transmissions, a VC can lose time, but it cannot transmit a subsequent cell earlier than normal to make up for the previously lost time. As a result, the actual rate may be less than the requested rate.

ATM Glossary

ATM Adaptation Layer 5 (AAL 5) A variable bit rate, delay tolerant, connection-based data transport standard.

Asynchronous Transfer Mode (ATM) A transfer mode that organizes data into cells.

ATM cell A 53-byte cell (5-byte header and 48 bytes for data). Each cell contains a VPI and a VCI in its 5-byte header.

ATM address A 20-byte address, consisting of a 13-byte ATM network prefix (OSI Network Service Access Point–NSAP) and 7-byte host part, of which six bytes, the ESI (End System Identifier), is the host MAC address.

ATM Address Resolution Protocol (ARP) The procedure used to resolve an IP address into a ATM address.

Broadcast/Unknown Server (BUS) Broadcasts inquiries on destination addresses that originate on the ATM network to all LEC clients on the emulated LAN.

Emulated Local Area Network (ELAN) A group of ATM and legacy devices registered with the LES that constitutes a logical network.

Frame A data pattern that a stream transmits.

Interim Local Management Interface (ILMI) Discovers and registers ATM addresses of attached hosts.

LAN Emulation (LANE) Allows an ATM network to function as a LAN backbone or WAN connection. Consists of LANE clients and LANE services.

LAN Emulation Client (LEC) A device such as server, switch, or workstation that performs ATM signaling and control functions while communicating with other devices in an ELAN. Every LEC client has an ATM address and a MAC address.

LAN Emulation Configuration Server (LECS) Provides mapping information about ELANs on the ATM network that a LEC may join.

LAN Emulation Server (LES) Registers the MAC addresses of each LEC on the non-ATM destination LAN and resolves the MAC address to an ATM address.

MAC address A 6-byte IEEE identifier for hardware devices, sometimes referred to as hardware address.

Permanent Virtual Circuit (PVC) A dedicated channel between endpoints through an ATM network used for long-term data transfer.

Stream An engine which defines where and how to transmit a frame over and over repeatedly.

Switched Virtual Circuit (SVC) A channel established on demand by ATM signaling that lasts only the duration of the transfer.

Virtual Channel Connection (VCC) A unidirectional communications path between two nodes based on label rather than fixed physical path that extends between two points in the ATM layer.

Virtual Channel Identifier (VCI) / Virtual Path Identifier (VPI) A connection in the form of a channel which has been successfully initialized and on which data is ready to be transmitted and received. Provides mapping information for routing cells from a source to destination.

Establishing PVCs

To test PVC throughput over a network implementation (*Figure 10-1*), you must configure both line parameters and—depending on the encapsulation method—specific protocol settings for either SNAP or CLIP.

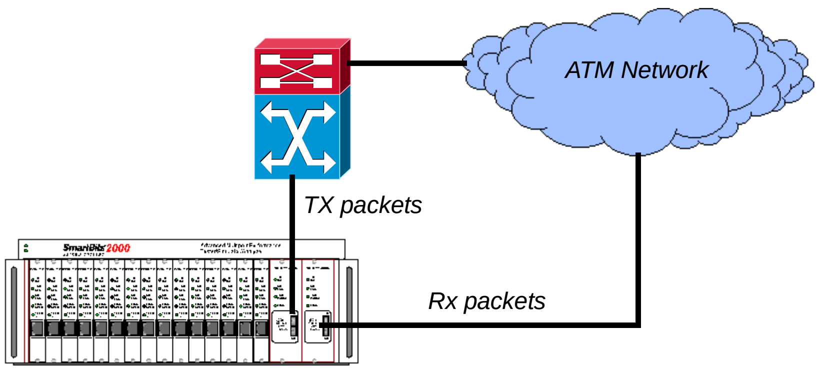


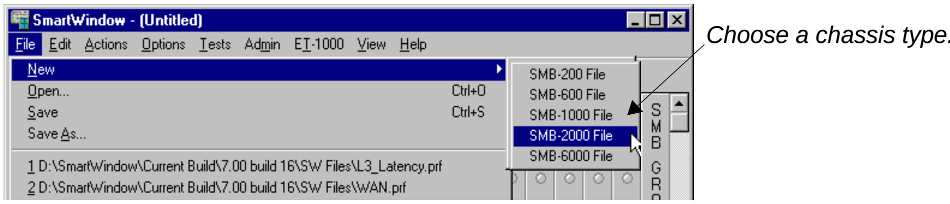
Figure 10-1. Using Two ATM cards on a Single SmartBits Chassis to Set up PVCs

To test the above scenario, follow the steps in *Table 10-1*.

Table 10-1. Configuring Two ATM Cards for PVC-SNAP

Step	Action
1	Set line interface parameters.
2	Create streams on card #1 (transmitting card).
3	Create streams for card #2 (receiving card).
4	Configure ATM switch to match PVCs.
5	Establish connection by connecting streams on both cards.
6	Open SmartCounters and clear.
7	Highlight corresponding streams on both cards and start card #1 transmitting.
8	Stop card #1 transmitting.
9	Check SmartCounters to see if Tx and Rx frame numbers match up. Verify error statistics.

Important: When configuring SmartWindow for ATM, be sure to select **File** > **New** > **(Chassis type)** or open a configuration file that has already been configured. This allows the ATM configuration set in SmartWindow to update the card.



Note: This test setup uses the AT-9155. Additional SmartCards that support this test include the following:

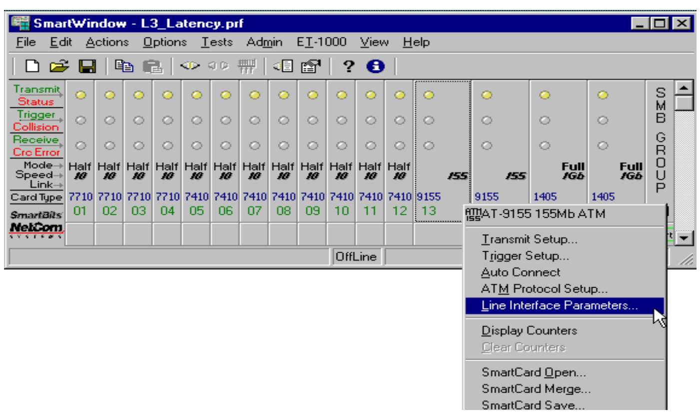
- All other ATM SmartCards can be substituted in this test.

PVC-SNAP Encapsulation

To set up line parameters:

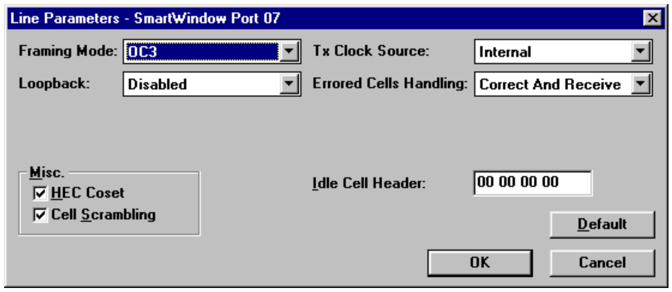
The line parameter settings must correspond to the ATM switch settings.

1. Start SmartWindow.
2. Right-click an ATM card image.
3. Choose **Line Interface Parameters.**



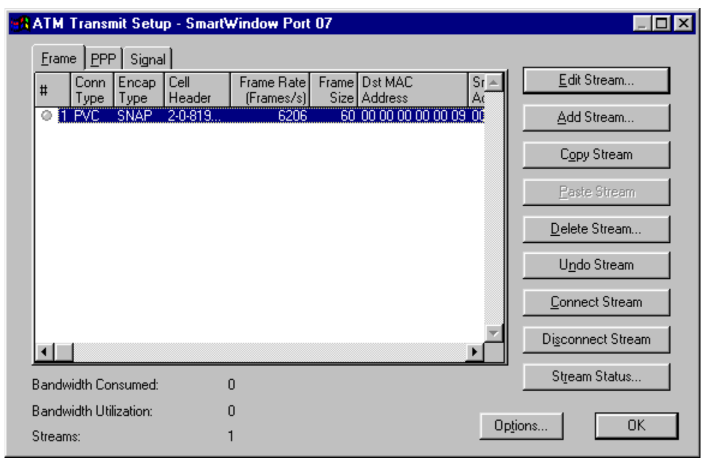
The *Line Parameters* window opens. The parameters displayed depend on the ATM card model. Modify the fields accordingly if the defaults are not acceptable.

4 Click **OK**.



To create a stream on card #1:

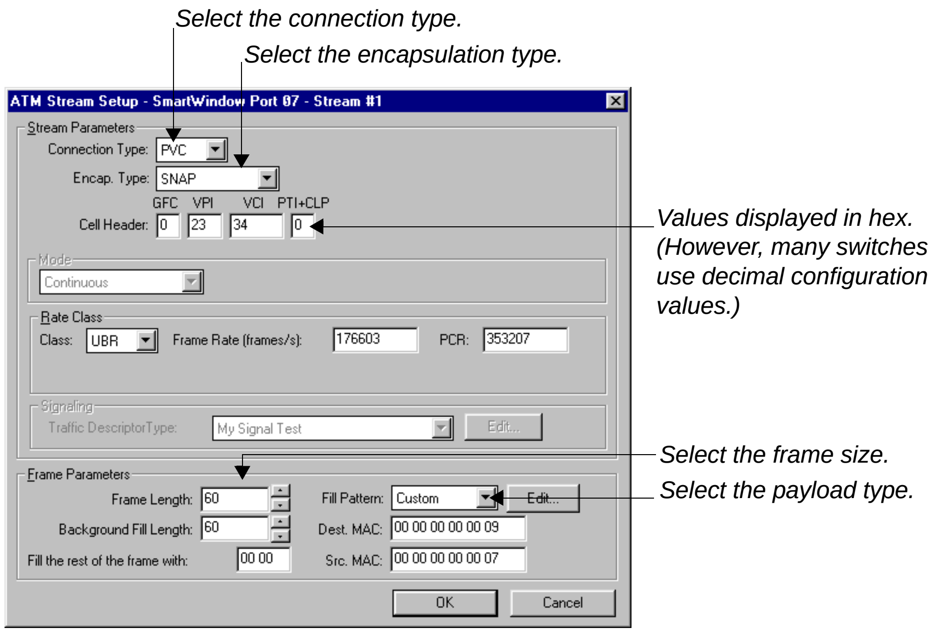
1 Right-click the ATM card (AT-9155) and choose **Transmit Setup**.
The following window appears.



2 Highlight and then double-click the default stream.

Select the connection and encapsulation types.

The following window appears.



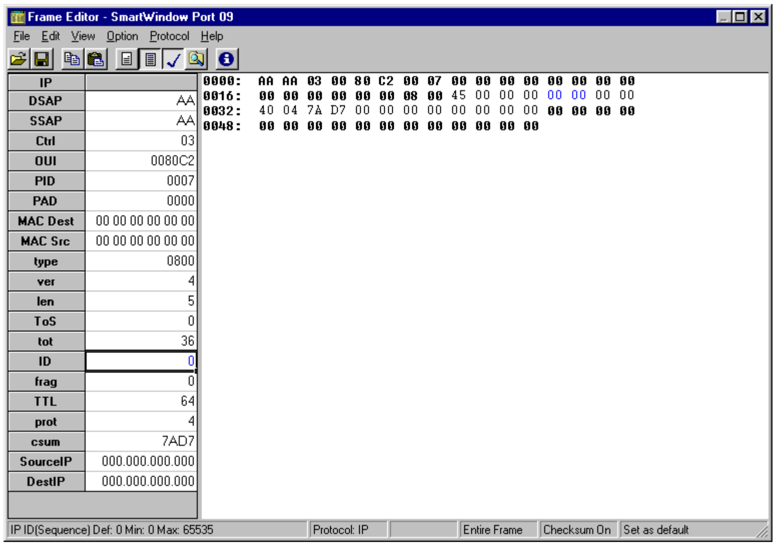
3 In the *Stream Parameters* pane, set **Connection Type** to **PVC** and **Encap(sulation) Type** to **SNAP**.[1]

4 In the *Rate Class* pane, specify the frame rate and the GFC/ VPI/VCI/PTI + CLP. (Refer to *Table 10-5 on page 542* for more information.)

5 In the *Frame Parameters* pane, select the frame size and payload type from the **Fill Pattern** field drop-down menu.

1. To change from hex to decimal, edit the preferences section of the `smartbit.ini` file as follows: `ATM VPI/VCI HEX=0`.

6 Click **Edit** and make any necessary adjustments to the payload.



7 Save the edits, then click the **Close** button.

8 In the *ATM Stream Setup* dialog box, click **OK** to return to the *Transmit Setup* dialog box.

9 Highlight the stream that was created, and click the **Connect Stream** button.

Verify the connection status by checking the green LED to the left of the stream number or by clicking the **Stream Status** button.

To create a stream on card #2:

1 To create a stream on card #2, repeat the procedure used for card #1.

To configure the ATM switch:

1 To configure the ATM switch, set parameter values to match those parameter values for the PVC that was just created.

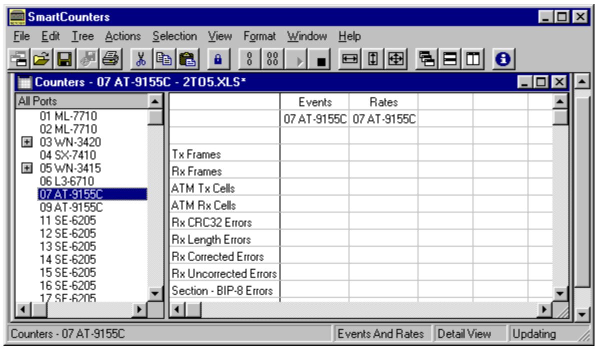
To connect streams on both cards:

1 Click the **Connect Stream** button on both cards.

When the streams are connected, the LED to the left of each stream turns green.

To configure SmartCounters:

1 To open SmartCounters, choose **Actions** > **SmartCounters** from the main menu.



2 Click the **Clear All Counters** button or choose **Actions > Clear All Counters**. (See *"Set up IGMP for SmartBits 600x/6000x Modules" on page 120* for more information.)

To run the test:

1 In the *Transmit Setup* dialog box, highlight the two streams to be set up.
2 On the main menu, click the **Start** button for card #1.
Watch SmartCounters as the test progresses.

Important: If you do not see Rx packets on the receiving card, click the **Update** button on the SmartWindow main menu to update the card configuration.

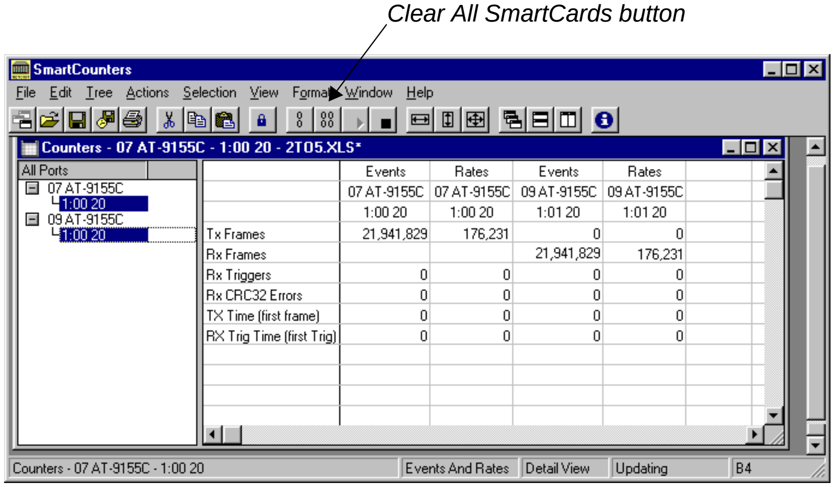
To stop the test:

1 Click the **Stop** button on card #1.
The test stops.

To check the test results:

1 Activate SmartCounters.
2 Verify that the Tx frame count on the transmitting card matches the Rx count on the receiving card.
3 Check for CRC and other errors.

Clear All SmartCards button



PVC-CLIP Encapsulation

To set up a PVC with Classic IP encapsulation (CLIP), use the same procedure that is performed to set up PVC-SNAP encapsulation. However, there is one difference: In *Step 3 on page 528*, set **Encap(sulation) Type** to **CLIP**.

PPP over ATM

The AT-9155C OC-3c/AT-9155Cs and AT-9622 ATM SmartCards support the Point-to-Point Protocol (PPP) over ATM per RFCs 1661 and 2364. PPP is used in xDSL networks to provide dynamic IP address allocation and user authentication.

PPP support allows testing in three areas:

- Functional testing of security mechanisms
- Capacity testing (i.e., the ability to determine the DUT maximum capacity to setup PPP sessions)
- Traditional IP testing over PPP (such as throughput and packet loss).

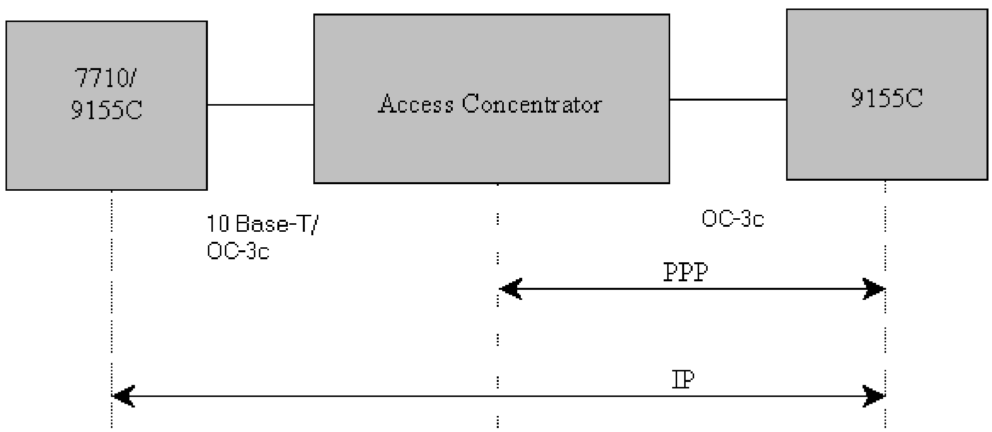


Figure 10-2. Testing PPP over ATM

AT-9155C SmartCards are used to setup PPP sessions with the DUT and then generate IP data over PPP. The DUT terminates the PPP sessions and forwards the IP data where it is terminated on a ML-7710 or another AT-9155C. The AT-9155C can simulate traffic coming out of a DSLAM and thousands of associated xDSL end users.

Note: This test setup uses the ML-7710 and AT-9155 cards. Additional SmartCards that support this test include the following:

- The AT-9622 ATM SmartCard can be substituted in this test.

PPP over ATM Tests

Table 10-2 summarizes the objectives of the three PPP over ATM tests.

Table 10-2. PPP over ATM tests

Test	Objective
1	Determine if a device can sustain a specified number of simultaneous PPP sessions.
2	Measure how long it takes to establish a PPP session.
3	Send IP frames over PPP.

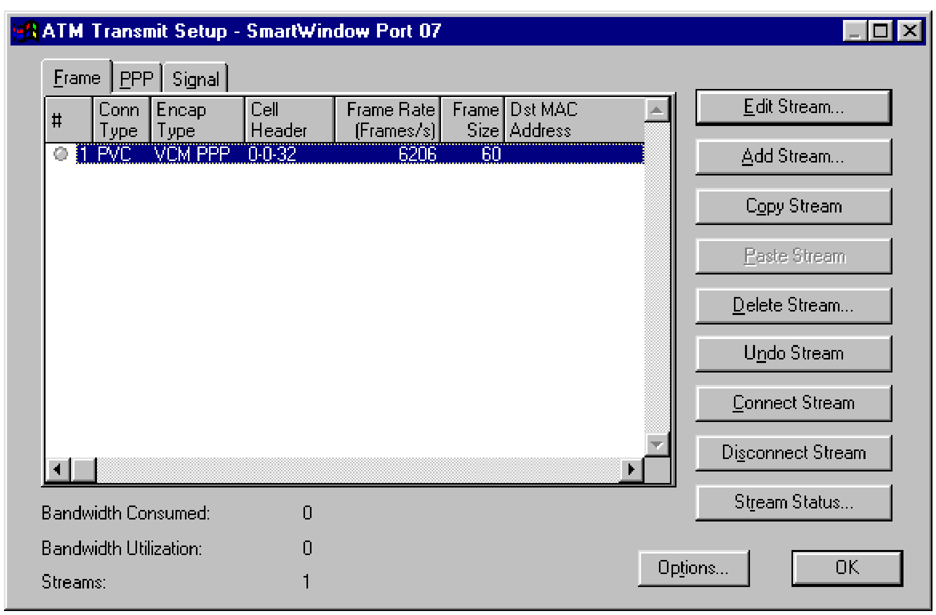
Determining the Number of Simultaneous PPP Sessions

Test 3 can be set up quickly to determine how many simultaneous PPP sessions the DUT is capable of setting up and maintaining.

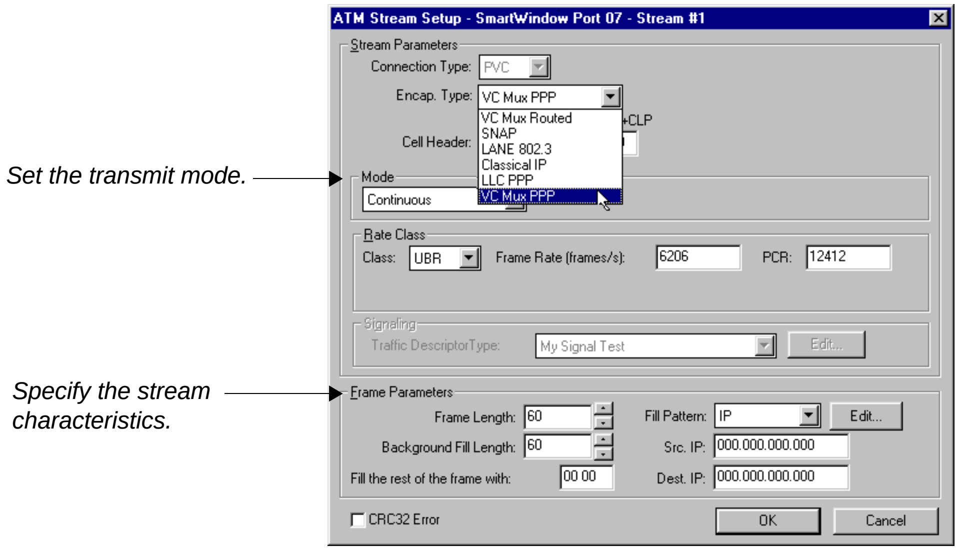
To run this test:

1 Set up the ATM line parameters as described in *"PVC-SNAP Encapsulation" on page 526*.

2 Click the card image and choose **Transmit Setup**.



3 Highlight the stream in row 1, and double-click (or click **Edit Stream**). The *ATM Stream Setup* dialog box appears.

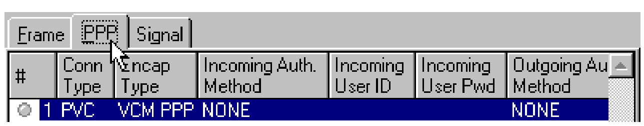


4 Set **Encap(sulation) Type** to **VC Mux PPP**.

Important: The VCI/VPI setup must match the router.

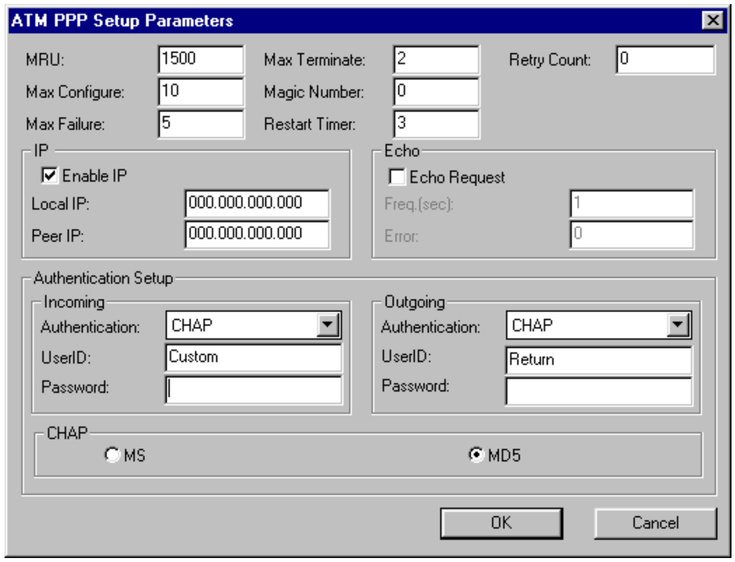
5 Click **OK**. The *Transmit Setup* dialog box reappears.

6 Click the **PPP** tab.



7 Highlight the stream in row 1, and double-click (or click **Edit Stream**). The *ATM PPP Setup Parameters* dialog box appears.

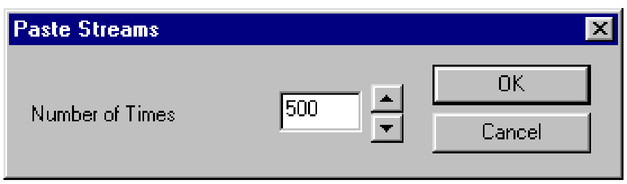
If PPP is enabled and the Local IP *address field value is set to* 0000, *the server assigns all IP addresses.*



Note: For security reasons, in the *Authentication* field, choose between *CHAP*, *PAP*, and *None*. Parameters in the *Incoming* and *Outgoing* panes should match.

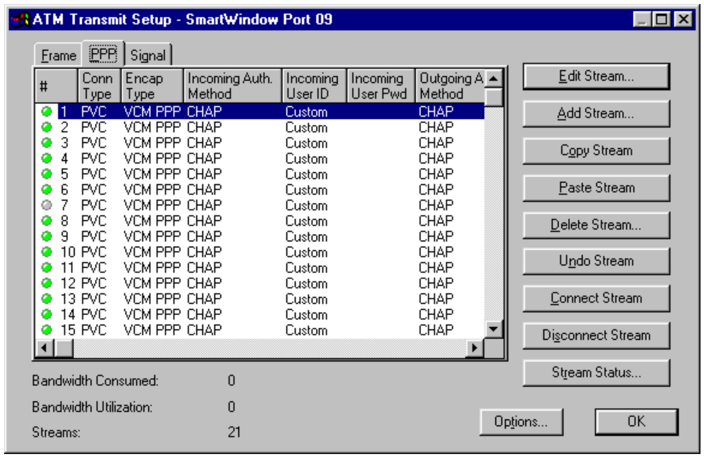
8 Click **OK** to return to *Transmit Setup* dialog box.

9 Highlight the stream that was created and click **Copy Stream**, then **Paste Stream**. The following dialog box appears.



10 Type in the number of streams, then click **OK**. The *Transmit Setup* dialog box reappears with all the streams.

11 Save the configuration file.



12 To run the test, highlight all the streams and click **Connect Stream**.
The green LED denotes that a stream is connected.

13 To verify an individual stream, highlight the desired stream, and click **Stream Status**.

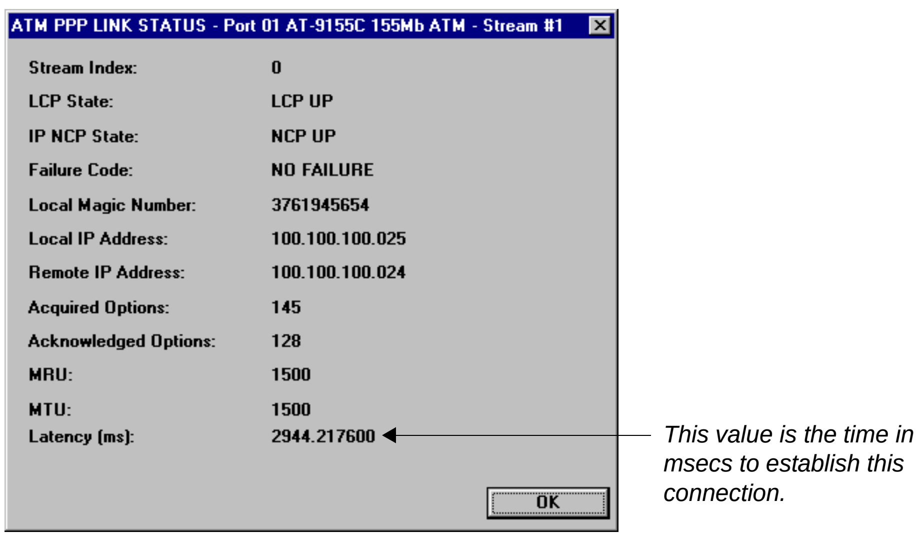


Table 10-3. Stream Connect Failure Codes

#	Code	Meaning
00	Unknown	Error not defined.
01	No authentication info received or timeout	Usually occurs when there is no response from the peer for that session. (Default is two tries.)
02	login/pwd failed - local reject	The local end rejected the login/password received from the peer.
03	login/pwd failed - peer reject	The peer end rejected the login/password received from the local end.
04	LCP establishment failure	Usually occurs when the peer disagrees with some or all of the proposed options in the configuration request packet (e.g., MRU).
05	LCP establishment timeout	This occurs when the number of maximum configuration requests is sent out without being ACKed in the LCP negotiation phase. (Maximum number is specified by the user; default is 10.)
06	NCP establishment failure	Same as #4: NCP configuration failure.
07	NCP establishment timeout	Same as #5. Occurs in NCP negotiation phase.
08	No failure	No failure

Establishing SVCs

When setting up an SVC, you must register the signaling parameters with the network, then wait for the network to assign a VPI/VCI.

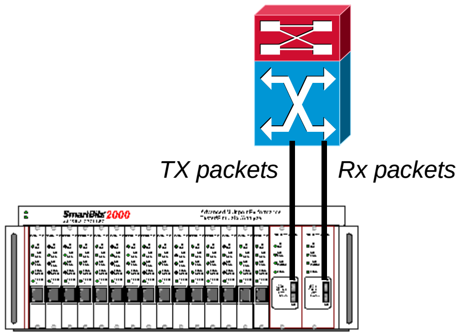


Figure 10-3. Using Two ATM Cards on a Single SmartBits Chassis to Receive Packets

To test the above scenario, follow the steps in *Table 10-4*.

Table 10-4. Configuring Two ATM cards for SVC-SNAP

Step	Action
1	Set line interface parameters.
2	Register ILMI.
3	Establish SSCOP/UNI.
4	Create traffic descriptor.
5	Create streams on card #1 (transmitting card).
6	Create streams for card #2 (receiving card).
7	Configure ATM switch to match SVCs.
8	Connect streams.
9	Open SmartCounters and clear.
10	Highlight corresponding streams on both cards, and start card #1 transmitting.
11	Stop card #1 transmitting.
12	Check SmartCounters to see if Tx and Rx frame numbers match up. Verify error statistics.

Note: This test setup uses the AT-9155. Additional SmartCards that support this test include the following:

- All other ATM SmartCards can be substituted in this test.

SVC-SNAP Encapsulation

To set the line interface parameters:

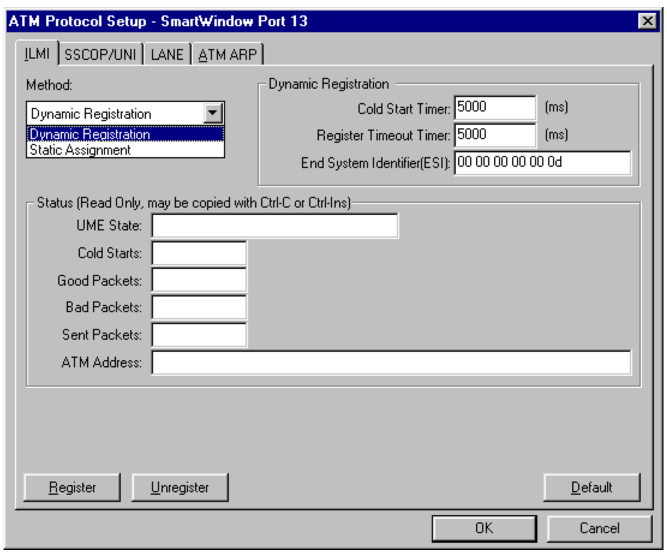
1 Set the interface parameters according to the procedures described in *"Start Smart-Window." on page 526*.

To set up and register ILMI:

1 To set up the ILMI protocol, click the ATM card.

2 Click the **ATM Protocol Setup** button.

The *ATM Protocol Setup* window opens.

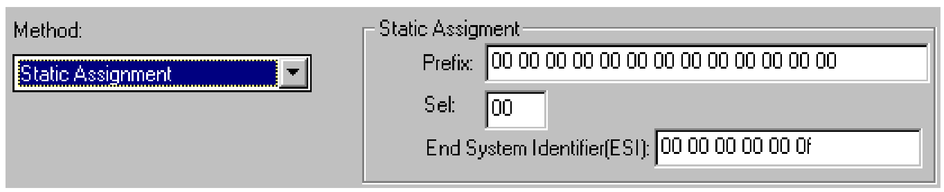


3 Click the **ILMI** tab, if necessary. Depending on the ILMI method selected (*Dynamic Registration* or *Static Assignment*), the dialog box fields change.

Dynamic registration method

By default, this field value is the ATM card slot number.

Static assignment method



4 Enter an ESI for the card slot number. This value can be any unique 6-byte number. In the *Dynamic Registration* pane, provide the ESI. (The ATM server provides the prefix.)

5 Enter the complete 20-byte ATM address. In the *Static Assignment* pane, provide the ESI, the ATM address, and the selector byte.

Caution: When using the static assignment method, the ATM server must be configured to recognize the static address.

6 Click the **Register** button.
Successful registration causes the UME state to change from *Inactive* to *Active* and from *Cold Start* to *Running*.
The ATM address is now retrieved from the switch.

7 Click **OK**.

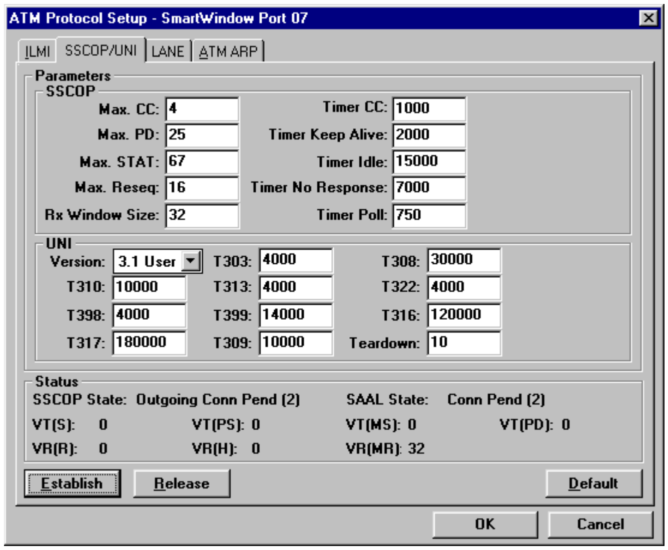
Note: If you cannot proceed from cold start, verify that the ATM switch is set to support ILMI and SVCs.

To set up the SSCOP/UNI protocol:

1 Click the ATM card.

2 Click the **ATM Protocol Setup** button. The *ATM Protocol Setup* window opens.

Change the SSCOP state from idle to data xfer ready.



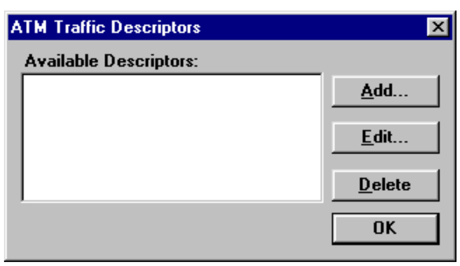
3 Click the **SSCOP/UNI** tab.

4 Set the **Version** field value in the *UNI* pane to match what is set at the ATM switch.

5 Click the **Establish** button.

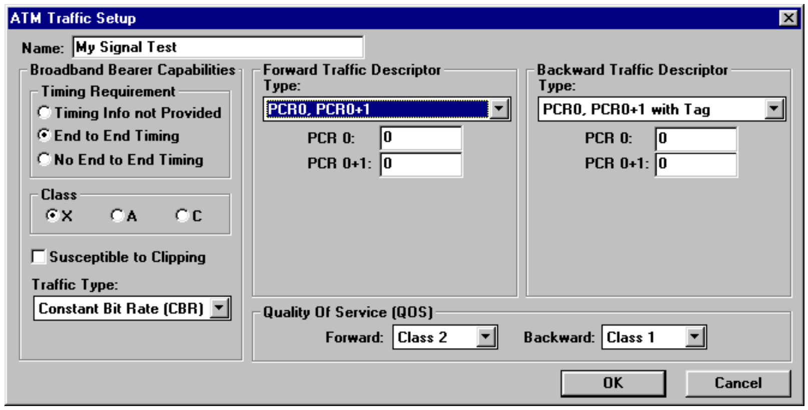
To create a traffic descriptor:

1 Choose **Options** > **ATM Traffic Setup** from the main menu.
The following dialog box appears.



SmartWindow allows the parameters to be specified according to your ATM service contract.

2 Click the **Add** button.
The following dialog box appears.



3 Enter a name for the traffic descriptor in the *Name* field, and select parameters according to the network contract type. (Refer to *Table 10-5, "QOS Classes,"* for Quality of Service definitions.)

Table 10-5. QOS Classes

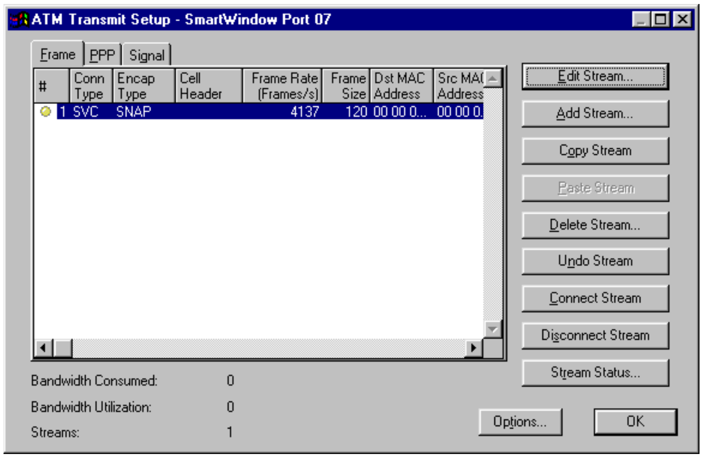
Quality (Class of Service)	Traffic Type
Class 0	Unspecified bit rate/available bit rate
Class 1	Constant bit rate, circuit bit rate
Class 2	Variable bit rate–audio and video
Class 3	Connection-oriented data
Class 4	Connectionless data

4 Click **OK**.

Note: The procedure for setting up SVC streams is similar to the procedure for setting up PVCs.

To create a stream on card #1:

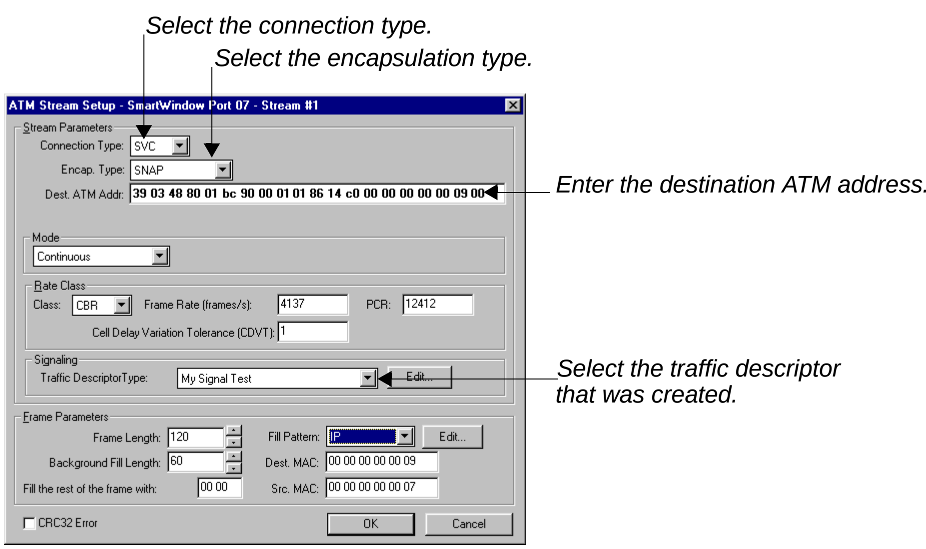
1 Right-click the ATM card (AT-9155) and choose **Transmit Setup**.
The following window appears.



2 Highlight and then double-click the default stream.

The following window appears.

Select the connection and encapsulation types.



3 In the *Stream Parameters* pane, select **SVC** in *Connection Type* field and **SNAP** in *Encap(sulation) Type* field.

4 Enter the destination ATM address. The 6-byte ESI must match the destination MAC address (bytes 14–19 of the ATM address).

Important: The source ATM address from the *ILMI* tab of another ATM card can be copied. Choose **ATM Protocol Setup** > **ILMI**, highlight the ATM address, then copy it to the clipboard. Return to the *ATM Stream Setup* dialog box, and paste the ATM address in the *ATM Address* field.[1]

5. In the *Rate Class* pane, specify the frame rate.
6. In the *Frame Parameters* pane, select the frame size and payload type from the *Fill Pattern* drop-down menu.
7. Click the **Edit** button, and make any necessary adjustments to the payload.
8. Save the edits, then click the **Close** button.

To create a stream on card #2:

1. To create a stream on card #2, simply repeat the procedure for card #1.

To configure the ATM switch:

1. To configure the ATM switch, use parameters that match the SVC that was just created.

To connect streams:

1. Click the **Connect Stream** button on both cards.
   When the streams are connected, the LED to the left of each stream turns green.

To open up SmartCounters:

1. To open SmartCounters, choose **Actions** > **SmartCounters** from the main menu.
2. Click the **Clear All Counters** button or choose **Actions** > **Clear All Counters**. (See *"Set up IGMP for SmartBits 600x/6000x Modules" on page 120* for more information.)

1. Right-click in the **ATM Address** field, then choose a value from the drop-down menu.

To start the test:

Highlight the streams on cards #1 and #2, and start card #1 transmitting.

1. In the *Transmit Setup* dialog box, highlight the two streams to be set up.
2. On the main menu, click the **Start** button for card #1.
   Watch the SmartCounters as the test progresses.

Important: If there are not any Rx packets on the receiving card, click the **Update** button on the SmartWindow main menu to update the card with your configuration.

To stop the test:

1. Click the **Stop** button.
   The test stops.

To use the SmartCounters:

1. Verify that the Tx frame count on the transmitting card matches the Rx count on the receiving card.
2. Check the test results for CRC and other errors.

SVC-CLIP Encapsulation

The steps to set up SVC-CLIP are similar to the steps used to set up SVC-SNAP, with the following differences.

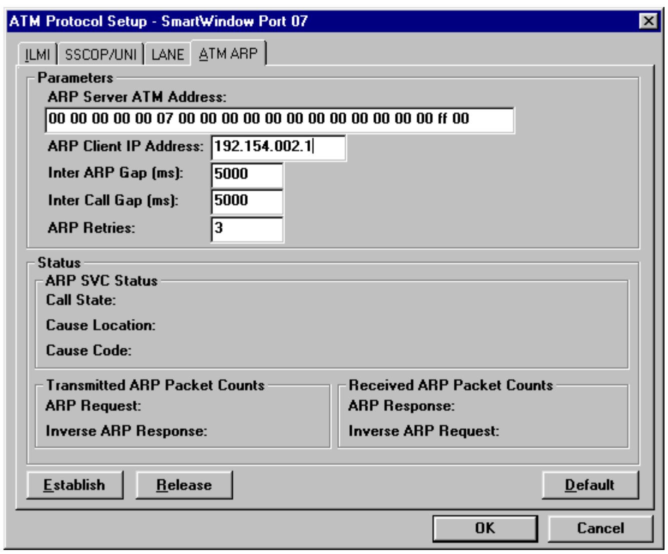
To set up SVC-CLIP:

1 Set the interface parameters according to the procedures described in *"Start Smart-Window." on page 526*.

2 Register ILMI according to the procedures described in *"To set up the ILMI protocol, click the ATM card." on page 539*.

3 Establish SSCOP/UNI according to the procedures described in *"Click the ATM card." on page 540*.

4 To establish a CLIP server connection, right-click the **ATM ARP** tab.
The following dialog box appears.



5 Enter the ATM address of the CLIP server in the **ARP Server ATM Address** field.

6 Enter the IP address of the ATM card in the **ARP Client IP Address** field.

7 Create a traffic descriptor according to the procedures in *"Choose Options > ATM Traffic Setup from the main menu." on page 541*.

8 Create streams as described in *"Right-click the ATM card (AT-9155) and choose Transmit Setup." on page 527* and following text.

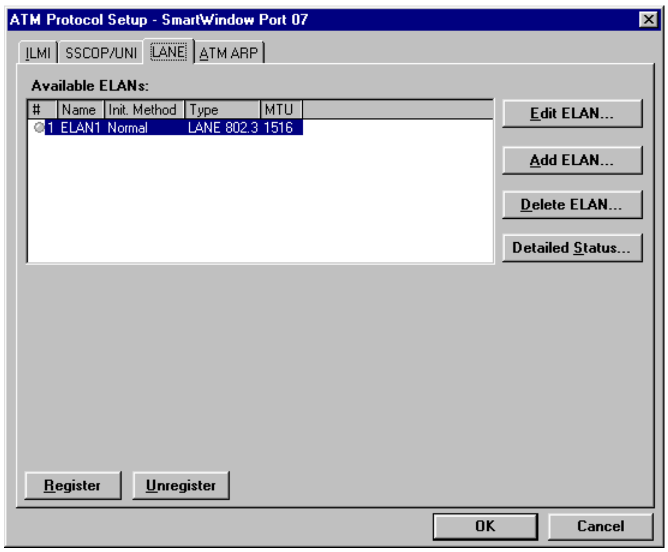
9 Complete the rest of the procedures as outlined in *"Configuring Two ATM cards for SVC-SNAP" on page 538*.

SVC-LANE

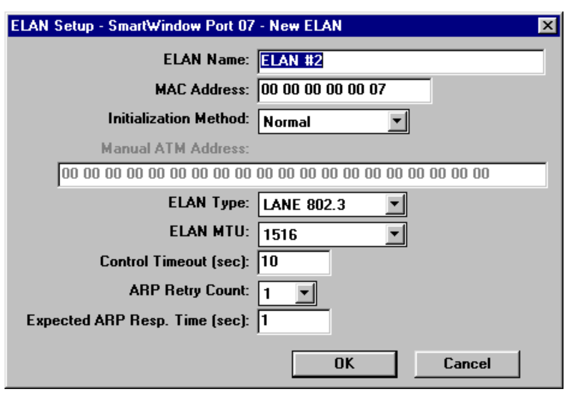
To configure ATM cards to work with an ATM switch/network with ELANs:

1. Set the interface parameters according to the procedures described in *"Start Smart-Window." on page 526*.
2. Register ILMI according to the procedures described in *"To set up the ILMI protocol, click the ATM card." on page 539*.
3. Establish SSCOP/UNI according to the procedures described in *"Click the ATM card." on page 540*.
4. To create ELANs, click the **LANE** tab in the *ATM Protocol Setup* window.

   The following dialog box appears.



5. Click the **Add ELAN** button to display the *ELAN Setup* window.



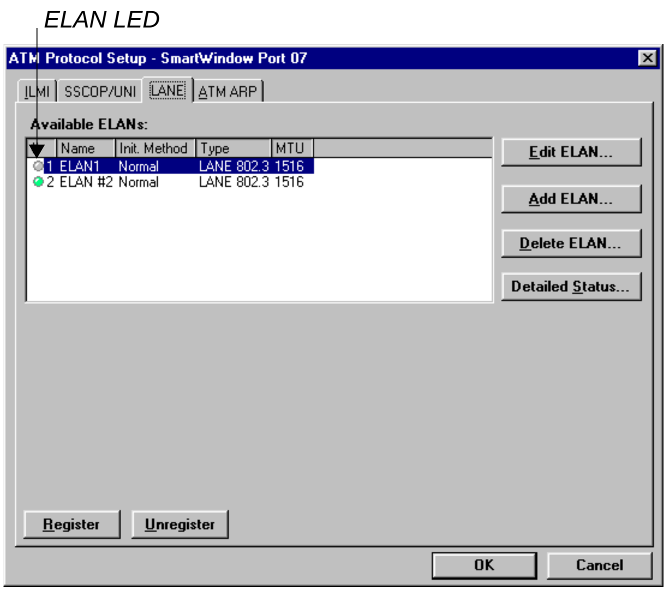
6. Set each **ELAN Name** field value to match an ELAN on the ATM switch.

7 Set the **MAC Address** field value to match the address of an ELAN on the ATM switch.

8 To use the automatic procedure to get the ATM address of LECS and LES, set **Initialization Method** to **Normal**.

9 Click **OK**.

10 To register LANE, click the **Register** button on the *ATM Protocol Setup* dialog box. The ELAN is registered if the ELAN LED is green.



11 Click **OK**.

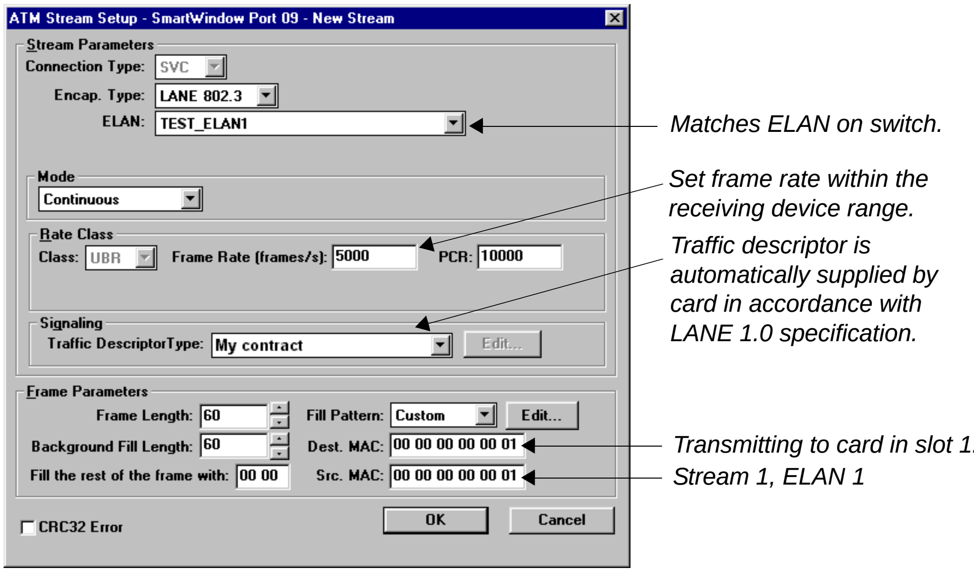
Important: If the LED next to the ELAN item number and name is not green, verify that ILMI is running, that SSCOP is set at *Data Xfer Ready*, and that SAAL is connected under ILNI and SSCOP.

12 Create a traffic descriptor by completing the procedure contained in *"Choose Options > ATM Traffic Setup from the main menu." on page 541*.

13 To create streams for LANE, click the ATM SmartCard.

14 In the main menu, click the **Transmit Setup** button. The *ATM Stream Setup* window opens.

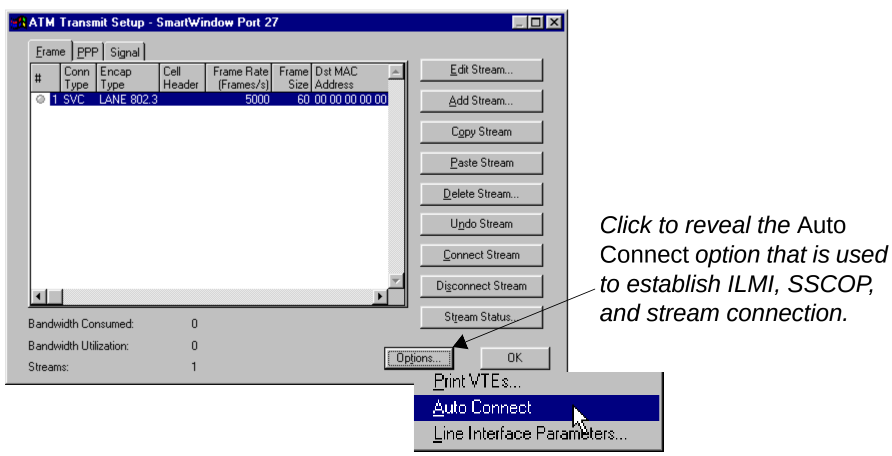
15 Click the **Edit Stream** button.



16 Verify the parameter settings identified in the illustration above. Note that the ELAN name cannot be edited but you can change which ELAN name is selected.

17 Click **OK**.

18 To connect a stream, highlight the stream and click the **Auto Connect** button.



19 Click **OK**.

20 To open SmartCounters, follow the steps in *"To open SmartCounters, choose Actions > SmartCounters from the main menu." on page 544*.

21 If an error occurs during testing, the following dialog box is displayed.

22 Verify or correct the following conditions:

- Is ILMI running?
- Is SSCOP set at *Data Xfer Ready*?
- Is SAAL connected?
- Is ELAN registered?
- Has the switch learned the MAC addresses of the targets?

23 Briefly transmit from the source cards. Then stop the transmission, and try again.

Incoming SVCs

Important: For this release, incoming SVCs are supported in SmartLibrary, but not in SmartWindow.

Running a New Test

Caution: When switching between different ATM SVC tests, keep in mind that selecting **File** > **New** to set up a new configuration file does not release the previous connection made in *ATM Protocol Setup* dialog box tabs.

To release an ILMI connection:

1. Right-click the ATM card, and choose **ATM Protocol Setup** > **ILMI**.
2. Click the **Unregister** button.
   The line is released.

To release an SSCOP/UNI connection:

1. Right-click the ATM card, and choose **ATM Protocol Setup** > **SSCOP/UNI**.
2. Click the **Unregister** button.
   The line is released.

To release a LANE connection:

1. Right-click the ATM card, and choose **ATM Protocol Setup** > **LANE**.
2. Click the **Unregister** button.
   The line is released.

To release an ATM ARP connection:

1. Right-click the ATM card, and choose **ATM Protocol Setup** > **ATM ARP**.
2. Click the **Unregister** button.
   The line is released.

MAC Address Guidelines

Table 10-6 summarizes how a typical set of LANE MAC addresses can be set up.

Table 10-6. Setting up MAC Addresses for ATM Cards

Variable	Value in this example	How did we get it?	Where is it set?
End System Identifier (ESI)	`00 00 00 00 00 05`	Last digit is port number of ATM card in chassis.	ATM Protocol Setup > ILMI
ELAN MAC Addresses		Second number is ELAN_TEST#.	ATM Protocol Setup > LANE
TEST_ELAN1	`00 00 00 00 01 00`		
TEST_ELAN2	`00 00 00 00 02 00`		
TEST_ELAN3	`00 00 00 00 03 00`		
Source MAC Addresses		Is ELAN MAC address with added stream number as last digit.	ATM Transmit Setup > Edit Stream
Stream 1 (attached to TEST_ELAN1)	`00 00 00 00 01 01`		
Stream 2 (attached to TEST_ELAN2)	`00 00 00 00 02 02`		
Destination MAC Addresses		Is MAC address of each SmartCard.	ATM Transmit Setup > Edit Stream
Stream 1 (transmitting to SmartBits card in port 1)	`00 00 00 00 00 01`		
Stream 2 (transmitting to SmartBits card in port 16)	`00 00 00 00 00 16`		

Obtaining Latency Measurements

Reasonable latency measurements with ATM SmartCards can be obtained by using the procedure described below. The procedure does not strictly comply with RFC-1242 because the results are based on the first frame transmitted and received in a stream, whereas the RFC requires that measurements be taken in the middle of transmission when the DUT is fully loaded. However, the latency value obtained is a reasonable predictor of the characteristic latency through the DUT.

This latency measurement is based on finding the difference between two timestamps shown in SmartCounters:

- Tx Time (first frame)
- Rx Trig Time (first trig).

Note: The Tx Time timestamp value is available only *after* SmartCounters is cleared.

This procedure may be used with the AT-9045B, AT-9155C/Cs, and AT-9622s SmartCards.

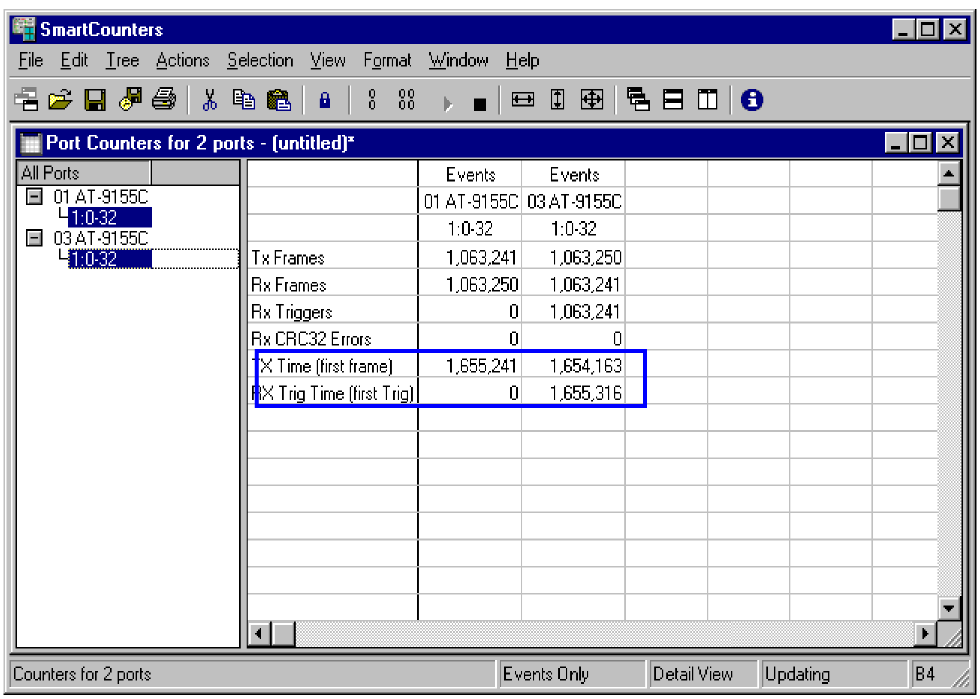


Figure 10-4. Using the Tx Time and Rx Trig Time Values to Calculate Latency

How to Find Latency Measurements with ATM SmartCards

Be sure to read the introductory information in this section for important notes on how this procedure is related to the RFC 1242 requirements.

To find latency measurements:

Set up streams.

1 Set up one stream on the transmitting SmartCard and one stream on the receiving SmartCard. Any encapsulation type may be used.

Refer to the following procedures in this chapter to set up streams:

- *"Start SmartWindow." on page 526*
- *"Right-click the ATM card (AT-9155) and choose Transmit Setup." on page 527*
- *"To create a stream on card #2, repeat the procedure used for card #1." on page 529.*

Set up the Rx trigger pattern.

2 Set the Rx trigger pattern on the receiving SmartCard. Click the card, then select **Trigger Setup** from the drop-down menu.

You can select either a per-connection trigger (connection trigger) or global trigger (all connections) or both. You can also specify individual trigger fields and edit the trigger pattern, if desired. In the example below, the receiving SmartCard is set up to trigger on the destination IP address in the incoming stream.

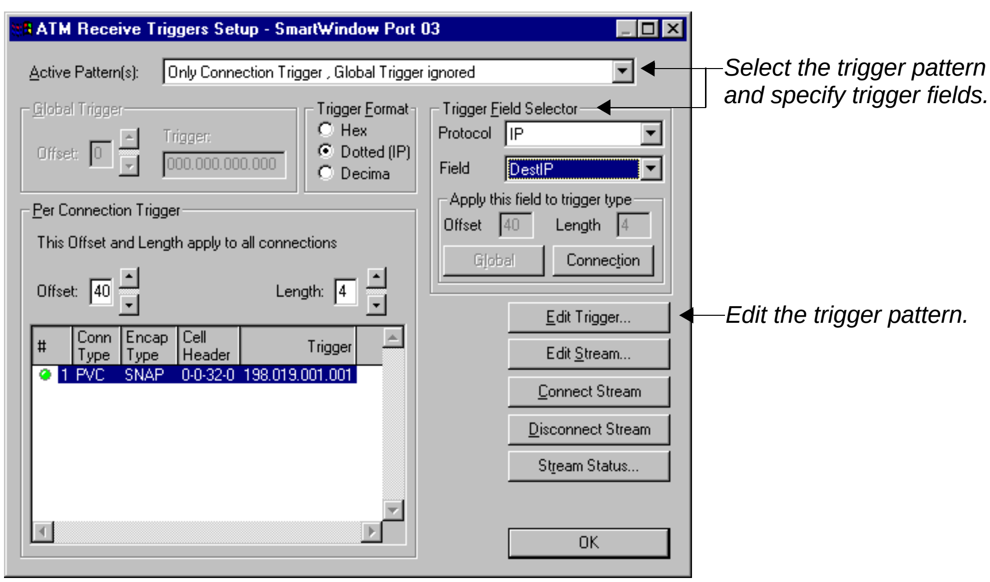


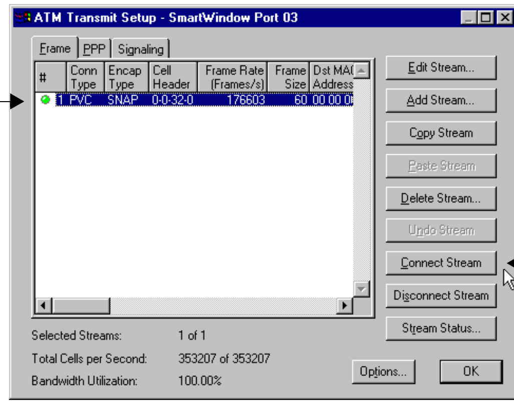
Figure 10-5. Setting up Trigger Pattern for Latency Measurements

Create a group of the tested cards.

3 Set up an SMB group of the transmitting and receiving card(s). Using a group start ensures that the cards are synchronized with the chassis backplane. (Refer to *"Defining a Group of SmartCards" on page 85* for steps, if needed.)

Connect the streams on each card.

4 Connect the streams on each card. Click the card image, then open the **Transmit Setup** or **Trigger Setup** pull-down menu. Click the stream to select it. Then click the **Connect Stream** button. The green LED at the left of each card comes on when the stream is connected.



Open SmartCounters and clear all counters.

5 Choose **Actions** > **SmartCounters** from the main menu to open SmartCounters. (Refer to *"Set up IGMP for SmartBits 600x/6000x Modules" on page 120* for more information about SmartCounters.)

6 Choose **File** > **New Counter Window** in the SmartCounters window to display a new window listing all ports or
To display an existing file, choose **File** > **Open**.

7 Click the **Clear All Counters** button or choose **Actions** > **Clear All Counters**.

Start the test, then stop.

8 Click the group **Start** button (to the right of the *SMB Group* pane). Watch Smart-Counters as the test progresses.

9 Click the **Stop** button, and the test stops.

Note: You can customize the SmartCounters window to speed the following steps. (Refer to *Figure 10-6 on page 556*.)

10 Select **Tree** > **Expand All** to show the stream below each port in the left pane.

11 Select **View** > **Events Only** so that only events (not rates) are displayed.

12 Press the **<Ctrl>** key and click the stream under each port (card) to select it.

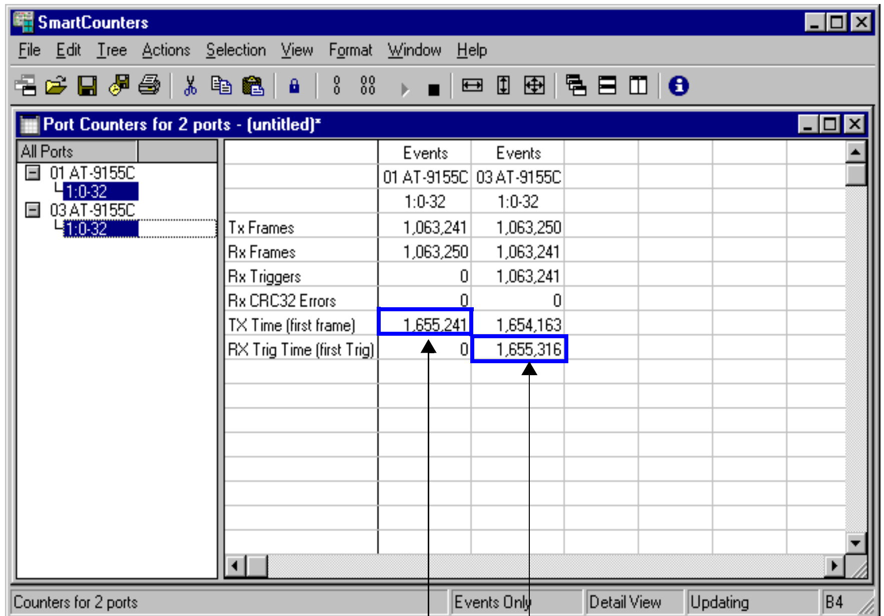
Calculate the latency value.

13 To find the latency value, subtract the **Tx Time (first frame)** field value from the **Rx Trig Time (first Trig)** field value.
The difference is shown in 100s of nanoseconds. Divide this value by 10 to find the final value in microseconds.

Example. In the example shown in *Figure 10-6 on page 556*, the calculation is as follows:

Rx Trig Time (first Trig) 1655316
Tx Time (first frame) – 1655241
75

Divided by 10= 7.5 microseconds



Subtract the Rx Trig Time value from the Tx Time to find the latency value in 100s of nanoseconds.

1655316
– 1655241
= 75

Divide by 10 to find the value in microseconds. *75 / 10 = 7.5 microseconds*

Figure 10-6. Using the Tx Time and Rx Trig Time Values to Calculate Latency

Chapter 11

Testing POS Routers

The SmartBits system, POS modules, and the easy-to-use SmartWindow program provide a highly effective testing tool for evaluating Packet Over SONET (POS) devices.

In this chapter...

Testing POS Routers

SONET and its European cousin Synchronous Digital Hierarchy (SDH) are octet-synchronous multiplexing schemes that define a family of standard rates and formats. Transmission rates are integral multiples of 51.840 Mbps.

- OC-3c/STM-1 155.520 Mbps
- OC-12c/STM-4 622.080 Mbps
- OC-48c/STM-16 2488.320 Mbps
- OC-192c/STM-64 9.953 Gbps

SONET/SDH is a perfect match for Point-to-Point Protocol (PPP). The PPP octet stream is mapped into the SONET/SDH Synchronous Payload Envelope (SPE) with the octet boundaries aligned to the SPE octet boundaries, enabling the seamless integration within IP networks of SONET/SDH routers and IP network elements.

Figure 11-1 illustrates a SmartBits 6000x equipped with two POS-3519As/AR modules used to send and receive test traffic through a POS router.

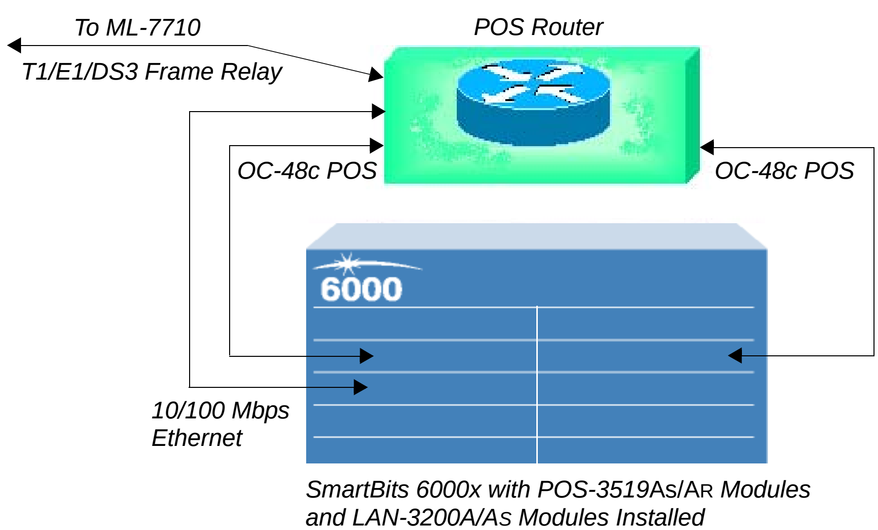


Figure 11-1. POS Router Testing Topology

Testing QOS for POS

Important benchmark tests for a POS router with a SONET interface include determining throughput in terms of packet sequencing, latency, latency distribution, and capacity. However, the overall objective is to test the QOS capabilities of the router.

Table 11-1 outlines the test methodology for this example.

Table 11-1. POS Test Methodology

Step	Objective
1	Configure the SONET port interface for PPP.
2	Configure the POS card with five streams. Each stream represents a different Quality of Service (QOS) level and is capable of cycling millions of IP addresses.
3	Configure the DUT to match the POS card.
4	Run the Sequence and Latency test.
5	Using MS Excel, view results in histogram format.

Frame Sizes Supported

When more than one stream is configured, SmartWindow supports a minimum frame size of 42 bytes (exclusive of CRC) and a maximum frame size of 16,384 bytes. (SmartLibrary supports 64K bytes.) You can set the payload bytes of each frame to be filled with a user-defined content (AA, 55, FF, etc.) or with a random pattern generated for each frame.

Frames are constructed as shown below. The *SmartBits Data Integrity CRC-16* covers the *SmartBits Data Integrity Byte Count* and *Payload* fields. The SmartBits frame length (without FCS) extends from after the initial *HDLC Flag* to the end of the *SmartBits Signature Field*.

1	4	20	8	8	2	
HDLC Flag	PPP or Cisco HDLC Header	IP Header	UDP Header	SmartBits Data Integrity Marker	SmartBits Data Integer Byte Count	> > > >

	Variable	2	18	2 or 4	1
> > > >	User Payload	SmartBits Data Integer CRC-16	SmartBits Signature Field	PPP CRC-16 or CRC-32	HDLC Flag

Test Using the POS-3519As/AR Module

This section outlines the steps to test QOS for POS using the POS-3519As/AR OC-192c/STM-64 TeraMetrics module (or the equivalent POS-3518As/AR SmartMetrics module).

Use these modules to perform frame-level testing for POS/SDH routers at full OC-192c/STM-64 wire-rate. Both modules provide full SmartMetrics test support. In addition, the POS-3519As/AR features the TeraMetrics open architecture for SmartBits cards and systems. A TeraMetrics module includes a Pentium-class processor running Linux Version 2.2. This provides on-board processing power sufficient for network-to-application layer performance testing at 1 terabit per second system speeds. It also makes possible support for third-party test applications.

Note: This test setup uses the POS-3519As/AR. Additional cards and modules that support this test include the following:

- The POS-3518As/AR.SmartMetrics module can also be used in this test.
- For testing at the OC-48c/STM-16 rate, the POS-3505As/AR.and POS-3504As/AR.modules can be used.

Set up POS Port Parameters

To set up the port parameters:

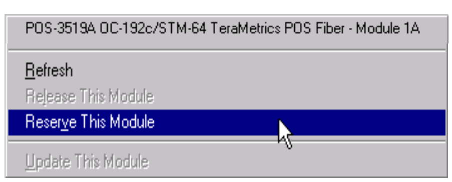
1 Launch SmartWindow, and connect to the SmartBits 6000x chassis.

Note: See *Chapter 2, "Install and Connect"* for the steps to make a connection from your PC and SmartWindow to the SmartBits chassis.

2 Reserve each card to be configured. Right-click anywhere on the card image except the port button.

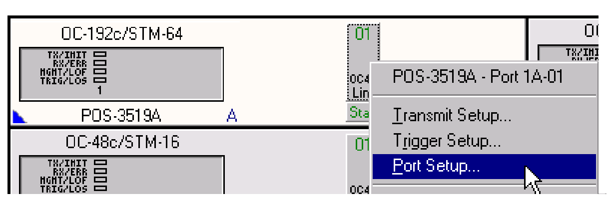
3 From the displayed menu, choose **Reserve This Module**.

4 Starting with the first card, click the port button to open the card menu.



*To reserve a card, right-click anywhere on the card image except on the port button. Select **Reserve This Module**.*

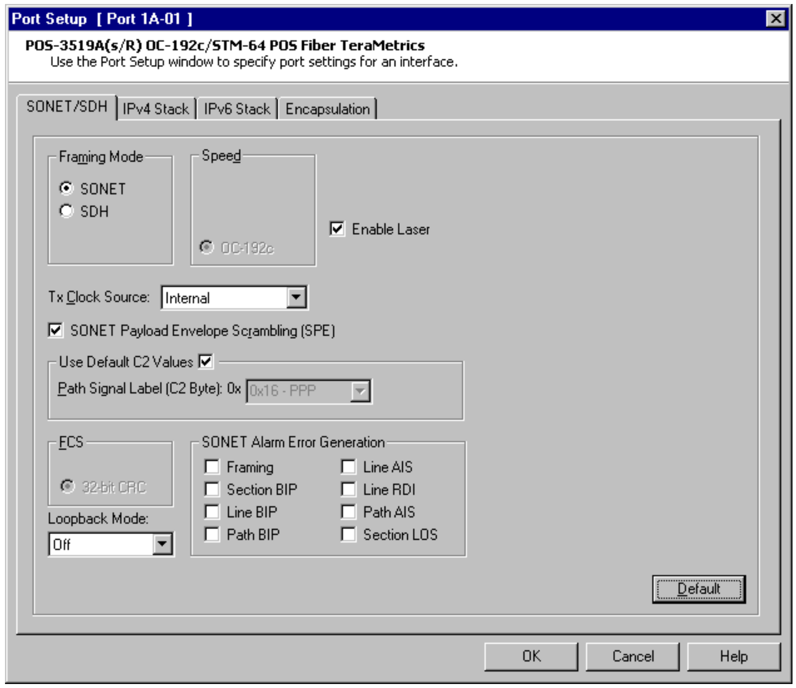
After the card is reserved, click the port button to open the card menu.



5 Choose **Port Setup**.

The *Port Setup* dialog box opens. This window contains tabs to organize options for SONET/SDH, IPv4 stack and IPv6 stack configuration, and encapsulation.

Click the tabs to set parameter values for SONET/SDH, encapsulation, and addressing.



SONET/SDH Tab

Select values on the *SONET/SDH* tab using the following guidelines.

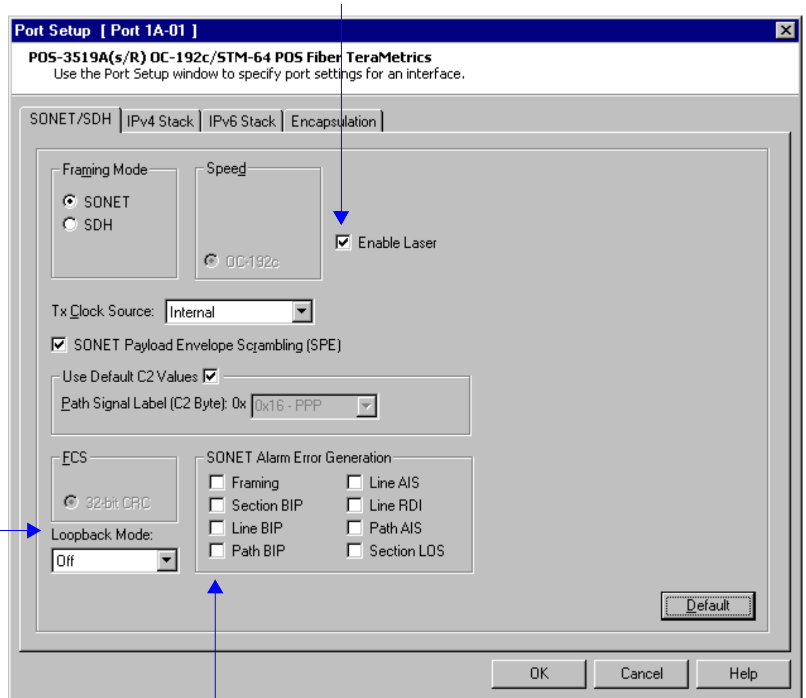
Framing mode, Tx clock source — Set the SONET/SDH parameters to conform with test requirements and installation characteristics. In regards to speed, the POS-3519As/AR always runs at the OC-192c rate.

Payload envelope scrambling — The *SONET Payload Envelope Scrambling (SPE)* option enables an x^{43}+1 self-synchronizing scrambler. Most POS equipment enables payload scrambling by default, because it ensures an adequate number of 0/1 transitions for clock recovery purposes. When this option is selected, the module scrambles the entire SONET payload envelope. If no PPP frames are being transmitted, it scrambles the idle pattern.

SONET alarm generation — Optionally, SONET alarm error generation can be enabled. Use the checkboxes to select which errors the card should generate.

Diagnostic options — The *Port Setup* dialog box includes diagnostic options.

Used to enable or disable the signal laser.



Used to place the port in a diagnostic loopback mode.

See Table 11-2 for choices.

SONET Alarm Error Generation

The *Enable Laser* checkbox is enabled by default, for normal operation. Clearing it disables the signal-generating laser for the line and provides a way to set the link to an unambiguously “down” state. (In some test cases, route flapping or other link behavior can create uncertainty about the actual link state.)

The **Loopback Mode** field is used for diagnostic purposes. Set the port into a local or remote loopback mode. Use the drop-down menu to select the mode. (See Table 11-2 on page 563.)

Table 11-2. Port Loopback Modes

Value	Description
Off	Loopback disabled.
Local Phy	The signal generated by the transmit engine for the local port is looped back at the PHY to the receive engine for the local port.
Remote Phy	The signal generated by the transmit engine of the remote port is looped back at the PHY of the local port to the receive engine of the remote port.
Local XCVR	The signal generated by the transmit engine for the local port is looped back at the transceiver to the receive engine for the local port.
Remote XCVR	The signal generated by the transmit engine of the remote port is looped back at the transceiver of the local port to the receive engine of the remote port.

Select the Encapsulation Type

You can enable PPP encapsulation or Cisco HDLC encapsulation.

PPP Encapsulation

When PPP encapsulation (the default) is selected, the full PPP stack is implemented. All PPP parameters are configurable, including incoming and outgoing authentication.

To select encapsulation type:

1 In the *Port Setup* window, click the **Encapsulation** tab (*Figure 11-2 on page 564*).
2 On the *Encapsulation* tab, select **PPP with HDLC Framing**.
3 Set values for other PPP parameters as appropriate for the test. In most cases, the default values may be used. The options in the *MRU* pane are used in the LCP protocol to configure the data link and negotiate operating characteristics.
4 Enter the IP address of the POS port. This value is the same as the IP address on the *Address* tab.

Figure 11-3 on page 565 shows the fields for entering IP addresses in SmartWindow.

Figure 11-4 on page 565 illustrates how these fields are applied in a test environment.

Note: Currently, the *Gateway* field is not used.

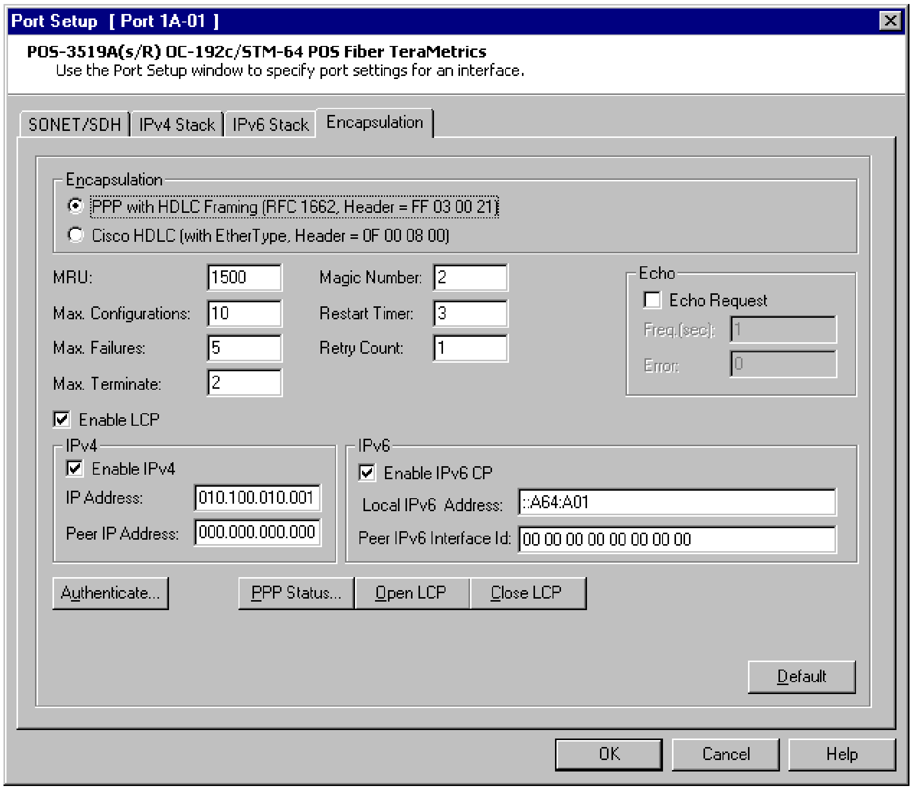


Figure 11-2. Selecting the Encapsulation Type

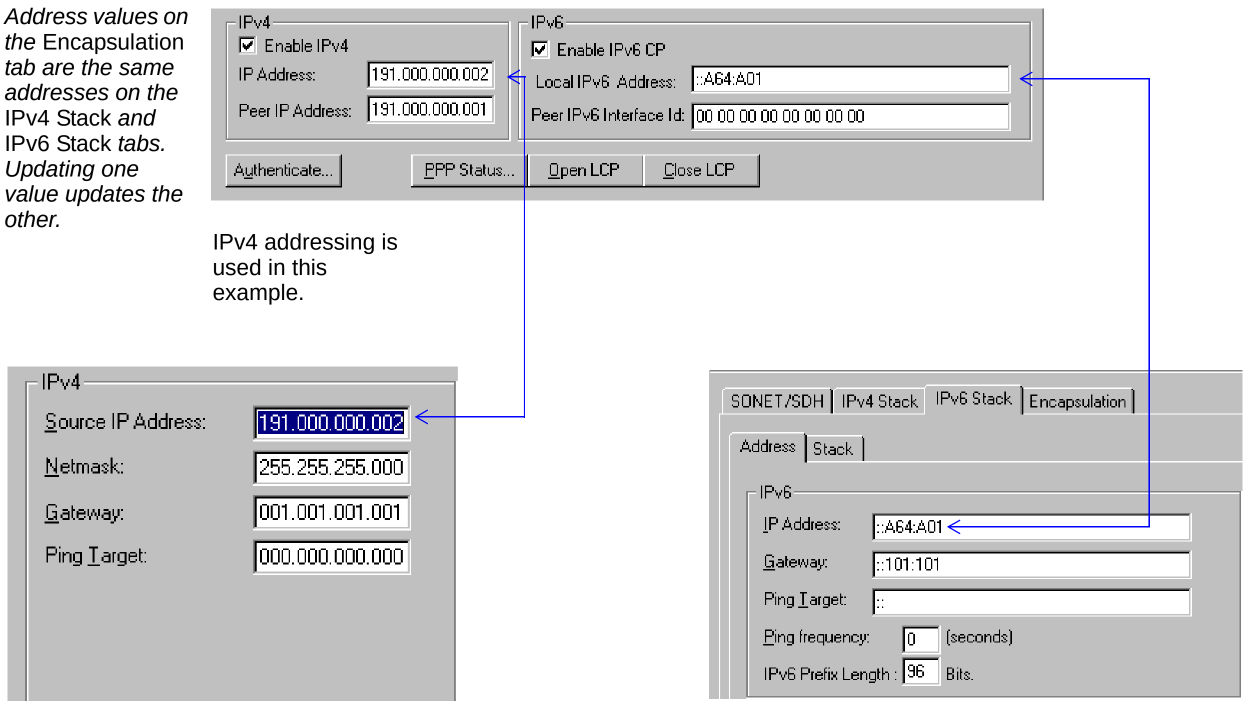


Figure 11-3. IP Address Fields in Port Setup Dialog

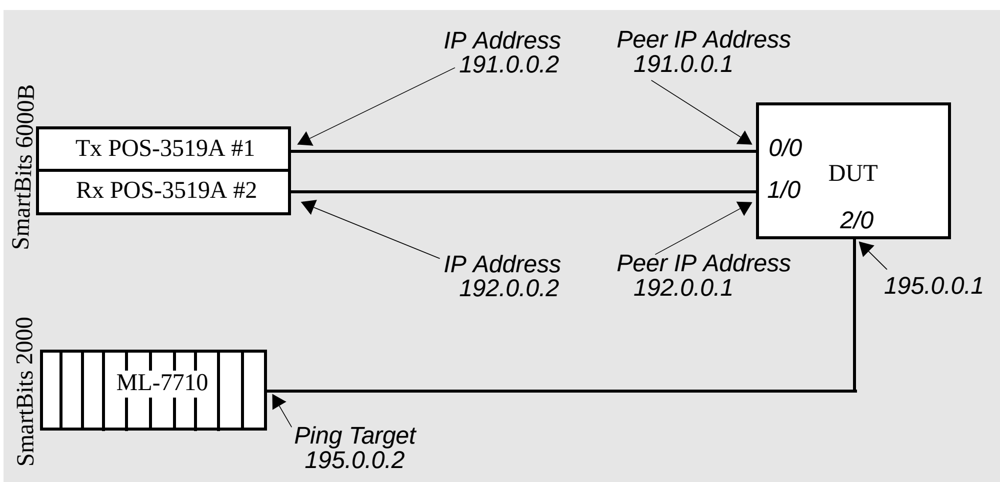


Figure 11-4. POS Card IP Address Configuration

Important: The card always replies to ping requests, but the card initiates ping packets only when the *Send Ping Packet* checkbox is selected. Specify the frequency if you wish to enable this option.

5 When done, click **OK**.

Verify the LCP and ICPC State

To verify the state:

1. Click the port button on the POS card image.
2. Select **Port Status**.
3. Verify that both LCP state and IPCP state indicate **Up** in the *Status* column.
   If not, click **Close LCP** and then **Open LCP**. The LCP initiates the handshaking phase of establishing a PPP session.
4. Click **OK**.

Set IP Addresses

To set up IP addresses:

1. Open the *Port Setup* dialog box, and select the **IPv4 Stack** tab.
2. Enter any IP addresses that the network needs to function (*Figure 11-5*).
3. Click **OK** to close the *Port Setup* dialog box.

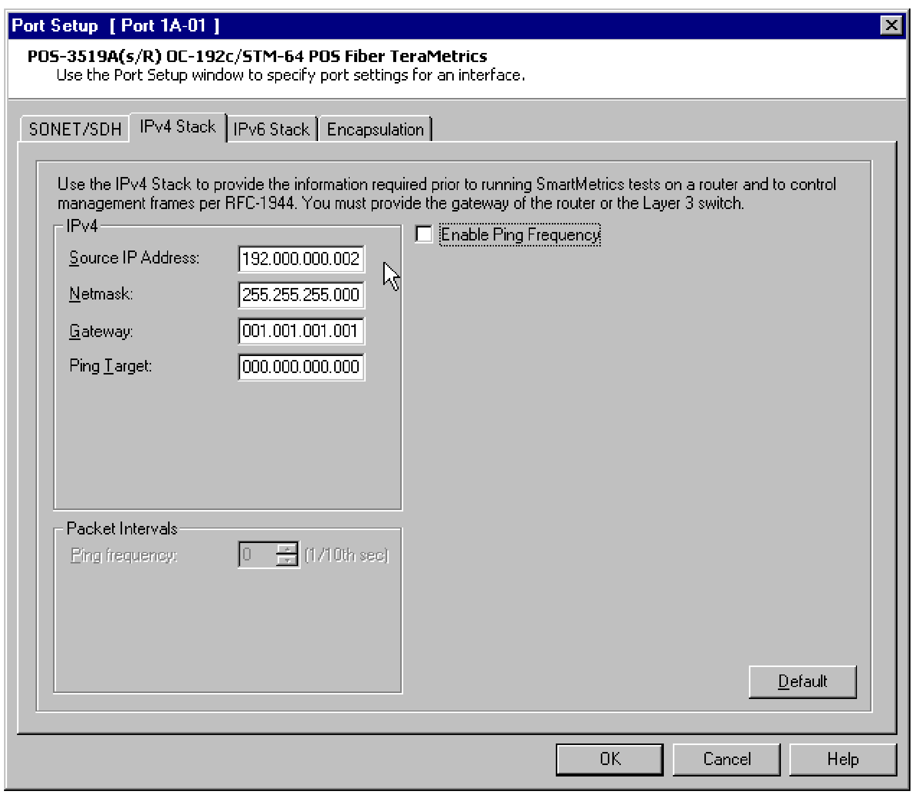
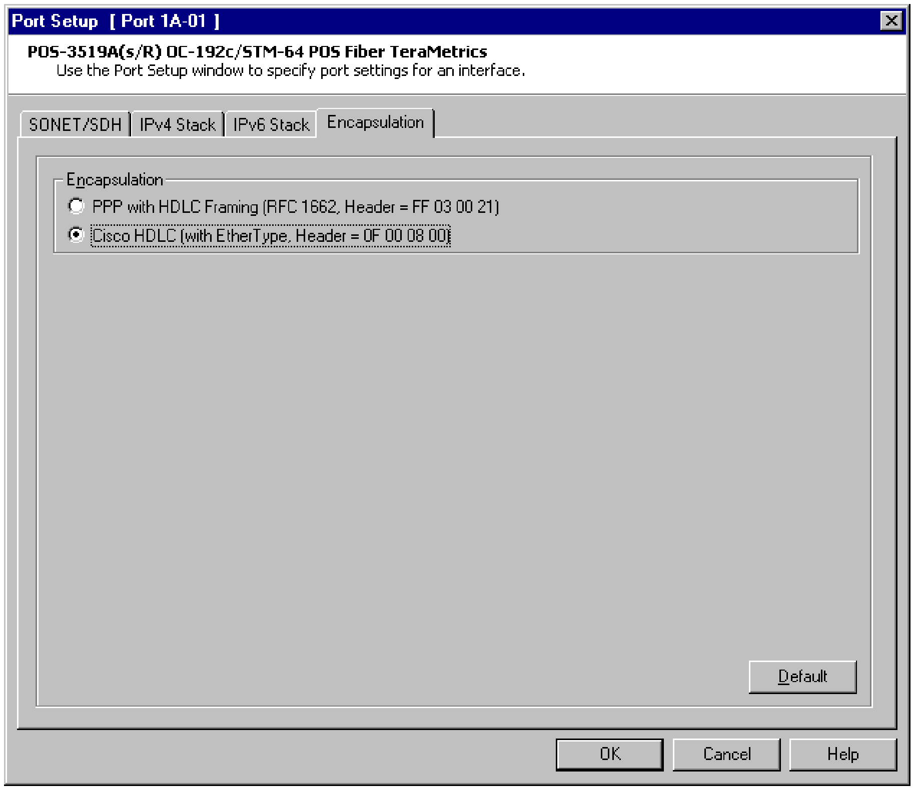


Figure 11-5. Setting IPv4 Addresses

Optional: Selecting CISCO HDLC Encapsulation

Cisco HDLC encapsulation uses a proprietary Cisco protocol. When the *Cisco HDLC* radio button is clicked, SmartWindow automatically configures the Cisco protocol.

Note: The Cisco protocol does not use standard HDLC.



Before a test can be run, you need to set up streams.

Continue with *"Configure Streams on the Transmitting Card" on page 568*.

Configure Streams on the Transmitting Card

After the POS port is configured, the streams need to be configured.

Note: This example shows the use of IPv4 protocol streams. IPv6 streams can also be set up on TeraMetrics-based POS modules. (See *“Using the Data Decoder” on page 167* for information about these options.)

Up to 512 IPv4 streams can be configured on the POS-3519As/AR and POS-3518As/AR modules. However, in most cases, many fewer streams are needed to obtain useful test results. For example, when measuring the QOS capability of a router, it is often better to create just enough streams to simulate each type of service. To evaluate five levels of service, create one stream for each level (e.g., five streams total). Because each stream can generate millions of flows, this test case may be more useful and manageable than one involving a very large number of streams.

To begin configuring streams:

1. Click the port button on the card image.
2. Choose **Transmit Setup**.
   The *Streams Setup* window opens (*Figure 11-6*).

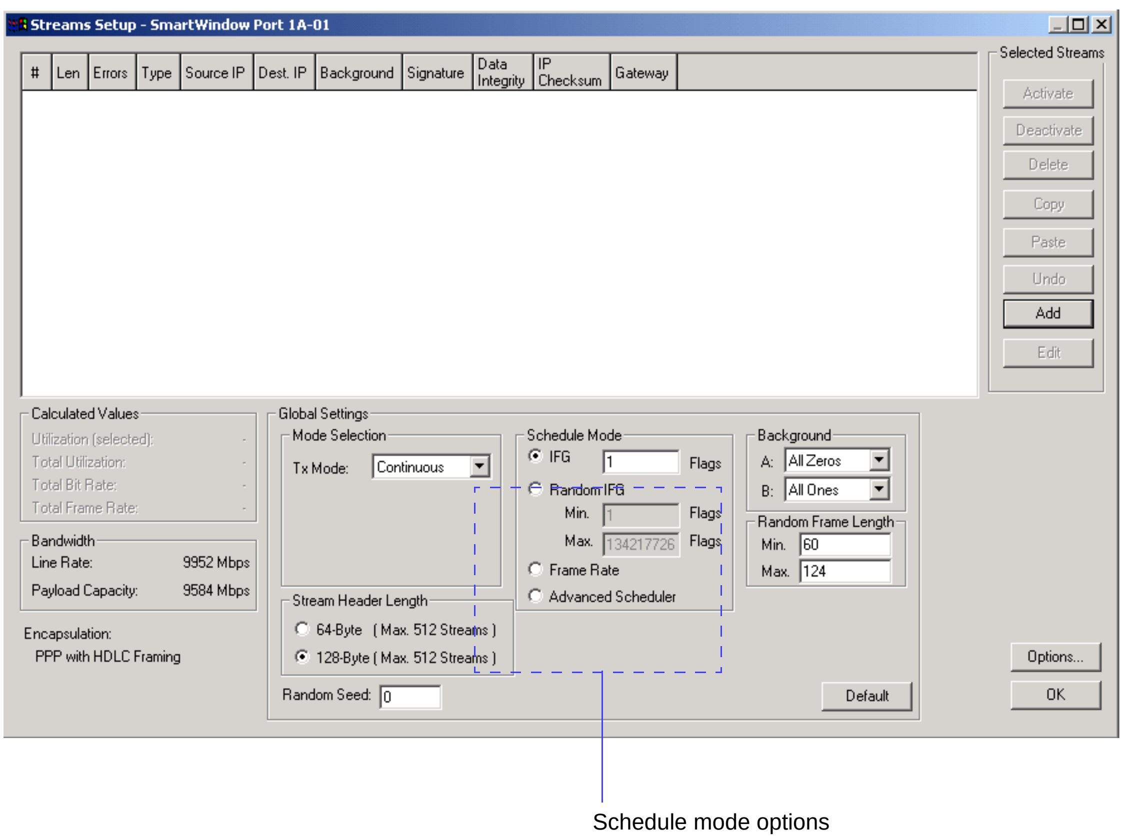


Figure 11-6. Streams Setup Window

Schedule Mode

The *Global Settings* pane of the *Streams Setup* window provides options for defining how the card schedules the streams that it transmits. Use these options before adding the streams, since these settings apply to the port overall.

In the *Schedule Mode* pane of the *Global Settings* pane (*Figure 11-6 on page 568*), there are four options for scheduling:

- *IFG* — Interframe Gap: a fixed number of bit times between frames
- *Random IFG* — A varying number of bit times between frames
- *Frame Rate* — A defined frames-per-second rate of transmission for each stream
- *Advanced Schedule*r— A scheduling of frames (using frame rate) based on a balanced mix that results in a smoother distribution of traffic between flows. This capability requires firmware 5.50 or later and is supported on LAN-3306A, LAN-332xA, POS-3504As/AR, POS-3505As/AR, POS-3510A/As, POS-3511A/As, POS-3518As/AR, POS-3519As/AR, XLW-372xA, XFP-373xA, and FBC-360xA modules.

The selected scheduling mode applies to all streams for the port. However, when frame rate or advanced scheduler is selected as the mode, a different rate can be specified for each stream. (With traffic based on fixed interframe gap, the specified gap applies to all streams.) Once the mode is specified, use the *Add* button to open the *Add Streams* window, which allows you to create one or multiple streams.

How Does Scheduling Work?

TeraMetrics cards include a software mechanism, called the scheduler, that calculates how to allocate line bandwidth to the streams that have been created.

For all four scheduling options, the scheduler calculates a scheduling table that organizes all streams for transmission before any traffic is sent. The schedule table is static—it does not vary as test traffic is sent—even though three of the scheduling options (*Random IFG*, *Frame Rate*, and *Advanced Scheduler*) appear to be dynamic in behavior because individual stream frame rates and random interframe gaps are allowed.

Gap-based Traffic

The two gap modes (IFG and Random IFG) belong in the same category. With each mode, the frame size and gap size (or range of gap sizes) are controlled, but not the frame rate.

With IFG mode, the card inserts the specified gap (i.e., number of bit times) between frames. It then sends out test traffic, with the selected frame size, at the maximum line rate.

With random IFG mode, a random number generator on the card produces gaps of varying sizes, within the bounds that were defined using the *Min.* and *Max.* fields in the *Streams Setup* window. These gaps are inserted between frames. Then test traffic is sent with the selected frame size at the maximum line rate.

Rate-based Traffic

When frame rate or advanced scheduler is the selected mode, you can specify a different rate for each stream, but the interframe gap cannot be controlled. Instead, the gaps are automatically calculated and inserted by the card.

With these modes, the scheduler always proposes full bandwidth for whatever stream(s) are to be added. However, it must use a portion of the bandwidth for the interframe gaps, thus the calculated utilization and calculated frame rates are always lower than what have been requested.

You can specify frame rates that are lower than the maximum rates proposed. In this case, some of the total line capacity is unused by the actual test frames. When the frame rates that are specified for all streams do not use all the possible bandwidth, the “extra” bandwidth is divided among the streams and used as the interframe gaps.

When the *Frame Rate* or *Advanced Scheduler* option is selected, the *Add Streams* dialog box allows you to specify the rate (and rate units) for the stream or streams that are created. (These options are disabled when the *IFG* or *Random IFG* option is selected.) As streams are created, the card calculates the stream order and interframe gaps.

In the streams list, the *Calculated Rate* and *Calculated Utilization* fields adjust as streams are added or the settings for any stream are modified. Similarly, the *Calculated Values* pane in the bottom of the *Streams Setup* window adjusts to reflect the settings. *Figure 11-7 on page 571* presents an example. Here, five rate-based streams have been added, and each has been allocated 20% of the total available bandwidth.

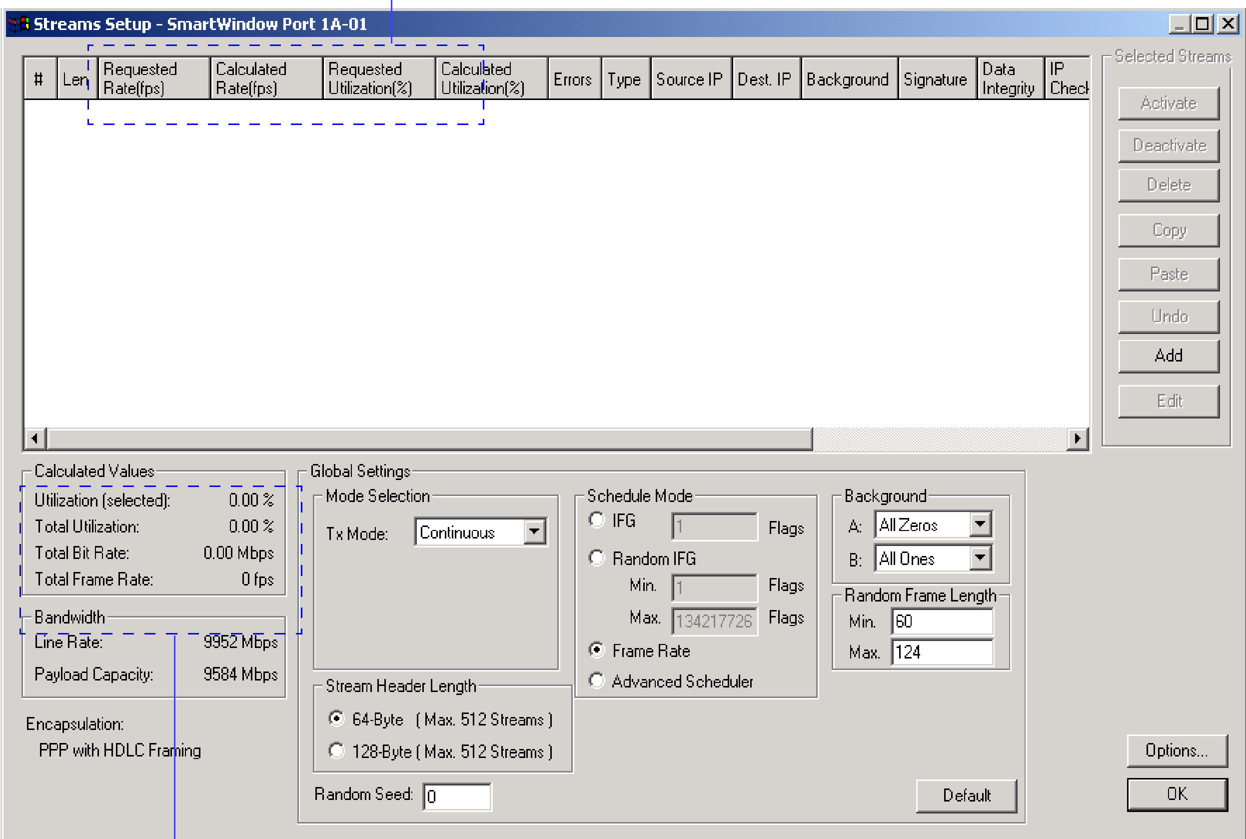
The algorithm used in rate-based scheduling is designed to provide the greatest accuracy to higher frame rates as opposed to lower frame rates. It meets the requested frame rate most closely for streams that have a high data rate, so the actual frame rate for a relatively slow stream may appear disproportionately “skewed” from the requested rate.

Table 11-3 describes the values shown in the *Calculated Values* pane.

Table 11-3. POS Frame Rates Calculations

Rate	Definition
Utilization (selected)	Total calculated bandwidth of all selected (highlighted) streams.
Total Utilization	Total calculated bandwidth of all streams.
Total Bit Rate	Total calculated capacity used by the aggregate of streams.
Total Frame Rate	Multiple of number of frames *x* total frames per second (fps) of each stream.

These fields appear when frame rate is selected as the scheduling mode.



When Schedule Mode *is set to* Frame Rate or Advanced Scheduler, *these fields show the total calculated frame rates and percentages for all streams that have been added.*

As streams are created, SmartWindow calculates the individual and total frame rates for the card, as well as interframe gaps. (See *Table 11-3, "POS Frame Rates Calculations," on page 570.**)*

Figure 11-7. Frame Scheduling Based on Frame Rate

Add New Streams

To add new streams:

1 Click the **Add** button. The following dialog box appears.

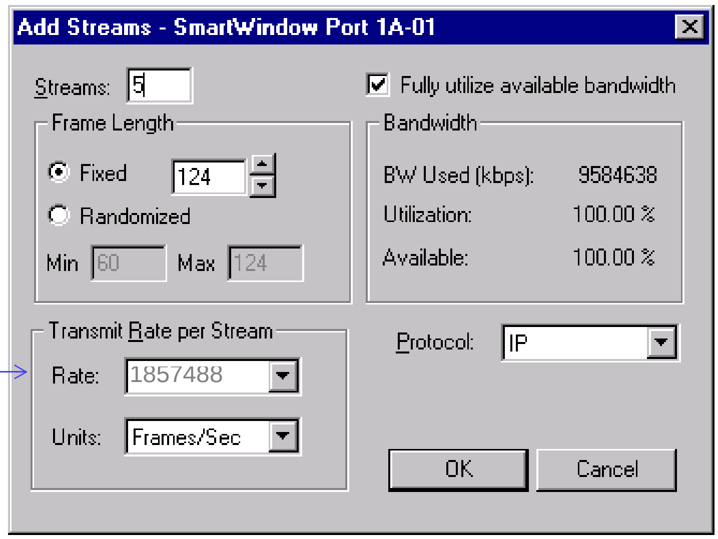


Figure 11-8. Configuring Streams

2 Change the number of streams to **5**.

3 Accept the default for fully utilizing the available bandwidth. (The *Fully utilize available bandwidth* checkbox is selected.) These five streams are the first to be added; as a result, each steam receives about 20% of total bandwidth.

Note: When the *Fully utilize available bandwidth* checkbox is selected, the *Rate* field cannot be edited. SmartWindow calculates the rate. The *Rate* field can be edited if the *Fully utilize available bandwidth* checkbox is cleared.

4 In the *Transmit Rate per Stream* pane, the *Rate* field value reflects the corresponding rate in the *Units* field of *Frames/Sec*. In the *Units* field, select *%Utilization* as the unit, if needed.

If the following error message appears, adjust the *Rate* field value to accommodate the number of streams.

5 Edit the other fields as required for the test.

6 When done, click **OK**. The *Streams Setup* window reappears.

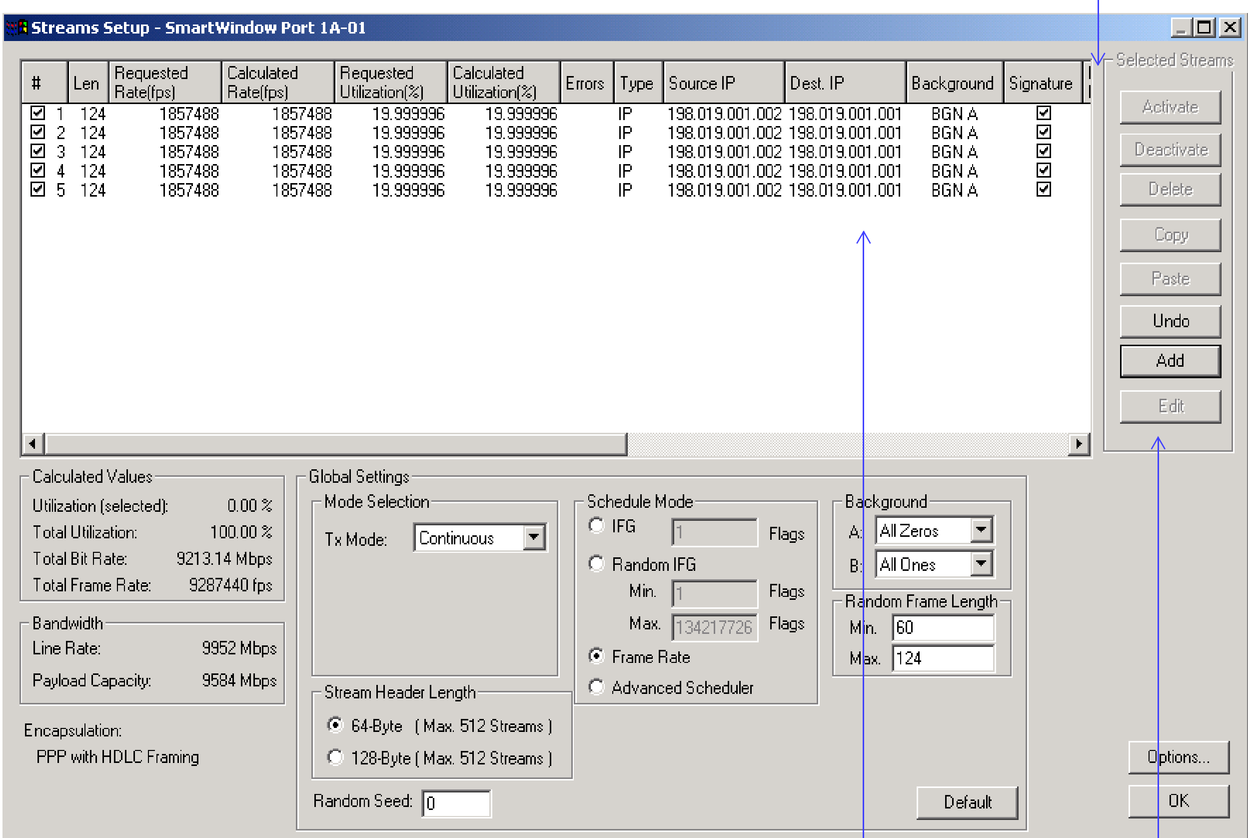
Set Type of Service Values

To set up the Type of Service (TOS) characteristics of each stream:

1 In the *Streams Setup* window, select all streams by using the **Shift** key and mouse.

2 Click the **Edit** button in the *Selected Streams* pane.

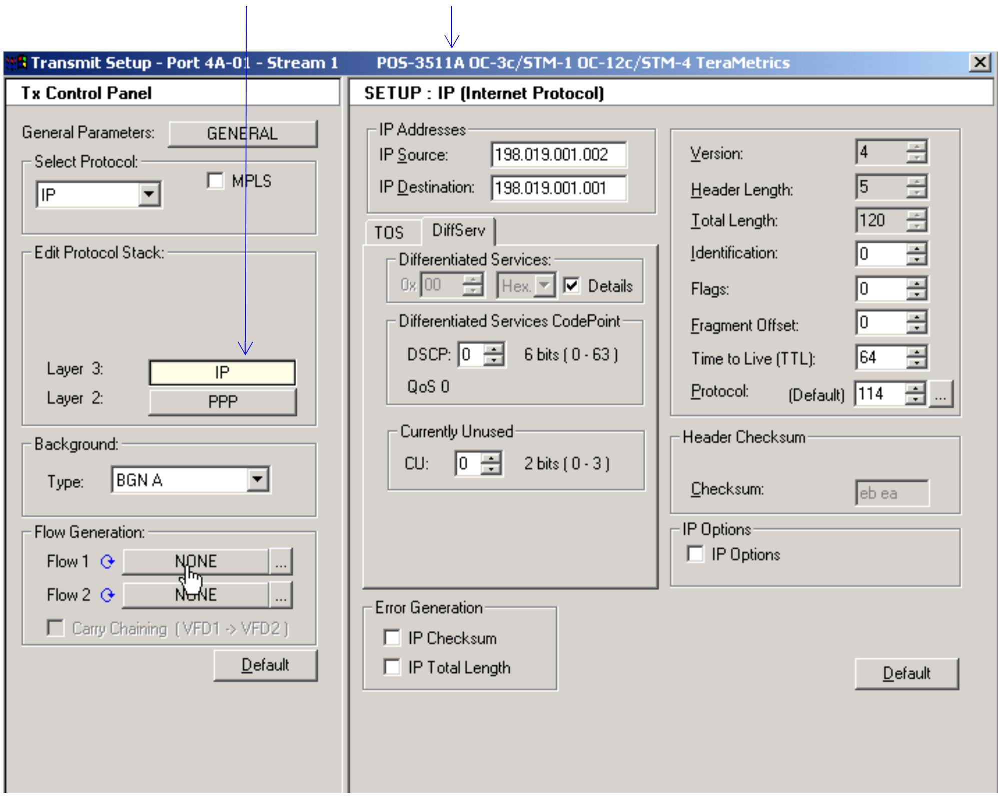
Selected Streams *pane*



Use the Shift *key and mouse to select all streams. Then click* Edit.

3 In the *Edit Protocol Stack* pane, click the **Layer 3: IP** button. The *Setup:IP (Internet Protocol)* view opens in the right pane.

*Click **IP** to open the SETUP pane for IP parameters.*



4 In the *Type of Service (TOS)* pane, set **Type of Service** to **92**. Notice that doing this automatically adjusts the value for *Precedence* and *TOS Bits* options, though these options remain greyed out.

5 Click **Details** to make these fields active. The edit mode reverses: the *Service Type* field becomes greyed out, and the *Precedence* and *TOS* options can be set explicitly. Now the *Service Type* field varies automatically (though still greyed out) in response to the *Precedence* value that is set and the *TOS* checkboxes that are enabled.

The *MBZ* checkbox toggles the least-significant bit in the TOS octet. This bit is labeled MBZ for “must be zero.” It is currently unused in normal IP routing, but it may be set for experimental purposes. Normally, the originator of a datagram sets this field to zero. Routers and recipients of datagrams ignore this field value. This field is copied on fragmentation.

6 Edit the other four streams following *Step 1* through *Step 4*, but set different *Precedence* values as follows:

Stream	Precedence Value
2	*d0x52*
3	*0x36*
4	*0x40*
5	*0x32*

Enable MPLS (Optional)

Multi-Protocol Label Switching (MPLS) provides an economical way of routing packets based on a brief label field rather than full IP address. MPLS labels are inserted as a shim protocol between the Layer 2 and Layer 3 protocol headers. Packets are routed through the core of the MPLS network based on the label value. Labels are removed when packets leave the MPLS network, and normal IP forwarding resumes.

The label stack is a sequence of label entries within the packet header information. Forwarding is performed based on the label value at the top of the stack. The bottom of the stack is closest to the IP header. In this bottom entry, the **S** bit in the label is set to **1**.

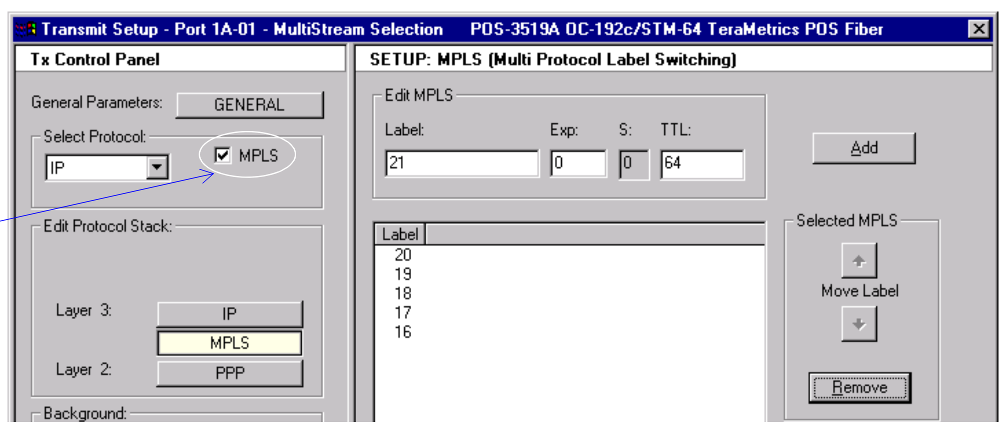
To enable MPLS for a stream:

1 Select the stream entry in the *Streams Setup* window.

2 Click the **Edit** button in the *Selected Streams* pane.

3 In the *Tx Control Panel* pane, select the **MPLS** checkbox.

The *SETUP:MPLS (Multi Protocol Label Switching)* view opens in the right pane. Use the *SETUP* pane to define the sequence of labels in the MPLS stack.



4 Set values in the *Edit MPLS* pane, as needed. (See *"MPLS Options" on page 576*.)

5 Click the **Add** button to add the label to the label stack.

Note: Up to 11 MPLS labels can be added in a frame definition.

Use the buttons in the *Selected MPLS* pane to move label entries up and down in the stack, or to delete entries from the stack.

All values can be reset by selecting the *Default* button.

MPLS Options

MPLS options in the *Setup:MPLS (Multi Protocol Label Switching)* pane include the following:

Label field
This 20-bit field is a flow identifier and is unique within a port (i.e., no two flows on the same port use the same label). A packet label value is changed with each hop toward the destination.

Exp (experimental) field
This field is reserved for future use. However, many devices use it for Class of Service (COS) identification.

S (bottom of stack indication) field
Set to **1** to indicate bottom of label stack.

TTL (time-to-live) field
The time-to-live value for the IP packet.

Edit IP Addresses

Edit the IP addresses, referring to *Figure 11-9* for guidance on the IP address scheme for this example.

Note: The steps below describe how to set source IP and destination IP addresses in the *Streams Setup* window. These values can also be set individually in the *Setup:IP* pane for each stream. (See *page 573*.)

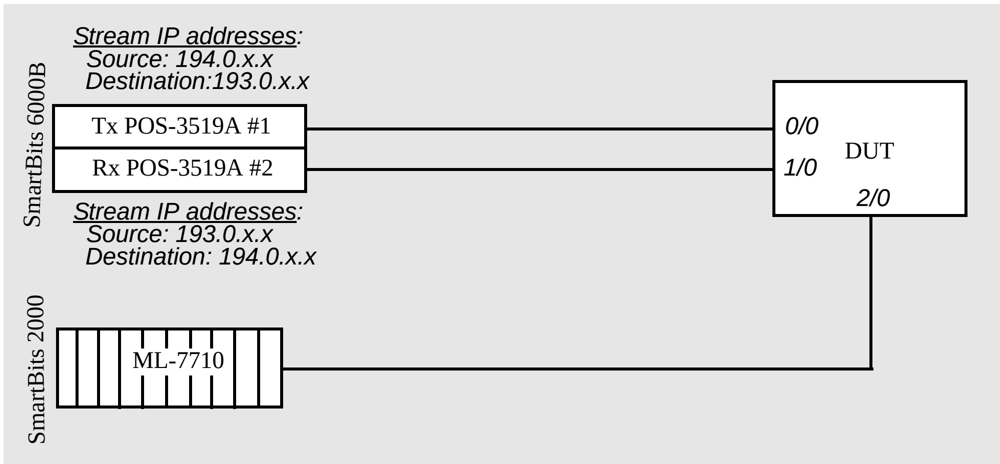


Figure 11-9. POS Stream IP Address Configuration

Source IP Address

To set source IP addresses:

1. In the *Streams Setup* window, double-click the **Source IP** field, and then enter the address **194.0.0.1**.
2. Press and hold the **Shift** key while clicking on stream **#5**.
   All five streams should now be highlighted.
3. Right-click stream **#1**, and select **Copy Down**.
   This action copies the first octet of the IP address to all five streams.
4. Right-click the last octet in the *Source IP* address column and select **Fill Increment** > **0.0.0.x**.
   This action sets the last octet in each stream to 001, 002, 003, 004, and 005 in sequence.

Destination IP Address

To set destination IP addresses:

1. Repeat *Step 1 on page 577* through *Step 4 on page 577*, but use the **Dest. IP** field in the *Streams Setup* window.
2. Set addresses to **193.0.0.1** through **193.0.0.5**.

Set up Flows for Each Stream

Each stream can be configured to cycle through up to 16,777,215 flows (for IP protocol streams) or 65,535 flows (for UDP or TCP protocol streams).

With IP streams, flow generation can be based on IP source or destination address or on VFD fields. With UDP or TCP streams, flow generation can be based on these IP address values as well as on source or destination port number.

To set up flows for each stream:

1. Select (click) the stream in the *Streams Setup* window.
2. Click the **Edit** button.
3. In the *Flow Generation* pane located in the *Tx Control Panel* pane, select the variable to use with Flow 1.

   The *Setup* view changes to show the associated options. For example, in *Figure 11-10 on page 579*, the selected protocol is *IP* and the generation variable for Flow 1 is *IP ADDR. SOURCE*.
4. Set values in the related *Setup* view to suit the flow generation variable that was selected.

Note: See *"When Setting up IP Flows" on page 579* for guidelines on setting up flows for IP protocol streams and for UDP or TCP protocol streams.

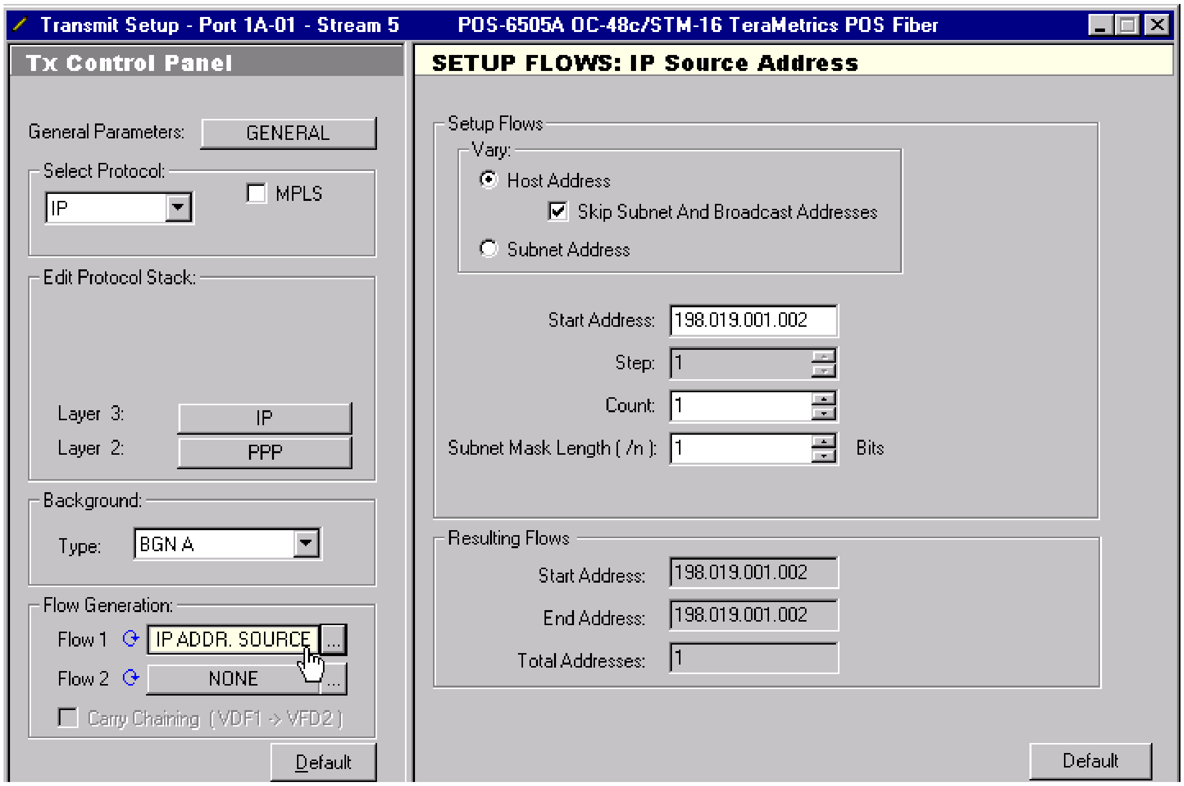


Figure 11-10. Setup for Flow Generation by IP Source Address

When Setting up IP Flows

When the *Host Address* checkbox is selected in the *Setup Flows* pane, the *Skip Subnet and Broadcast Addresses* checkbox becomes active and can be selected. Each transmitted frame then increments the selected IP address by 1 (the *Step* value), skipping 0 and 255, and starting with the IP address set in the *Start Address* field. When all addresses have been cycled through, the process starts again with the initial IP address.

The *Count* field can contain a maximum value of 16,777,215. The *Subnet Mask Length (/n)* field can contain a maximum value of 30 bits.

When the *Subnet Address* checkbox is selected in the *Setup Flows* pane, the *Count* field value varies automatically according to the *Subnet Mask Length (/n)* field value.

Use the *Resulting Flows* pane to review the proposed configuration, in terms of starting address, ending address, and total number of flows.

When all settings are correct, click **OK**.

When Setting up Layer 4 Flows (UDP or TCP)

Select *SOURCE PORT* or *DEST. PORT* as the flow generation variable only when a Layer 4 protocol (UDP or TCP) has been selected in the *Select Protocol* field.

The *Source Port* and *Destination Port* fields each can contain a maximum value of 65535. The *Subnet Mask Length (/n)* field can contain a maximum value of 30 bits.

When all settings are correct, click **OK**.

Send the Configuration to the Cards

Click the **Update** button in the SmartWindow toolbar to copy your configuration to the card, or select **Actions > Update** from the main menu.

Caution: When the card is updated, the PPP link automatically renegotiates.

To configure the line interface and IP addresses of the receiving card, see *"Configuring a Card to Receive"*.

Configuring a Card to Receive

Streams do not need to be created on the receiving card, unless there needs to be two-way transmission and reception. However, the port interface and the IP addresses do need to be configured. Perform this action by using the procedures already described in *"Set up Line Parameters" on page 582*.

Use the information in *Figure 11-9 on page 577* to set the card IP addresses.

Set up the DUT

Set Port IP Addresses

On the DUT, set up the port IP addresses using *Figure 11-9 on page 577* as a guide.

Set Stream IP Addresses

The POS router must be able to handle the IP addresses of the streams that have been created, so the router must be configured so it can build a routing table that knows what to do with each flow.

Depending on the capabilities of the POS router, you may need to set up static routes or supernetting (i.e., assigning to each stream a different second byte in the IP address, such as 193.19.x.x, 193.20.x.x, 193.21.x.x, etc.) In this way, as the streams cycle through the frames of a flow, no frames are discarded or lost, and each stream is treated separately in SmartMetrics test results.

Get Test Results

See *"Running SmartCounters" on page 594* and *"Running the Sequence and Latency Test" on page 595* for the steps to retrieve counters and SmartMetrics tests results.

Test Using the POS-3500B/Bs Module

This section outlines the steps to test QOS for POS using the POS-3500B/Bs OC-12c/STM-4 module.

POS-3500B/Bs Features and Functions

Each POS-3500B/Bs supports one OC-12c/STM-4 port in the SmartBits 600x/6000x chassis.

These modules are capable of:

- Generating up to 8,192 streams at any time and analyzing the results.
- Implementing up to 65,535 flows per stream, for a total of 524 million flows per port.
- Testing real POS router performance with SmartMetrics tests, including per-flow Frame Loss, Latency, Latency and Sequence, and Latency Distribution tracking.
- Testing core and edge router capabilities through a fully integrated array of SmartBits SmartMetrics cards.

These cards feature:

- True 622 Mbps line rate traffic generation and analysis
- Multi-mode or single-mode fiber support
- SONET or SDH framing
- Fully independent port operation
- 1310 nm physical output/input wave length
- SONET/SDH analysis of section overhead, line overhead, and path overhead
- User-enabled SONET/SDH payload scrambling (X^{43}+1)
- FCS: 16-bit and 32-bit CRC supported
- Encapsulation:
  - PPP as per RFC-1662
  - HDLC with Ethertype (Cisco HDLC).

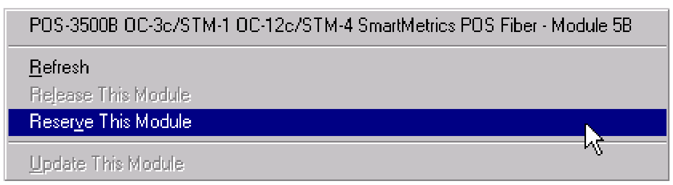
Note: This test setup uses the ML-7710 and POS-3500B/Bs. Additional cards and modules that support this test include the following:

- The POS-3502A/As OC-3 module can also be used in this test.

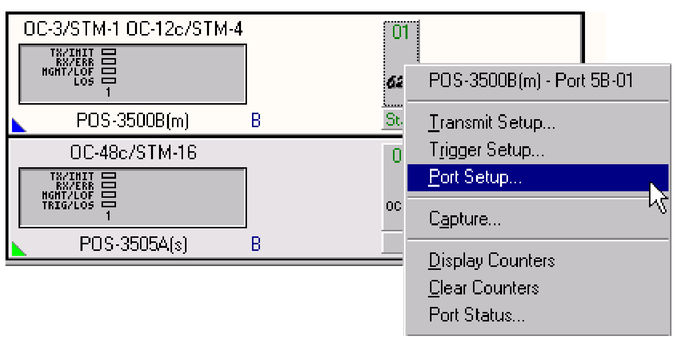
Set up Line Parameters

To set up the line parameters:

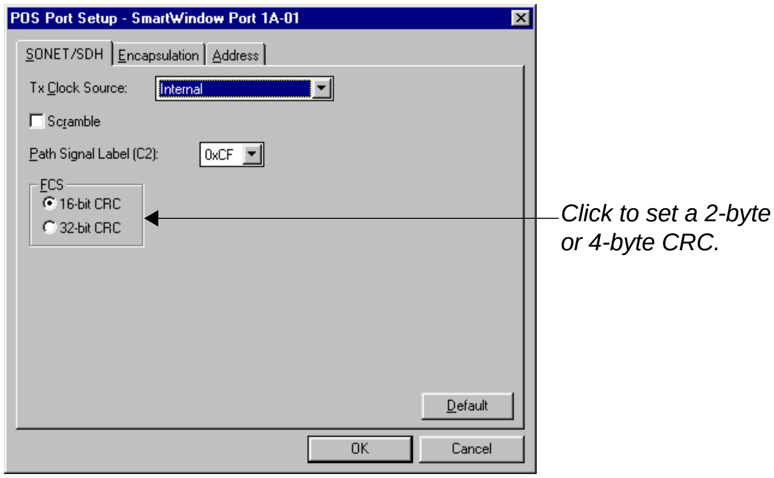
1. Connect to the SmartBits 6000B/6000C chassis. (Refer to *"SmartBits 6000x Multi-user Operation" on page 92* for more information.)
2. To reserve the cards to be configured, right-click anywhere on the card image except the *Start* button and choose **Reserve This Module**.



3. Click the port button. The POS drop-down menu appears.



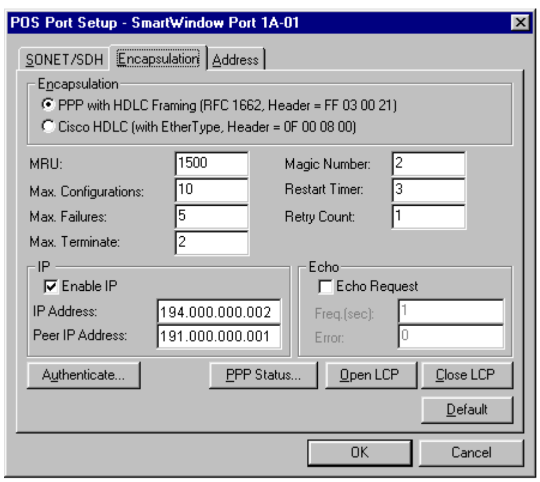
4. Choose **Port Setup**. The following dialog box appears.



5 Set the SONET/SDH parameters in accordance with installation requirements.

The purpose of the POS scrambler is to protect against malicious users generating long streams of all-zero patterns which could create synchronization problems. When the *Scramble* checkbox is selected, it scrambles the entire SONET payload envelope. Even when no PPP frames are being transmitted, the idle pattern is scrambled.

6 Click the **Encapsulation** tab. The following dialog box appears.



PPP Encapsulation

If PPP encapsulation (the default) is selected, the full PPP stack is implemented, and all PPP configuration parameters are under your control, including incoming and outgoing authentication.

To select PPP encapsulation:

1 Click the **Encapsulation** tab, if the tab is not already selected.
2 Click the **PPP with HDLC Framing** button in the *Encapsulation* pane.
3 Set the other PPP parameters, as necessary. In most cases, the default values may be used. In this phase, each PPP device uses LCP packets to configure the data link and negotiate the values in the MRU field.

Figure 11-11 shows the fields for entering IP addresses in SmartWindow.

Figure 11-12 on page 585 illustrates how these fields are applied in a test environment.

4 Enter the IP address of the POS card. (This IP address is identical to the IP address on the *Address* tab.) The *Gateway* field is not currently supported.

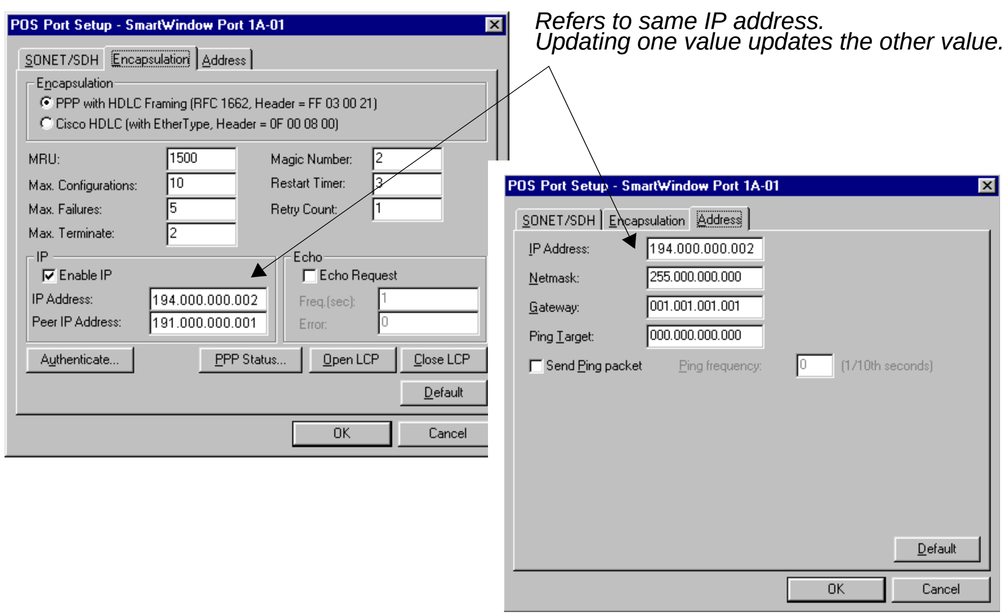


Figure 11-11.IP Address Fields in POS Dialogs

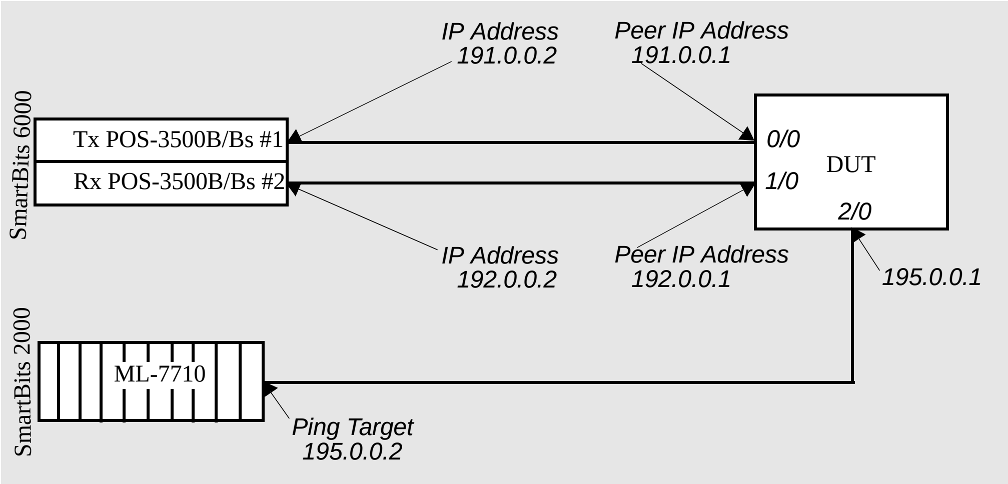


Figure 11-12.POS "Card" IP Address Configuration

Important: The card always replies to ping requests, but the card only initiates ping packets if the **Send Ping packet** checkbox is selected on the *Address* tab.

5 Right-click the **Start** button on the SmartWindow main menu.

6 Select **PPP Status**.

7 Verify that both *LCP State* and *IPCP State* indicate *Up* in the *Status* field. If not, click the **Close LCP** button and then click the **Open LCP** button.

LCP now initiates the handshaking phase to establish a PPP session. LCP can be manually brought down and then brought up again by clicking the **Close LCP** button and then clicking the **Open LCP** button.

8 Click **OK**.

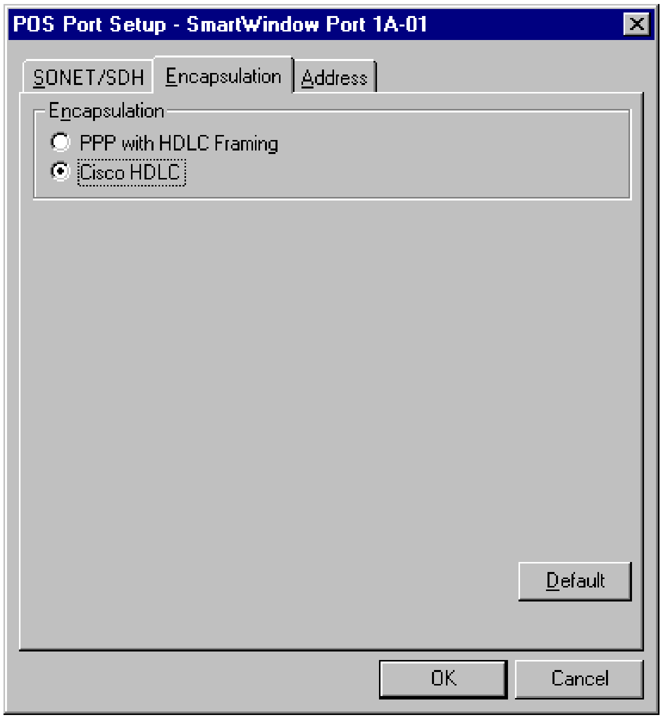
9 Click the **Address** tab and type in any IP addresses that the network may need in order to function as shown in *Figure 11-12*.

10 Click **OK**.

CISCO HDLC Encapsulation

Cisco HDLC encapsulation uses a proprietary Cisco protocol which is automatically configured when the *Cisco HDLC* button is clicked.

Note: The Cisco protocol does not use PPP.



Note: Before a test can be run, streams need to be set up.

Configure Streams on the Transmitting Card

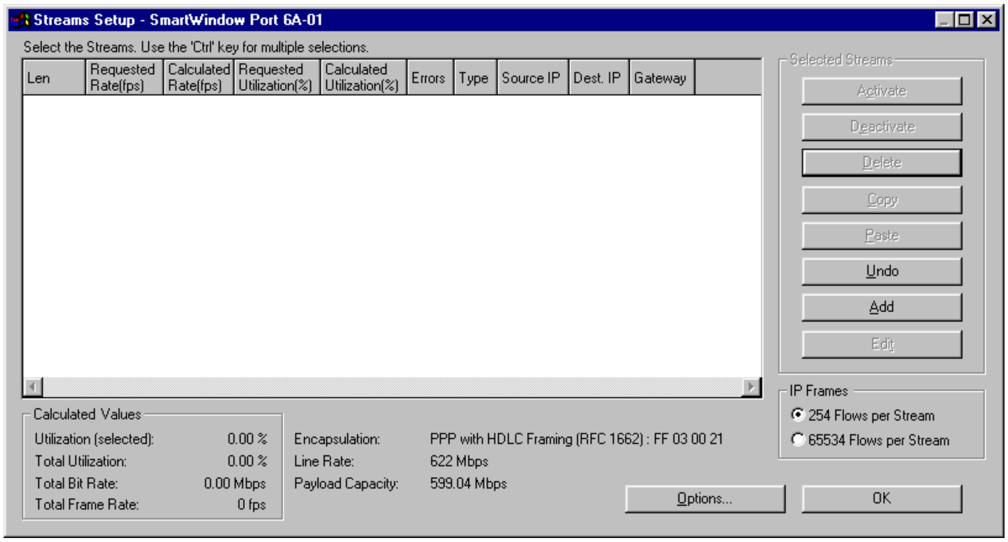
After setting values in the *Port Setup* dialog box, streams need to be configured. Although it is possible to configure 2,000 streams, it is generally not necessary to configure that many streams. When measuring the QOS capability of a router, it is better to create only enough streams to simulate each type of service.

For instance, if there are five levels of service, create one stream for each level for a total of five streams. Because each stream can generate 64,000 individually configurable flows—the equivalent to 320,000 flows per port—the POS-3500B/Bs card actually creates a test case that is more manageable and useful than creating a lot of hard to manage streams.

To configure streams on the transmitting card:

1 From the main menu, right-click the **Start** button on the card to be configured.

2 Choose **Transmit Setup**. The following dialog box appears.



As streams are created, SmartWindow calculates the individual and total frame rates for the specified card. *Table 11-4 on page 588* describes the values shown in the *Calculated Values* pane.

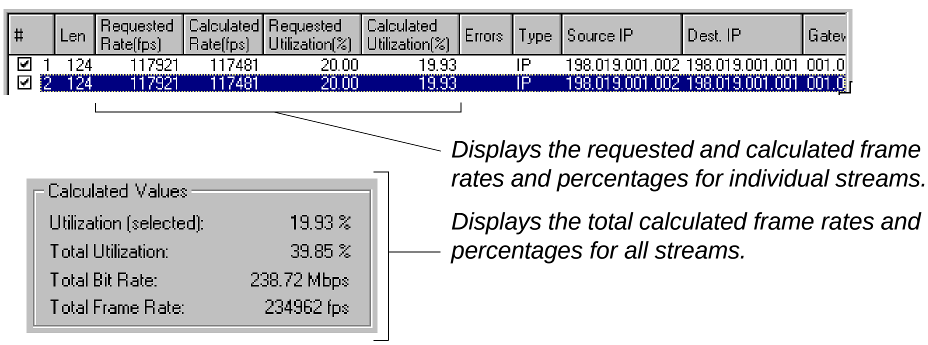


Table 11-4. POS Frame Rates Defined

Rate	Definition
Requested	The rate (in fps) that factors into its calculation the percent of bandwidth for a given transmission speed (OC-3c, OC-12c), frame length (without FCS), length of CRC, and minimum interfame gap.
Calculated[1]	The rate that factors the actual clock rate into the above.
Actual[2]	The true overall rate (inclusive of byte stuffing) at which frames were transmitted.

1 For more detail, see *"Algorithm for Calculated Rate (POS-35xx Modules)" on page 678*.

2 This value cannot be computed until frames are received.

3 Click the **Add** button.

The following dialog box appears.

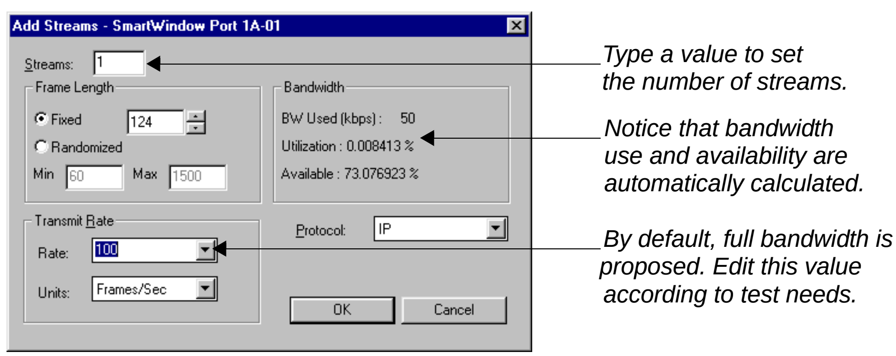
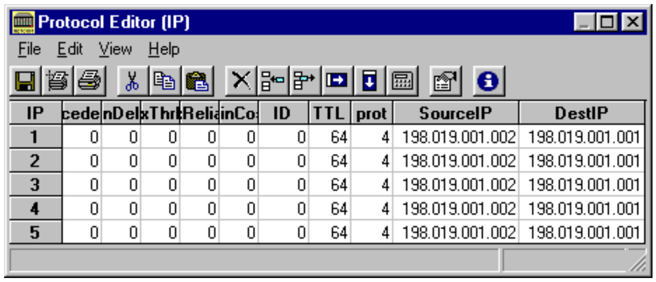


Figure 11-13. Configuring Streams

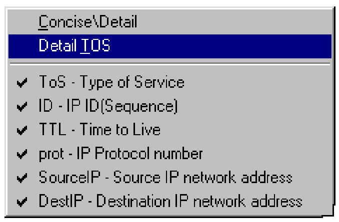
4 Change the **Streams** field value to **5**.

5 Edit the other fields according to *Figure 11-13*.

6 Click **OK** when all changes to the dialog box have been entered. The Protocol Editor appears, which displays IP header information.

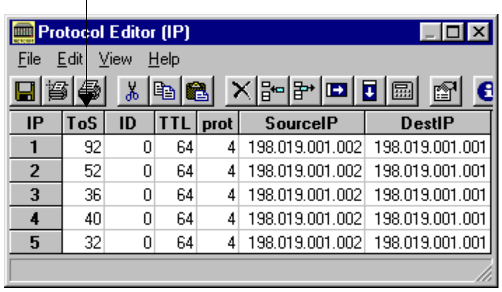


7 Choose **View** > **Detail TOS**, then **View** > **Invert Table**.



This action clears the **Detail TOS** option and opens the following view.

Type in a TOS value in decimal format.



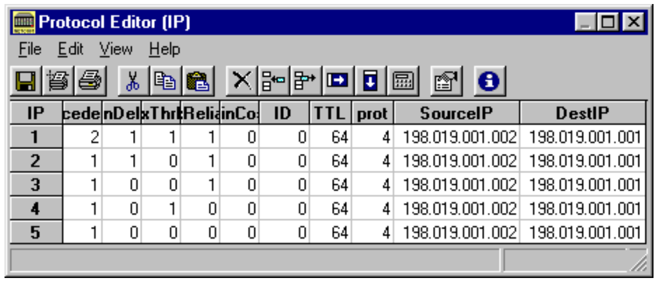
8 Enter a service quality value for stream #1.
For this example, enter **92** (i.e., the decimal value for **Immediate, Low Delay, High Throughput, High Reliability**) in the first row of the TOS column.

By entering these values, you are configuring the five streams that were created with different levels of service. After running a test with these streams, the test results can be loaded into a histogram and viewed in graphic form.

9 Using 52, 36, 40, and 32, respectively, repeat *Step 8* for streams #2 through 5.

10 Choose **View** > **Detail TOS**.

The following view breaks down the TOS detail into individual fields.



IP	cede	nDel	xThr	Reli	inCo	ID	TTL	prot	SourceIP	DestIP
1	2	1	1	1	0	0	64	4	198.019.001.002	198.019.001.001
2	1	1	0	1	0	0	64	4	198.019.001.002	198.019.001.001
3	1	0	0	1	0	0	64	4	198.019.001.002	198.019.001.001
4	1	0	1	0	0	0	64	4	198.019.001.002	198.019.001.001
5	1	0	0	0	0	0	64	4	198.019.001.002	198.019.001.001

11 Now close the window, and save your work when prompted.

The *Streams Setup* dialog box appears, containing the parameters of the streams that were created.

12 Edit the IP addresses. (Refer to *Figure 11-14* for guidance on the numbering scheme.)

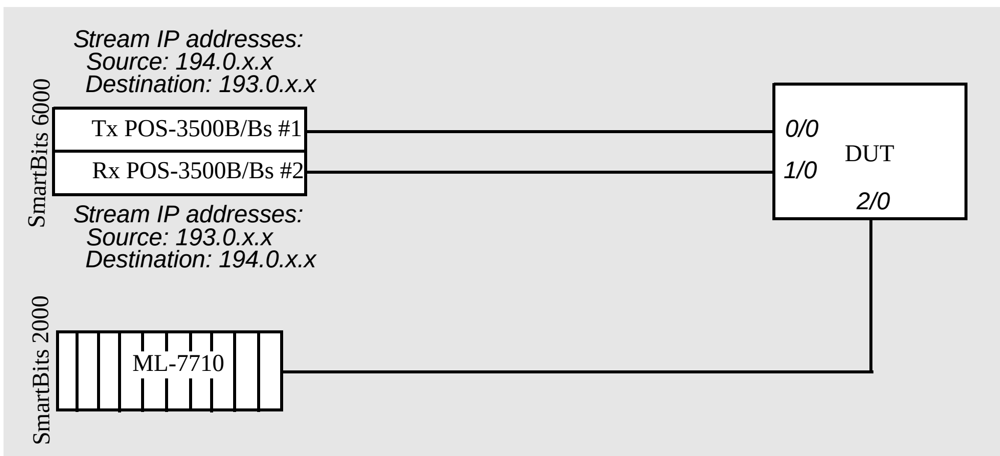
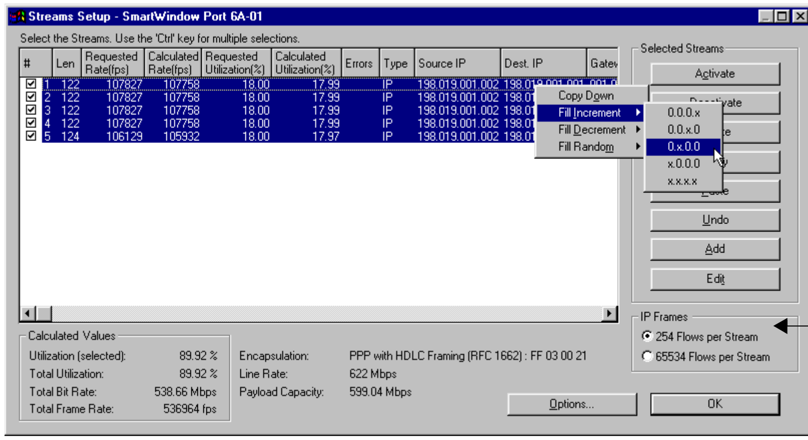


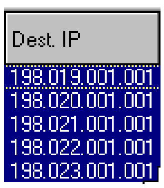
Figure 11-14.POS "Stream" IP Address Configuration

13 Highlight the streams that need to be edited, then right-click the field to be edited within the highlighted area. (Alternately, highlight a single stream and click the **Edit** button to invoke the *Transmit Setup* option, then click **Edit** again to invoke the Protocol Editor.)



Click a radio button to select the number of flows per stream.

For each stream, the selected byte of destination IP address is incremented as follows:



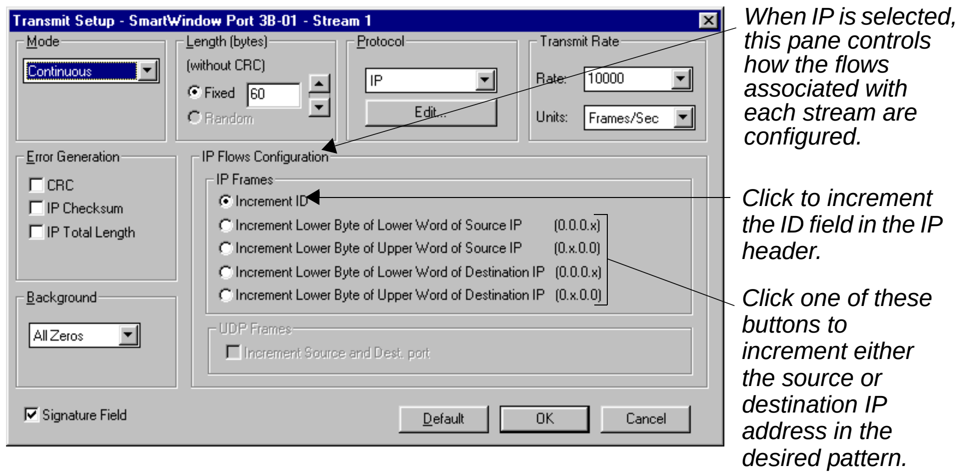
Set up the Flows for Each Stream

Each stream cycles through 254 or 65,534 flows, depending on the option choosen in the *IP Frames* pane in the *Streams Setup* dialog box. IP addresses must be established for each stream and these IP addresses must be different from the IP addresses of the card or DUT. Once IP addresses are created, each flow can be customized, incrementing the IP addresses as described below.

To set up flows for each stream:

1 Double-click the first stream.

The *Transmit Setup* dialog box appears. Customize the flows for each stream as follows:



Note: If source or destination IP address is selected, each transmitted frame increments the selected IP address by 1, skipping 0 and 255 (starting with the IP address set in the Protocol Editor). When all 65,534 addresses have been cycled through, the cycling process starts again with the IP address set in the Protocol Editor.

2 Make the necessary edits to each stream.

You are finished with stream and flow configuration.

3 Click **OK**.

4 Click the **Download** button on the SmartWindow toolbar to copy the configuration to the card.

Caution: When the card is updated, the PPP link automatically renegotiates.

Note: The line interface and IP addresses of the receiving card need to be configured.

Refer to *"Configuring a Card to Receive" on page 593*.

Configuring a Card to Receive

Although the line interface and IP addresses need to be configured, you do not need to create streams on the receiving card, unless two-way transmission and reception are required.

To configure a card to receive, repeat the procedures in *"Set up Line Parameters" on page 582* and use the information in *Figure 11-12 on page 585* to set the card IP addresses.

Set up the DUT

Set up the port IP addresses using *Figure 11-12 on page 585* as a guide.

Setting the Stream IP Addresses

Set up the POS router so that it can deal with the IP addresses of the streams that have been created. Set the router so that it can build a routing table that knows what to do with each flow.

Depending on the POS router capabilities, you may need to set up static routes or supernetting (i.e., giving each stream a different second byte, such as 198.19.x.x, 198.20.x.x, 198.21.x.x, etc.). In this way, as the streams cycle through the 65K frames of a flow, no frames are discarded or lost, and each stream is treated separately in SmartMetrics test results.

Get Test Results

See *"Running SmartCounters" on page 594* and *"Running the Sequence and Latency Test" on page 595* for the steps to retrieve counter statistics and SmartMetrics tests results.

Running SmartCounters

It is useful to start SmartCounters before the test is run in order to see the frame totals run during the Sequence and Latency test. See *Table 11-5* for a listing of locations in this manual that describe how to display, configure, and run SmartCounters.

Table 11-5. Information on SmartCounters

Information	**Location**
Design of SmartCounters	*“SmartCounters Structure” on page 416*
Pre-defined views	*“Results Framework” on page 417*
Setting formulas	*Step 4 on page 427*
Running SmartCounters	*“Running SmartCounters” on page 435*

Choose **Actions** > **SmartCounters** to view SmartCounters during the test. (See *Figure 11-15*.)

Note: SmartCounters totals for POS cards *do not* include framing bits when the encapsulation mode is set to *PPP with HDLC Framing* or *Cisco HDLC.*

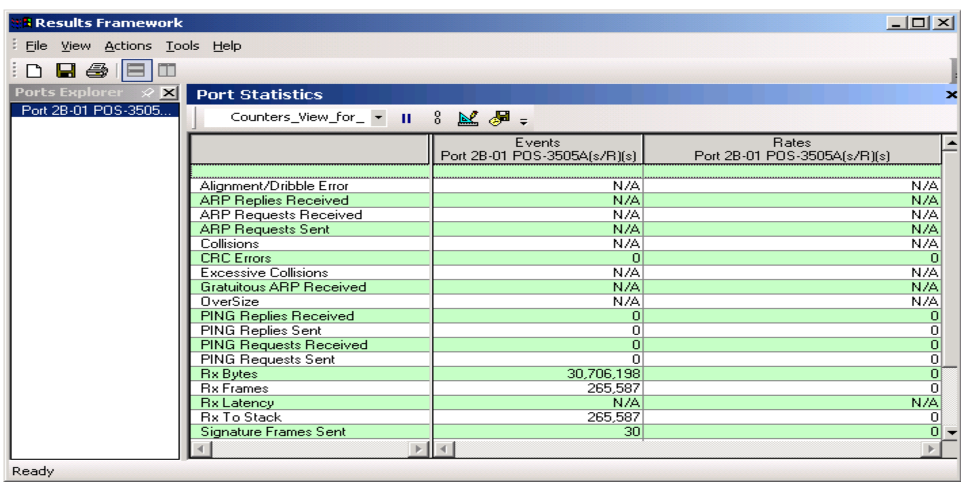


Figure 11-15. SmartCounters Result Framework Window

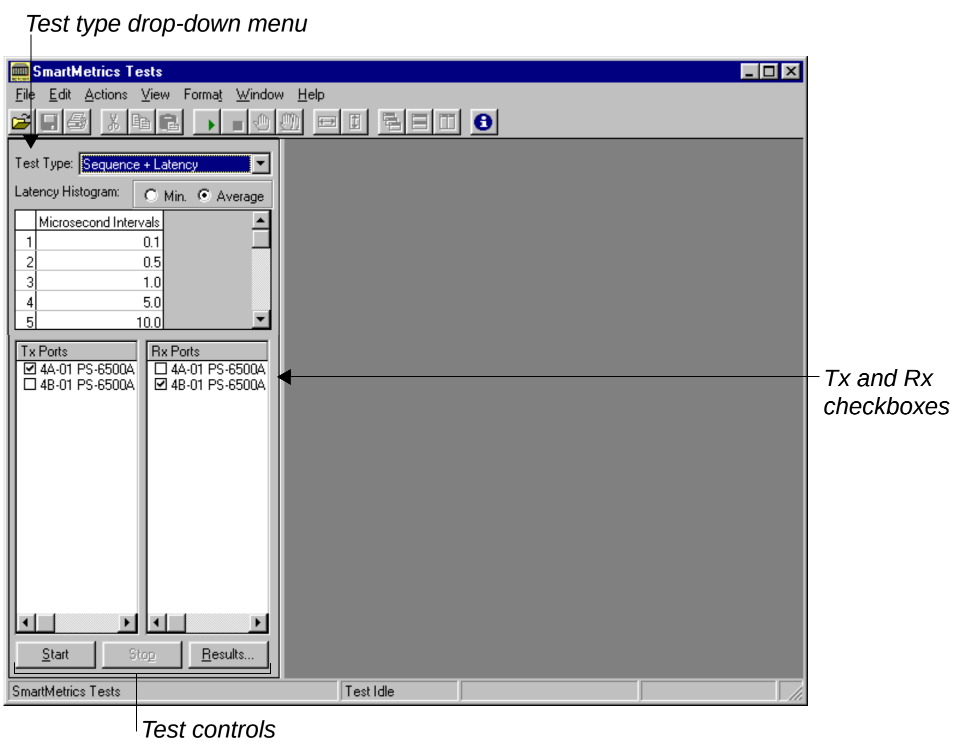
Now run the Sequence and Latency test. Refer to *“Running the Sequence and Latency Test” on page 595*.

Running the Sequence and Latency Test

The Sequence and Latency test provides information on latency, latency distribution, frame loss, and frame sequencing.

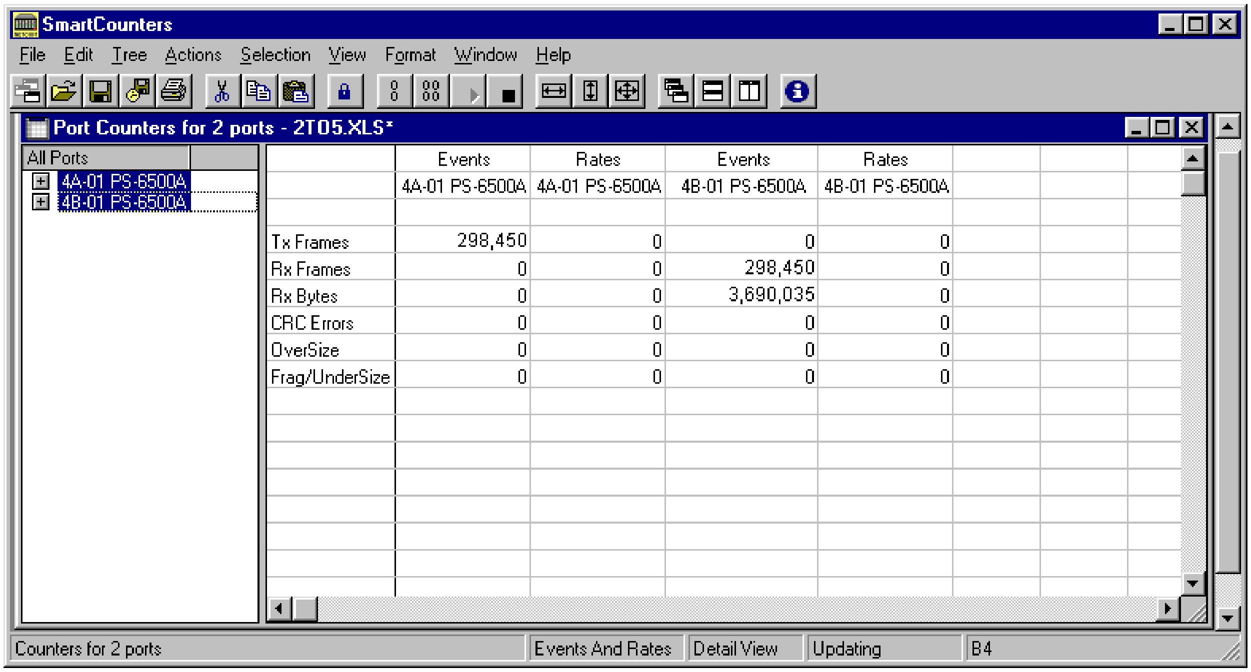
To run the test:

1. If not already connected, connect to the SmartBits 6000x chassis and reserve the two POS cards for the test.
2. Choose **Tests** > **SmartMetrics Tests**. The SmartMetrics window appears.



3. From the *Test Type* drop-down menu, choose **Sequence + Latency**.
4. Select results to be shown as minimum or average latency values by clicking the *Min.* or *Average* button.
5. Select port 4A-01 as the transmitting port and port 4B-01 as the receiving port since the test is using ports 4A and 4B in the example above.
6. Click the **Start** button.

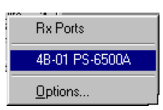
Note: At this point, make SmartCounters the active window in order to view statistics while the test is running.



Important: The test can also be run in single burst mode, so you can control the exact number of frames sent during the test.

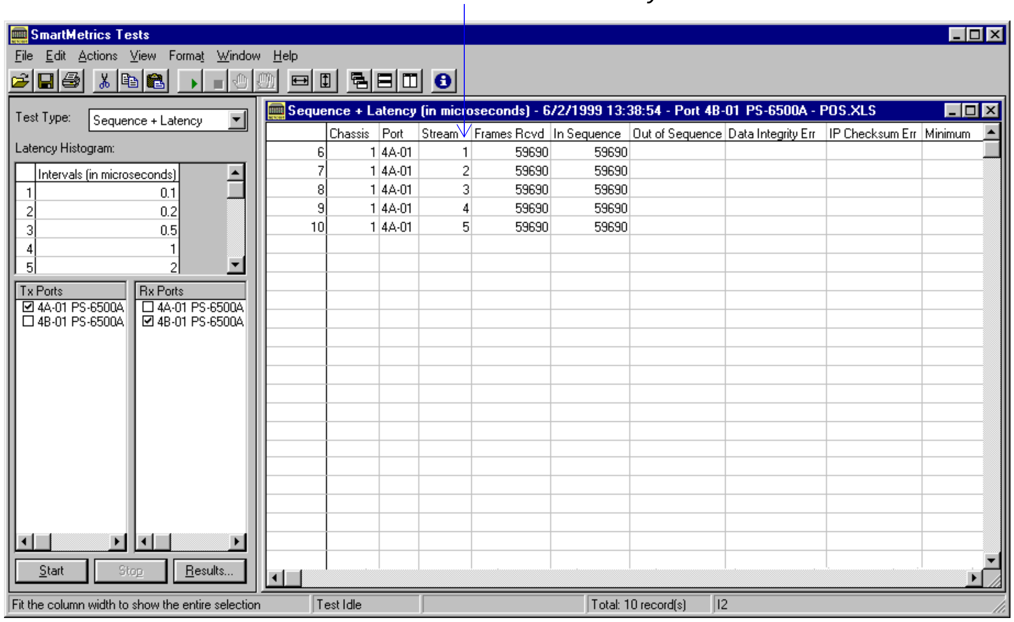
7 To stop the test, click the **Stop** button.

8 Click the **Results** button, and choose the receiving card from the drop-down menu.



The SmartMetrics spreadsheet appears.

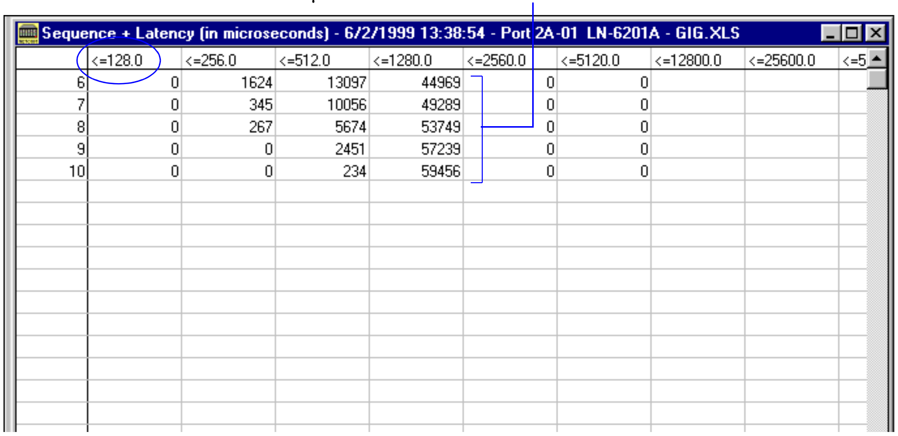
The Stream column lists the five streams by number.



9 Scroll to the right to view the latency distribution buckets.

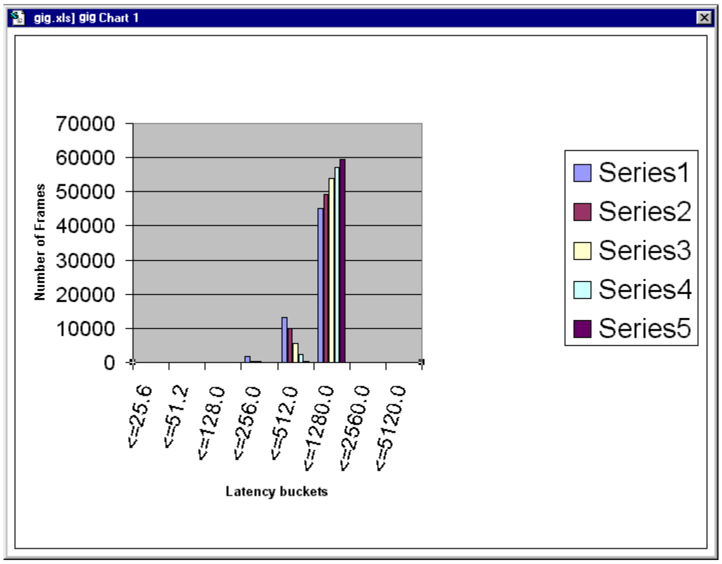
Buckets are incremented in µs.

When the test completes, the frame count in SmartCounters should equal the total number of frames for all buckets.



10 To save the results in Excel format, choose **File** > **Save As**. Name the file, and select `.xls`.

11 Double-click the Excel file that was saved to open it, and then graph the results. Each data series represents one of the QOS streams that was created.



Chapter 12

Testing xDSL

The SmartBits system, ATM SmartCards, and SmartWindow provide a testing methodology which is highly effective in providing critical data to evaluate xDSL devices.

In order to deal with the increasing volume and bandwidth-intensive demand of multimedia, video, Internet, and e-mail services, xDSL offers several extremely cost-effective solutions over existing copper telephone lines.

In this chapter...

xDSL Overview

In networking asymmetric traffic, the most common situation today (*Figure 12-1*) connects a subscriber with an ADSL modem (known as ATU-R) to the central office Digital Subscriber Line Access Multiplexer (DSLAM), which is connected via ATM or frame relay to the Internet and to both private and public networks. The subscriber sends low speed traffic (32 kbps to 640 kbps) up to the ISP or telco, while the ISP returns high volume and high speed (6 to 8 Mbps) video and services to the subscriber.

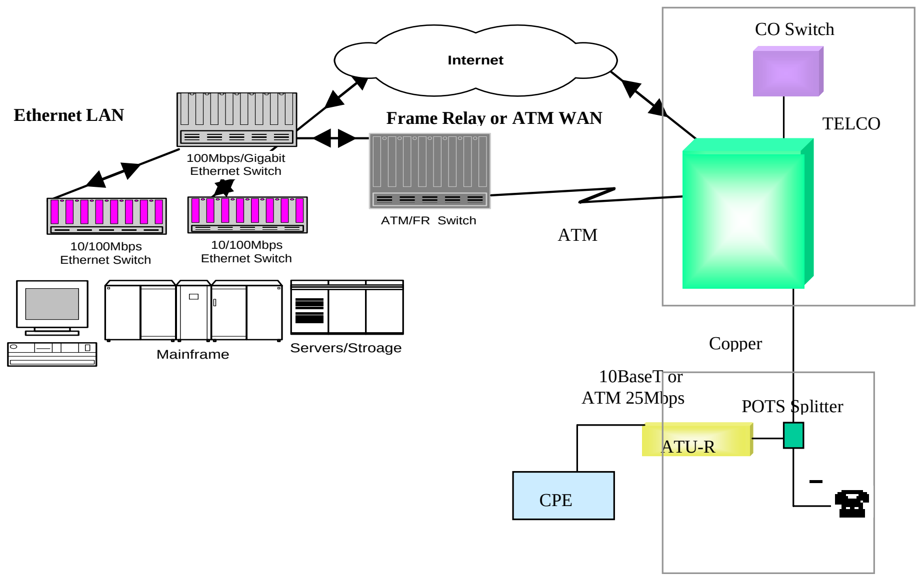


Figure 12-1. Typical xDSL Installation

Refer to the following for additional applications for ATM testing with xDSL networks:

- *Chapter 10, "Testing ATM"* in this *SmartWindow User Guide*
- *SmartApplications User Guide*
- *SmartSignaling User Guide.*

Within an xDSL network or interrelated set of networks, there typically is the following traffic to and from LANs, WANs, ISPs, and central offices:

- Ethernet
- SDH or SONET ATM
- Voice and video over IP
- IP over ATM.

Test Methodology

With the increasing complexity of these hybrid networks, it is becoming very important to test and forecast network performance—from edge-to-edge, edge-to-core, and core-to-edge. The SmartBits performance analysis test system provides comprehensive coverage in these areas through the use of individual SmartCard modules for each technology type.

With the SmartBits system, you can:

- Generate, capture, and analyze traffic at full wire rate with multiple technologies.
- Scale 100s of ports with 100,000s of streams.
- Test layer 2, layer 3, and layer 4 networks.
- Perform repeatable and remotely controllable tests.
- Perform traditional metrics (namely per packet/frame/cell metrics for throughput, latency, and packet loss) and respond to bursts of traffic.
- Perform SmartMetrics to include traditional metrics and the following:
    - Call/connection metrics–max call/connection setup rate
    - Call/connection metrics–max sustained calls
    - IP over ATM to Ethernet, ATM to Frame Relay (FR)
    - For Ethernet-to-Ethernet or to FR: per stream latency variation, sequence tracking
    - For Ethernet-to-Ethernet or to FR: per stream latency, throughput, and packet loss.

SmartBits systems offer edge-to-edge performance testing, either locally in a test lab or remotely through a live xDSL network (*Figure 12-2*).

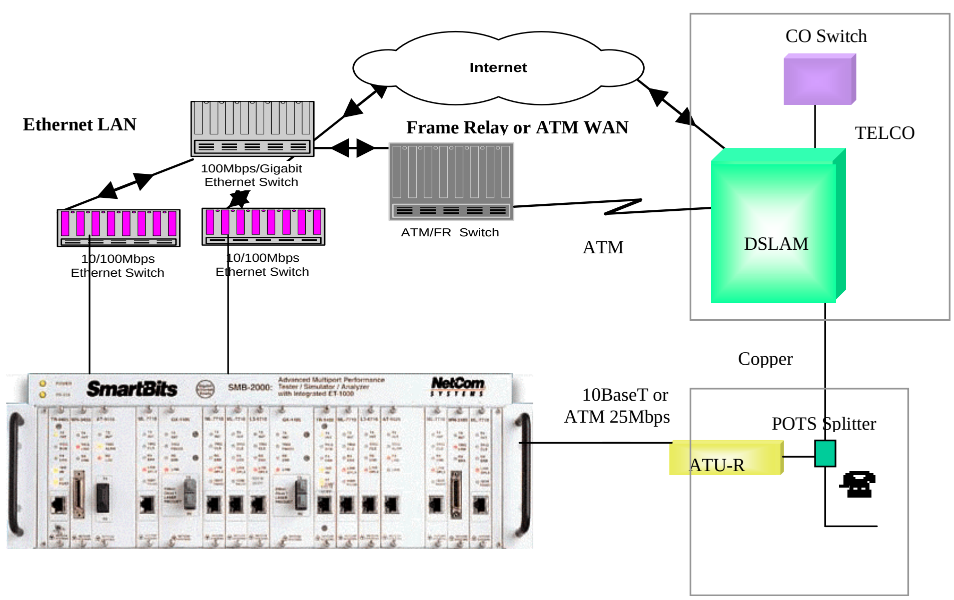
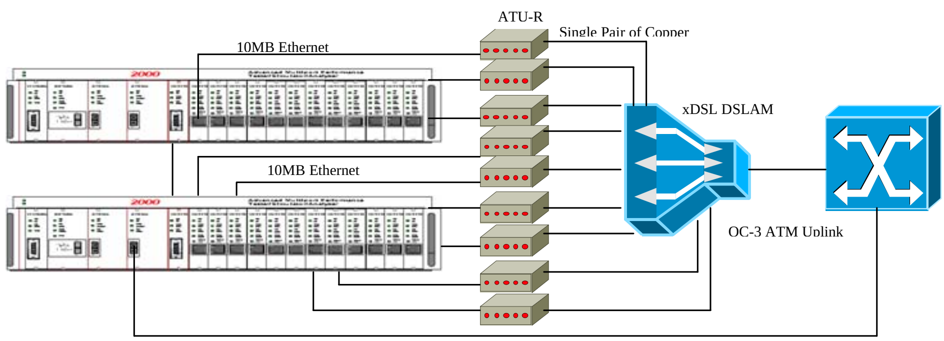


Figure 12-2. SmartBits Testing in xDSL Test Labs and Networks

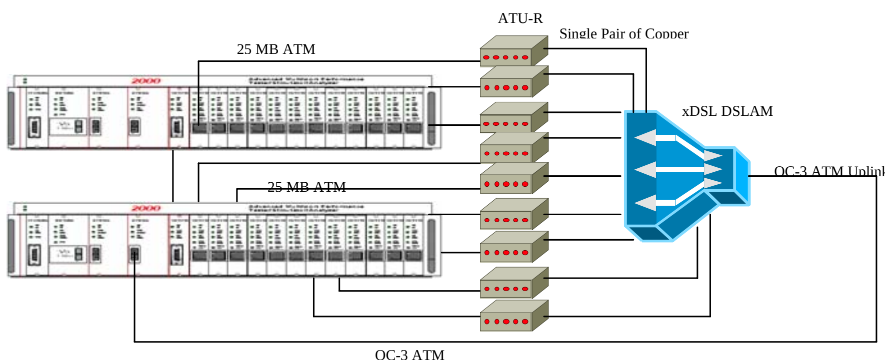
The following test procedure highlights some of the ADSL performance tests available with a SmartBits system.

- **Stability test**
  Stresses the configuration under test using IP frames over ATM.
- **Payload checking**
  Checks the content of a cell and a frame, verifies that the cell is delivered to the right modem, and measures transit delay end-to-end.
- **Loss per PVC**
  Counts frames and cells per VPI/VCI, and locates which channel has loss on the upstream or the downstream.

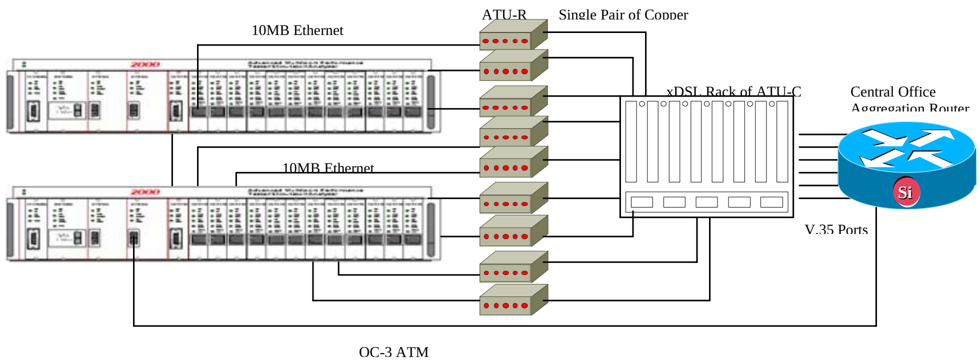
Test Scenario 1: DSLAM Throughput Test, Ethernet to ATM



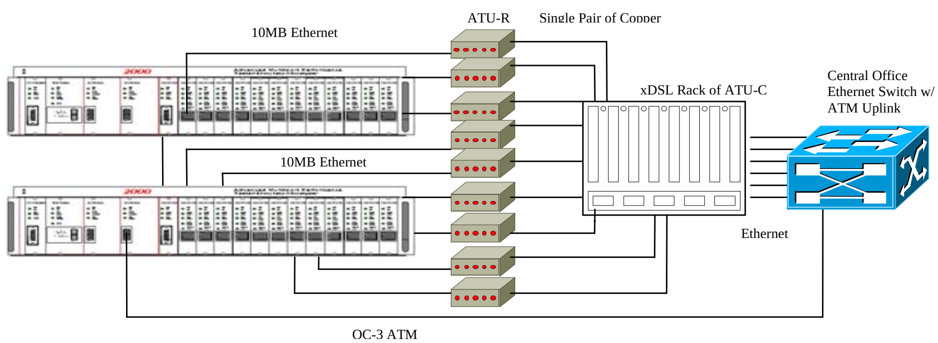
Test Scenario 2: DSLAM Throughput Test, 25 Mbps ATM to OC-3 ATM



Test Scenario 3: DSLAM Throughput Test, Ethernet to PPP to ATM



Test Scenario 4: DSLAM Throughput Test, Ethernet to Ethernet to ATM



Connecting SmartBits to ADSL Network

Note: This test setup uses the AT-9155 and ML-7710. Additional SmartCards that support this test include the following:

- Connected to the DSLAM, the AT-9015, AT-9020, AT-9034B, AT-9045, or AT-9622 ATM SmartCards can be substituted for the AT-9155 in this test.
- Connected to the xDSL modem, the AT-9025, SE-6205, ST-6410, SX-7210, or SX-7410/B SmartCards can be substituted for the ML-7710 in this test.

For this example, connect two SmartCards (or more) as follows (*Figure 12-3*, *Figure 12-4 on page 605*, and *Figure 12-5 on page 605*):

- An OC-3/STM-1 port at the central office DSLAM or at E3/DS3 port for a remote DSLAM
- A subscriber DSL modem with 25 Mbps ATM and/or 10 Mbps Ethernet.

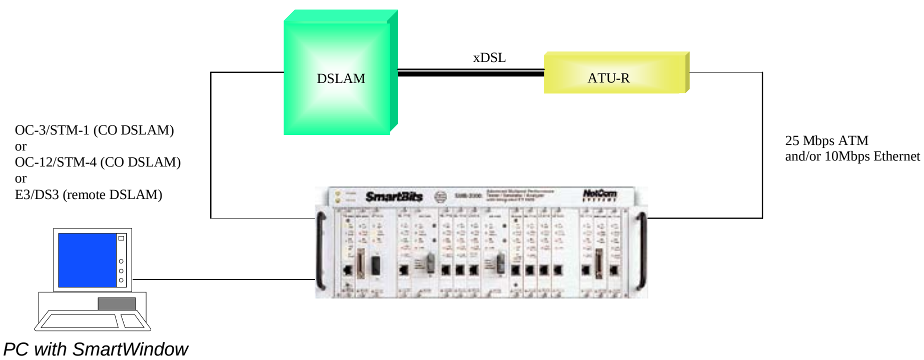


Figure 12-3. SmartBits Test Setup

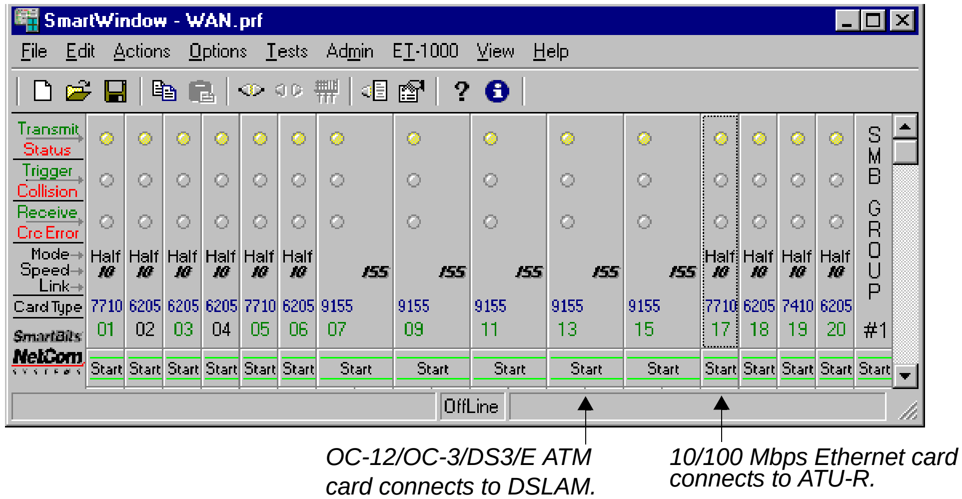


Figure 12-4. SmartCards in the Test

Each ATM SmartCard fills two chassis slots, and each Ethernet SmartCard fills one chassis slot. With 20 slots available in the SmartBits 2000 chassis, the maximum configurations per chassis are:

- One OC-12/OC-3/DS-3/E-3 SmartCard and nine 25Mbps ATM SmartCards or
- One OC-12/OC-3/DS-3/E-3 SmartCard and 18 Ethernet SmartCards.

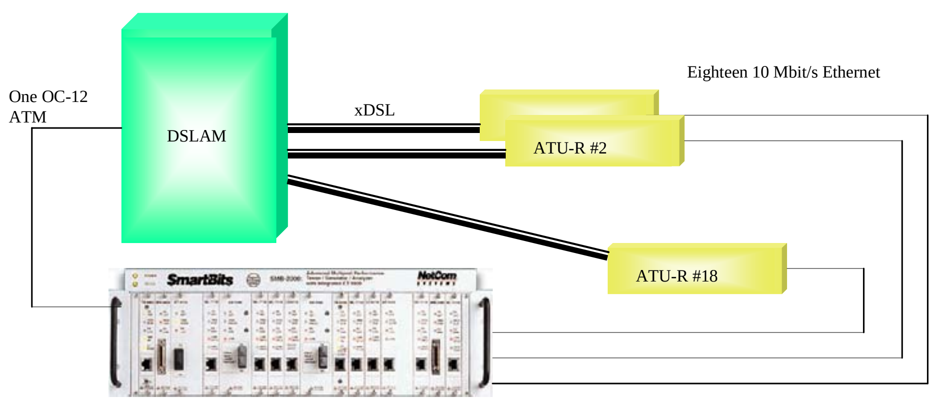


Figure 12-5. Expanding the Test Configuration

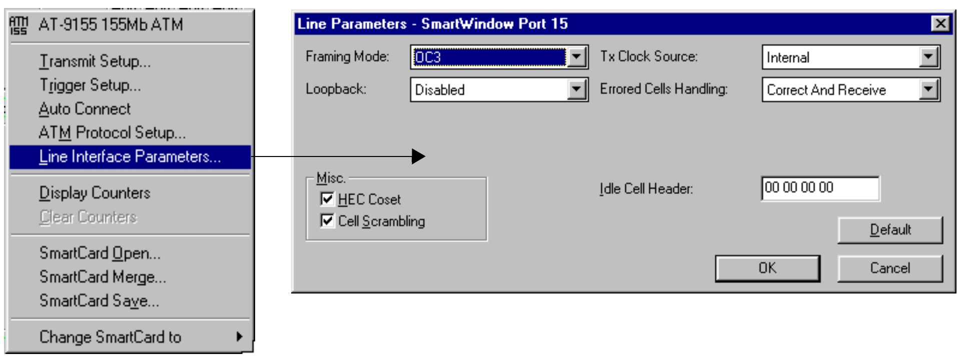
Configuring xDSL Tests

To configure xDSL tests, perform the procedures in this section.

Set up ATM Line Interface Parameters

To set up parameters:

1. From the SmartWindow main menu, click each ATM SmartCard.
2. Select the **Line Interface Parameters** option to verify physical interface parameters.



3. For this test case, in the *Framing Mode* field, select **SONET (OC3c)** or **SDH (STM-1)**.
4. Accept the checkbox defaults for HEC coset and cell scrambling.

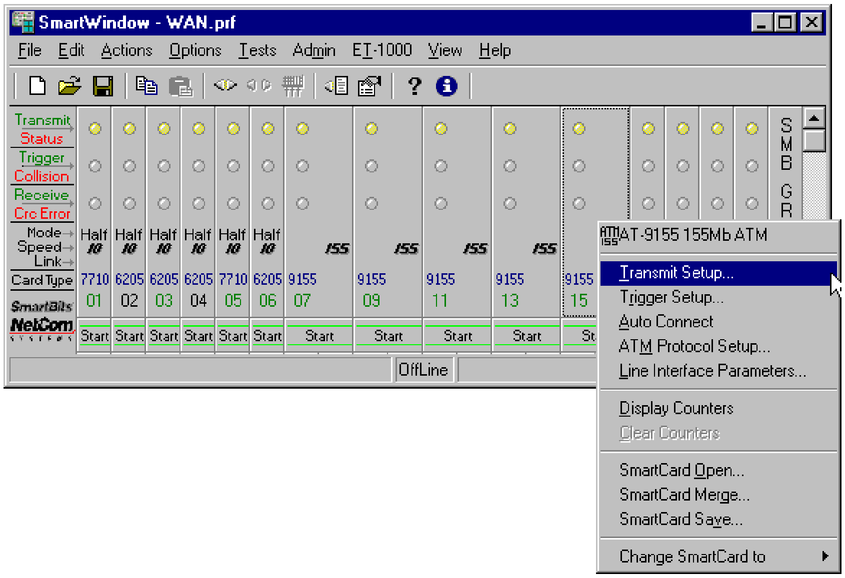
Set up PVCs

Most default values for the PVCs fit standard testing.

To set up PVCs:

1. To start SmartWindow, click the SmartWindow icon.
   The SmartBits virtual front panel appears.
2. Choose **Actions > Connect** and make the appropriate selection to activate the connection between SmartWindow and SmartBits.
   The SmartBits front panel now displays the installed SmartCards in the SmartBits system in use.
3. Click each ATM card that will transmit traffic.

4 From the pull-down menu, choose the **Transmit Setup** option in order to set up to 2,048 virtual circuits.



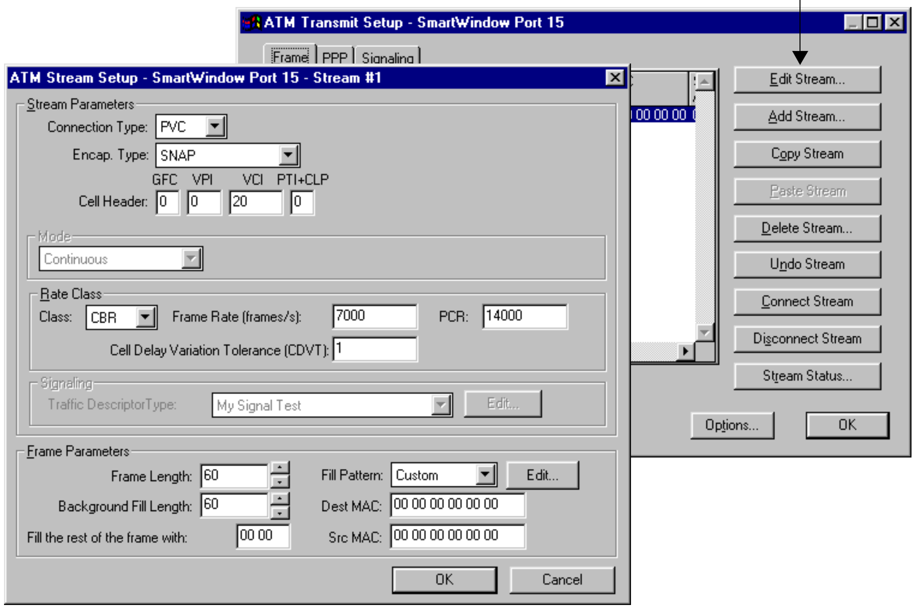
In the Transmit Setup *window, set up streams for each SVC or PVC in order to test the DUT.*

The ATM SmartCard connected to the DSLAM supports a maximum of 2,048 Virtual Connections (VCs) within the limit of the total amount of the traffic (155,622 Mbps in this case).

Note: If the ATM SmartCard is connected to the ADSL modem, it supports at least two VCs in order to simulate a CBR of 6.1 Mbps traffic downstream and 600 Kbps UBR traffic upstream, which mimics the behavior of an Internet connection.

5 Click the **Edit Stream** button in the *Transmit Setup* window to set up the VPI/VCI.

Click to display the ATM Stream Setup *dialog box.*

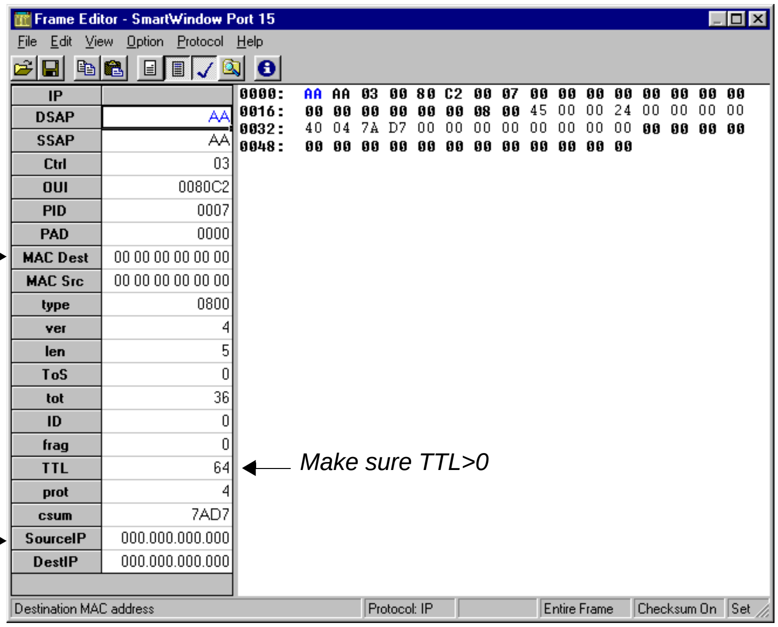


6 Set the type of class and frames per second for each stream to simulate the bandwidth downstream of 6.1 Mbps.

With the default value set for a frame at 60 bytes, two cells per frame are needed, which results in a Peak Cell Rate (PCR) that is twice the number of frames/second. Remember that the PCR dictates the amount of bandwidth downstream to the xDSL modem.

7 To change the frame content, click the **Edit** button to use the Frame Editor. Then select **IP** on the Protocol menu to access and edit an IP frame.

8 Click **File** > **Save** to save changes, then **File** > **Exit** to return to the *Transmit Setup* window.



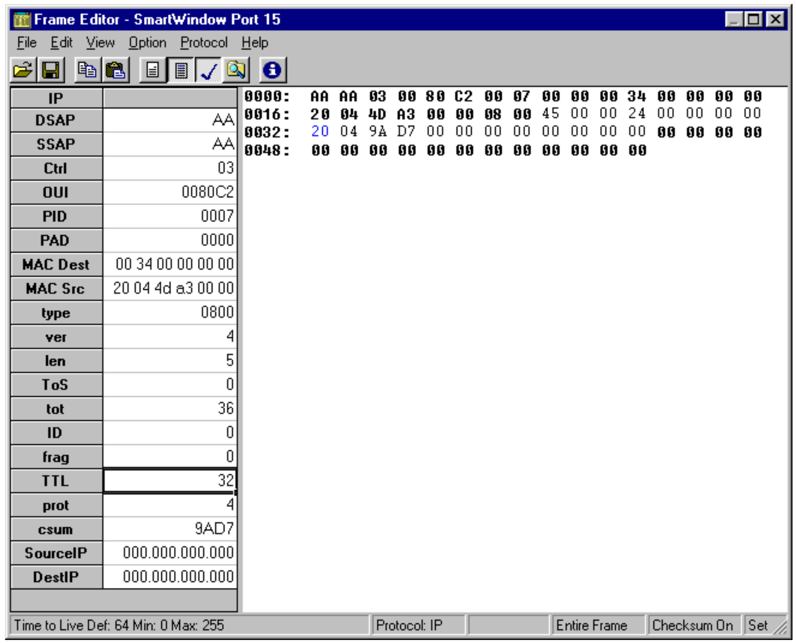
In this example, IP frames are sent at 7,000 frames per second. Each frame is the default 60 bytes in length (without FCS).

Set up a Stream for Bridged Ethernet

The following typical setup is used to allow an ATM SmartCard to transmit a stream of traffic for bridged Ethernet.

To set up a stream:

1. Right-click the ATM SmartCard.
2. Choose the **Transmit Setup** option, then click the **Edit Stream** button to set up a bridged Ethernet stream compliant with RFC 1483.
3. Select **PVC** in the *Type* field.
4. Select **SNAP** in the *Encapsulation* field.
5. Go to fill pattern, select **IP**, then click the **Edit** button.
   All the fields are set to RFC 1483 standard.
6. Enter the following values, where necessary:
   - MAC addresses
   - IP addresses
   - TOS bits
   - PID (Ethernet = 00–07).



7 Choose **File** > **Save**, then **File** > **Exit.**

8 Click **OK**.

9 Click the **Connect Stream** button, then click **OK** to exit the window.

Set up and Test for Routed Ethernet

Similarly, an ATM SmartCard can be set up to transmit a stream of traffic for routed Ethernet.

To set up and test:

1 Right-click on ATM SmartCard. Choose the **Transmit Setup** option, then click the **Edit Stream** button to set up a routed Ethernet stream compliant with RFC 1483.

2 Select **PVC** in the *Type* field.

3 Select **Classical IP** in the *Encapsulation* field.

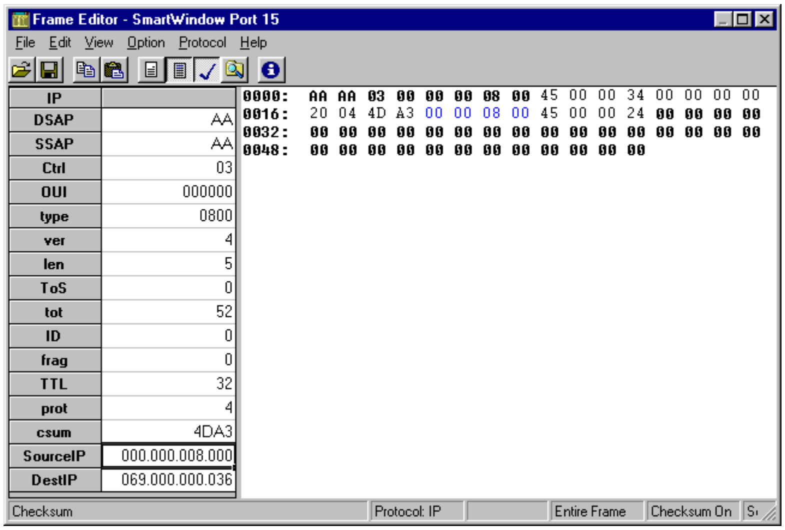
4 Go to fill pattern, select **IP**, then click the **Edit** button.
All fields are set to conform to the RFC 1483 standard.

5 Change the **OUI** value from `00 80 C2` to `00 00 00`.

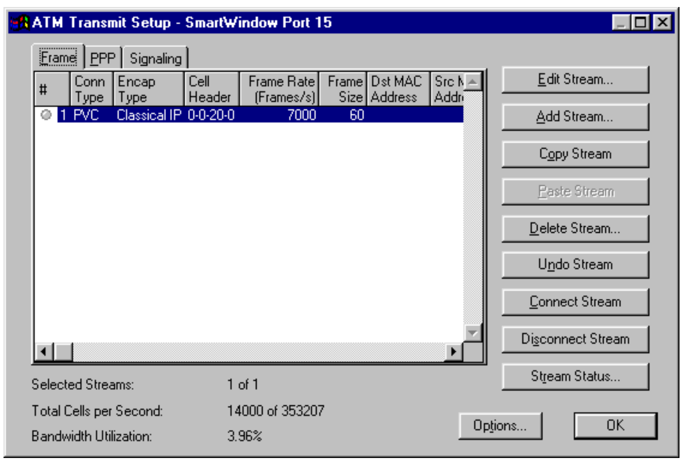
6 Edit the values to be changed or added (IP addresses).

7 Click **File** > **Save**, then **File** > **Exit**.

8 Click **OK**.



9 Click the **Connect Stream** button. Click **OK** to exit the window.



Set up an Ethernet Connection

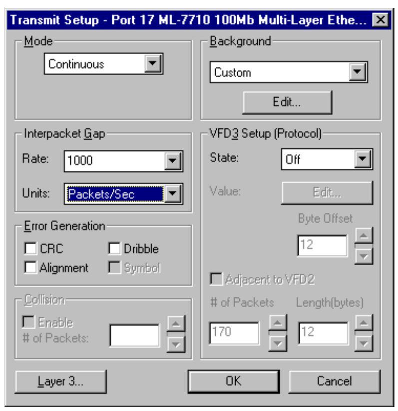
To set up a connection:

1 If an Ethernet SmartCard is used for the DSL modem connection, click an Ethernet SmartCard such as the ML-7710.

2 To set up an Ethernet stream, choose the **Transmit Setup** option.
Since this ADSL modem is a bridge only, accept the defaults.

3 Select the **SmartMetric Mode** checkbox, scroll to the right, and add the **Netmask** and **Gateway** of the Ethernet SmartCard.

4 Highlight **VTE** to select it, and then click the **This Port** button.
The following dialog box appears.



5 In the *Interpacket Gap* pane, select **Packets/Sec** in the *Units* field.

6 Enter a frames per second rate of **1000** in the *Rate* field.[1]

7 Click **OK**.

8 To change the bytes per frame, double-click the stream, and edit the *Length (without FCS)* field.

9 Click **OK**.

Note: The non-Layer 3 Mode enables Layer 2 (MAC addresses), Layer 3 (IP protocol and addresses), and Layer 4 (TCP protocol) streams via variable field definitions, but does not generate advanced data analysis and histograms.

10 Highlight **VTE** again, and click **Selected VTEs**.

11 Select the **IP** as the protocol, and click the **Edit** button.

1. For subscriber upstream traffic, 1000 packets/sec multiplied by default 60-byte frames is 600 Kbps. The Layer 3 Mode is the multi-layer mode that generates Layers 2, 3, and 4 streams, and enables advanced data analysis and histograms.

12 Select **MAC Src,** and enter the MAC address of the ML-7710 SmartCard (i.e., the address defaults to the ML-7710 slot number in the SmartBits 2000).

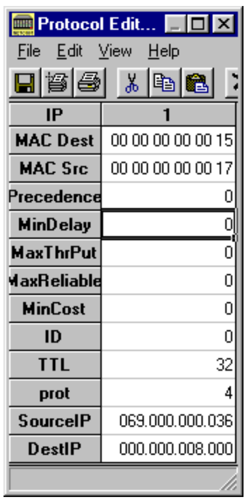
13 Select **MAC Dest**, and enter the destination MAC address of the AT-9155 SmartCard.

14 Select **TTL**, and set TTL to a value greater than 0.

15 Verify that the **prot** field is set to **4** (IP).

16 Select **SourceIP,** and enter the IP address of the ML-7710 SmartCard.

17 Select **DestIP,** and enter the IP address of the AT-9155 SmartCard.



18 Click **File > Save,** then **File > Exit**.

19 Click **OK** in the *Transmit Setup* dialog box.

20 Click **OK** in the *VTE Setup* dialog box.

Save the Configuration and Run Test

After the configuration is saved and renamed for future use (if necessary), you are ready to run the initial tests and view a large number of counters in real-time mode, for individual ports and cards as well as for total counts.

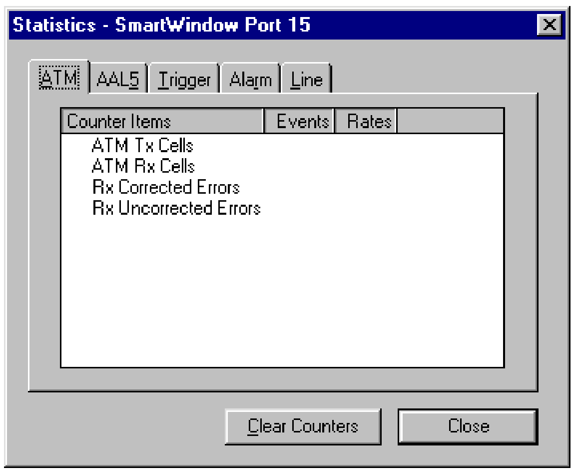
To save the configuration and run the test:

1. Choose **File > Save**.
2. Click the **Start** button on the ATM SmartCard.
3. To begin transmission and to run the test, click **Start** on the Ethernet SmartCard.

Display Counters and Statistics

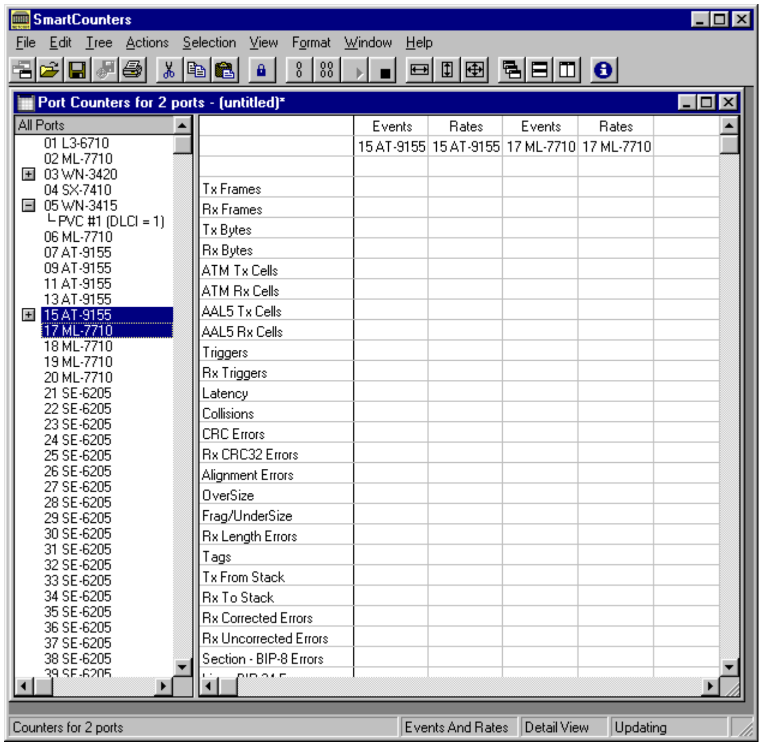
To display:

1. Click the SmartCard, then select **Display Counters**.
2. Click the different tabs to show the different sets of counters: ATM cell-level, AAL5-only cell, trigger, alarm, and line counters.

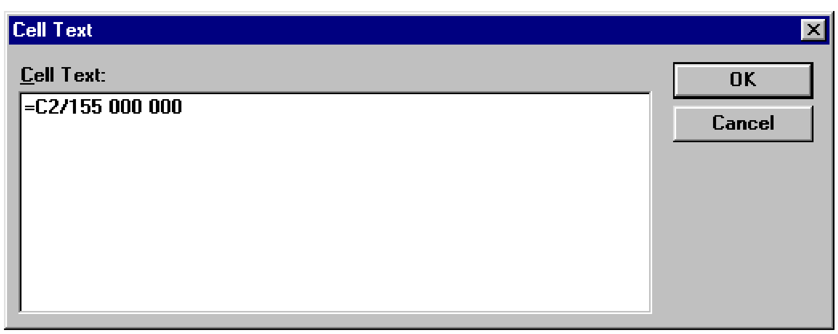


3. To get frame and cell counters plus set your own indicators, choose **Actions > Smart-Counters > File > New Counter Window**.

4 Highlight the cards to be monitored.



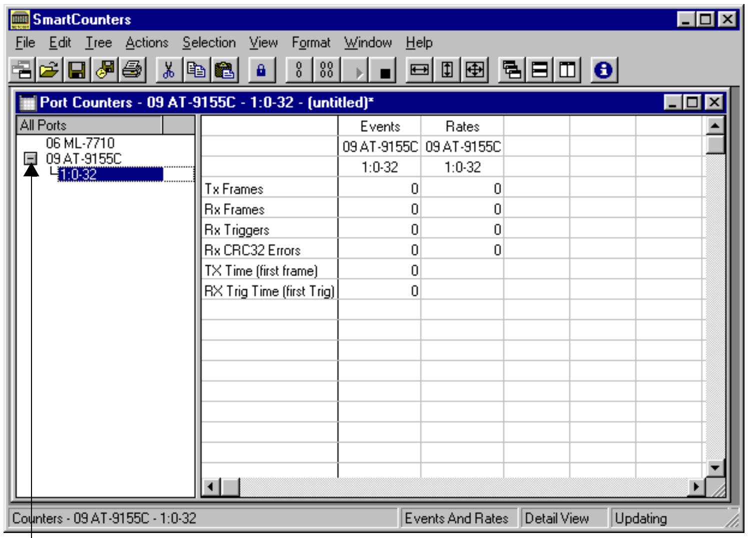
5 To define a custom indicator, select an empty cell to the right of the cells where data is to be entered. Left-click inside this cell, then insert the math equation. (Using spreadsheet conventions, press **F2**.)



For the cell designators (such as C2), highlight the target cell and note the designator in the bottom right corner of the window.

Note: If a cell designator is not visible, enlarge the window until it comes into view.

6 To view statistics per VC or stream, click the + sign to open SmartCounters per stream statistics.



Click buttons to hide/display per stream statistics.

Transit Delay Test

Transit delay is the difference between the value of the transmit latency trigger and the value of the receive latency trigger.

Assume that AT-9155 ATM SmartCard port 15 is set for a transmit trigger and ML-7710 Ethernet SmartCard port 17 is set for a receive trigger.

The following table provides typical values for routing and bridging scenarios with standard triggers set up for both source and destination addresses.

Table 12-1. Routed vs. Bridged Test Setup

Test Scenario	ATM	Ethernet
Routed (Classical IP)	Offset 20 decimal: Source IP Offset 24 decimal: Destination IP	Offset: 26: Source IP 30: Dest IP
	Direction: Transmit Cell Header: Set VPI/VCI to match stream Active Trigger: 1 & 2	
	Trigger 1: Pattern: Source IP Offset: 20 Length: 4 Mask: FF FF FF FF Trigger 2: Pattern: Dest IP Offset: 24 Length: 4 Mask: FF FF FF FF	Trigger 1: Pattern: Source IP Offset: 26x8=208 Length: 4x8=32 Trigger 2: Pattern: Dest IP Offset: 30x8=240 Length: 4x8=32
Bridged (LLC/SNAP)	Offset 10 decimal: Destination MAC Offset 16 decimal: Source MAC	Offset: 0: Dest MAC 6: Source MAC
	Direction: Transmit Cell Header: Set VPI/VCI to match stream Active Trigger: 1 & 2	
	Trigger 1: Pattern: Dest MAC Offset: 10 Length: 6 Mask: FF FF FF FF FF FF Trigger 2: Pattern: Source MAC Offset: 16 Length: 6 Mask: FF FF FF FF FF FF	Trigger 1: Pattern: Dest MAC Offset: 0 Length: 6x8=48 Trigger 2: Pattern: Source MAC Offset: 6x8=48 Length: 6x8=48

Note: The offset and length (without FCS) for Ethernet SmartCards may be displayed in bytes or in bits. For the ATM SmartCard, the values are always in bytes.

The difference in offsets between ATM and Ethernet is due to encapsulation methods.

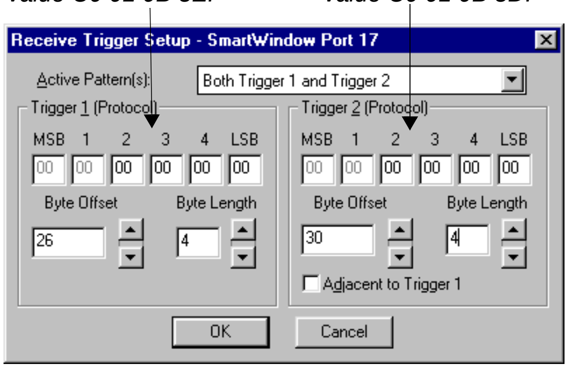
The following example shows routing parameters for the Ethernet SmartCard on port 17 and for the ATM SmartCard on port 15. The source and destination IP addresses for each pair of communicating cards must be the same for the triggers to correspond with each other correctly.

To set up a transmit delay test:

1. Click the ML-7710 SmartCard, and choose the **Trigger Setup** option. Set receive trigger for ML-7710 port 17 with the values as shown.

For a source IP address of 192.1.11.94, enter the hex value C0 01 0B 5E.

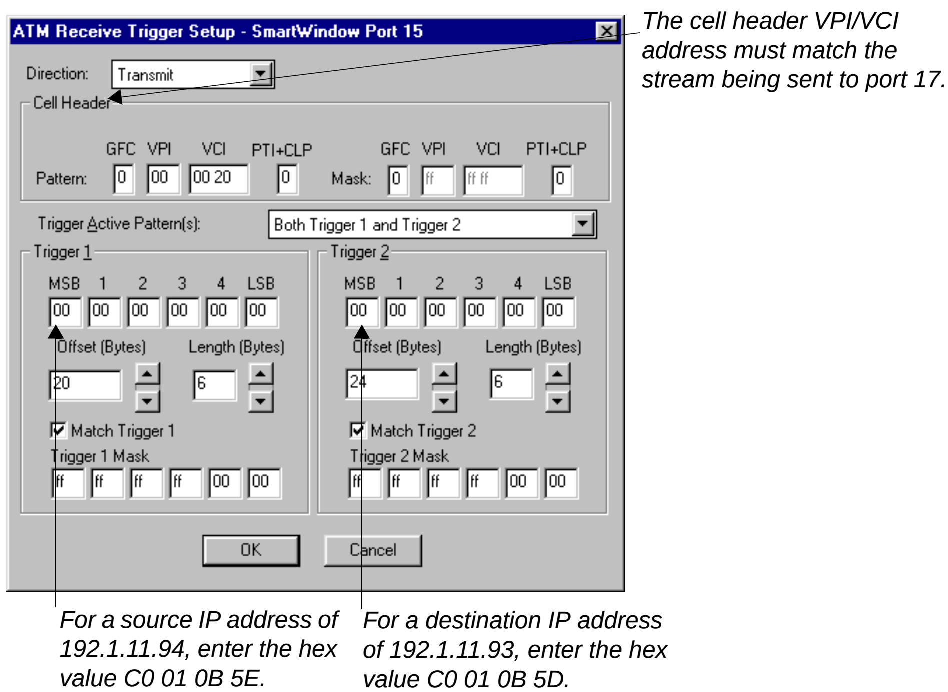
For a destination IP address of 192.1.11.93, enter the hex value C0 01 0B 5D.



2. Click **OK**.
3. To set transmit trigger for AT-9155 port 15, click the SmartCard and choose **Trigger Setup**.

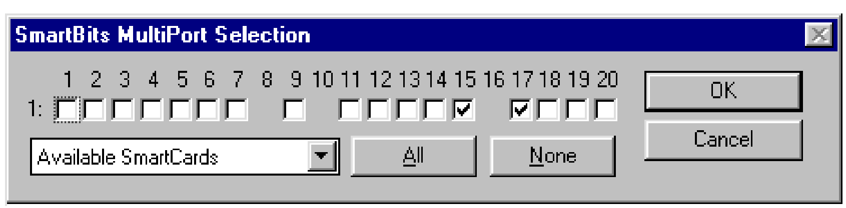
4 Set **Direction** to **Transmit**, and set other values as shown.

5 Click **OK**.



6 To synchronize latency counters for ports 15 and 17, set up a group for both ports.

7 Click the **SMB Group** vertical bar on the right-hand side of the SmartBits icon.

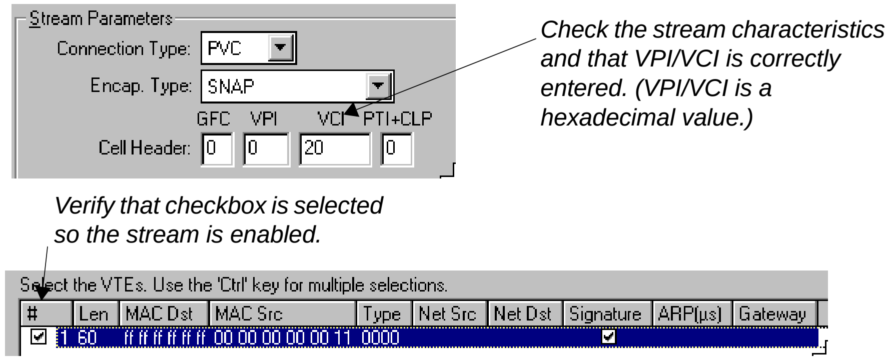


8 Choose **Set Group**. In the pop-up window, click **None**.

9 Select ports 15 and 17.

10 Click each SmartCard used in the test, then choose the **Transmit Setup** option.

11 Verify that the streams are connected for both ports (15 and 17) by checking that the ATM transmit setup LED is green for the ATM SmartCard and that the VTE stream is enabled for the ML-7710 SmartCard.



Run the Test and View Results

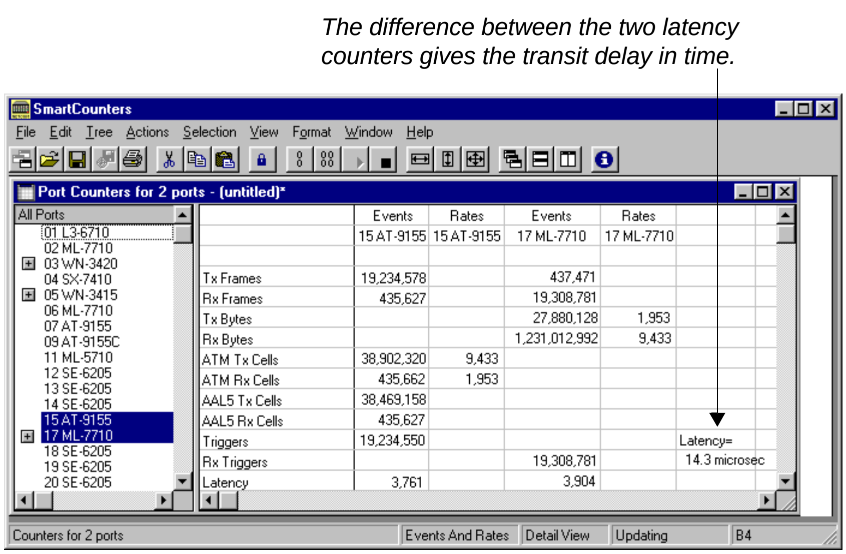
To run test and view results:

1 Click the **SMB Group** vertical bar and select **Clear Counters**.

2 Click the **Start** button in the SMB GROUP pane.

This action starts the test on both cards at the same time.

3 Choose **Actions** > **SmartCounters** to view the results.

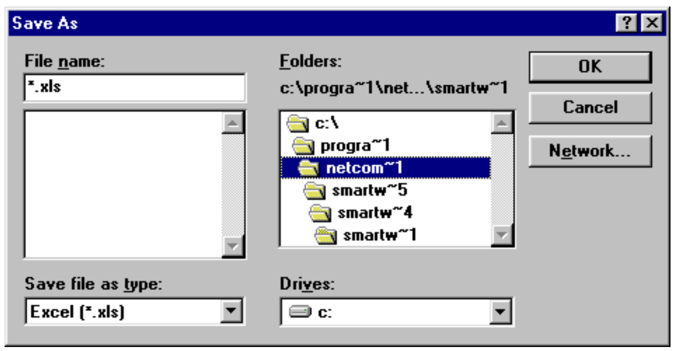


Save the Report

Important: For more information on SmartCounters, see *"Set up IGMP for SmartBits 600x/6000x Modules" on page 120*.

To save report:

1. Click **Actions** > **SmartCounters** window.
2. Select the cards in the left column of the window, then select the values to be saved.
3. Click **File** > **Save As** to save values to an Excel spreadsheet (`.xls` format).



Chapter 13

Testing Storage Area Networks

The FBC-3601A and FBC-3602A Fibre Channel modules provide an outstanding tool to assess the performance of fibre channel switches, hubs, and fabrics.

Use SmartWindow with these modules to perform tests for throughput, frame loss, latency, and sequence tracking on systems ranging from a single Device Under Test (DUT) to a large complex SAN network (fabric). You can set up multiple flows of FC frames to simulate traffic in a SAN network plus measure latency and frame loss.

In this chapter...

About Fibre Channel and SANs

Fibre channel defines a method of data transport with the primary goal of transferring data at the fastest possible rate using any current media. Because of its speed, capacity, and flexibility, fibre channel has been widely adopted for use in storage area networks, which require the rapid transfer of large quantities of data between servers and storage systems.

Fibre channel may be used with both fiber and non-fiber serial media (such as copper coaxial cable or twisted pair). It applies to both channel-based communications (peripheral-to-host) and network communications among many host interfaces.

Supported Standards

Operation of the FBC-3601A/FBC-6302A modules in SmartWindow conforms to the following ANSI and other standards for fibre channel.

Table 13-1. ANSI Standards Support

Reference	Title
RFC 1242	Benchmarking Terminology for Network Interconnection Devices
RFC 2544	Benchmarking Methodology for Network Interconnect Devices
GBIC Rev. 5.2	–
ANSI X3.230-1994, FC-PH	Fibre Channel - Physical and Signaling Interface, Rev. 4.3
ANSI X3.297-1996, FC-PH 2	Fibre Channel - Physical and Signaling Interface, Rev 7.4
ANSI X3.303-1996, FC-PH 3	Fibre Channel - Physical and Signaling Interface, Rev 9.4
ANSI X3.272-1996, FC-AL	Fibre Channel - Arbitrated Loop, Rev 4.5
ANSI X3.332-1999, FC-AL 2	Fibre Channel - Arbitrated Loop, Rev 7.0
ANSI X3.289-1996, FC-FG	Fibre Channel - Fabric Generic Requirements, Rev 3.5
NCITS TR-20-1998, FC-FLA	Fibre Channel - Fabric Loop Attachment, Rev 2.7
NCITS 321-200x, FC-SW	Fibre Channel - Switch Fabric, Rev 4.0
NCITS TR-19-1998, PLDA	Fibre Channel - Private Loop Direct Attach, Rev 2.1

Terminology

This section describes the terminology introduced in this chapter, as well as selected related terms used in telecommunications technology and standards.

Arbitrated Loop

A fibre channel topology in which two or more ports can be interconnected, but only two at a time can communicate. The loop supports up to 126 devices and one fabric attachment on one loop. Each device in the loop must arbitrate for access and use of the shared medium.

Arbitrated Loop Physical Address (ALPA)

The value that identifies a device in an arbitrated loop. This value is always the last 8 bits of the 24-bit address field.

Arbitration

The process that controls orderly access to a shared-loop technology.

Backbone

The test traffic pattern in SmartWindow in which traffic can be configured from one to many ports or from many to one port. Traffic can be uni-directional or bi-directional.

Binary Test Mode

The search mode used to determine the maximum transmission rate of the DUT or SUT when no frame loss or acceptable frame loss occurs. It is also known as *scaled search*, in which the search determines a rate between the last failed rate and the last successful rate.

Buffer-to-Buffer (BB) Credit

The fibre channel flow control system that determines how many frames can be sent to a recipient. A credit represents the ability of a device to accept an additional frame. If no credits are issued by a recipient to a sender, the sender cannot send to that recipient.

Channel

In fibre channel, the medium for high-speed transfer of information between devices.

Class of Service (CoS)

The fibre channel term for five levels (i.e., classes) of services provided in the areas of delivery guarantees, bandwidth, and connectivity between communicating devices in a fabric network. SmartWindow supports classes 2 and 3.

Class 2

A connectionless Class of Service (CoS) that allows streams of frames to be sent to different destinations quickly and requires acknowledgment of frame delivery. It is generally used in applications requiring a high degree of data integrity at the transport level.

Class 3

A connectionless CoS that does not require acknowledgment of frame delivery. Class 3 provides higher performance with less overhead, but can be less reliable since under highly congested conditions, it may discard frames.

Combo Test Mode

A test mode that combines the step and binary search operations. The mode begins in step test mode, stepping up the rate until the test fails. It then performs binary searches to determine a rate between the last failed rate and the last successful rate.

Cut-through Logic

A switching technique that allows a routing decision to be made a soon as the destination address of a frame is received.

Cyclic Redundancy Check (CRC)

A method of checking for errors in transmitted data, it is used to protect blocks of data called *frames*. Using this technique, the transmitter appends an extra n-bit sequence, called Frame Check Sequence (FCS), to every frame. The FCS holds redundant information about the frame that helps the transmitter detect errors in the frame.

Dense Wave Division Multiplexing (DWDM)

In data transmission systems, Wave Division Multiplexing (WDM) is a way to greatly increase the capacity of a single optical fiber by simultaneously transmitting at more than one wavelength of light (e.g., up to four wavelengths for WDM). DWDM is the higher capacity version of WDM and supports from 8 to 40 wavelengths.

Destination WWN

The World-Wide Name (WWN) that identifies the port that will receive the frame. (See also *Source WWN* and *World Wide Name.)*

Device

A single unit on the SCSI bus, identifiable by a unique SCSI address. A SCSI device can act as an initiator or as a target.

Discovery

In a fabric network, the process of identifying other devices in the network. (See also *Name Server* and *Loop Initialization*.)

Duration

A test setup field used to specify the length of a test. The test can be measured in seconds that the test is to run at each load interval, or in number of frames sent per test iteration.

Device Under Test (DUT)

The device being tested.

E_Port

An expansion port on a switch that is used to connect to another E_port on a different switch. This type of connection is used to connect several devices in order to create a large fabric.

Extended Link Services (ELS)

Additional control functions added to fibre channel from time to time by ANSI, such as PLOGI and FLOGI.

Exchange

A mechanism for identifying and managing an operation between two ports.

Exchange ID

The 16-bit identifier assigned to a specific operation.

Fabric

One or more fibre channel switch(es) in a network configuration in which each port in a node (device) is attached to the fabric through a link that consists of a pair of fibers. (See also *Link.)*

Failover

When a network component (such as a disk or server) fails, this is the automatic process that switches from the failed component to its redundant backup. The process is transparent to the user. In SmartFabric, the failover test is used to determine downtime in a network with failover capability.

Fiber

A generic term that describes the serial media types supported by fibre channel, such as coaxial cable, optical, or twisted pair. (See also *Link*.)

Fibre Channel

The set of ANSI standards that describe the serial gigabit transport protocol that supports both channel and network users.

FLOGI

Fabric Login. The process in which a port establishes all network operating parameters between two participants. (See also *Fabric* and *Port Login*.)

Flow

One or more frames sent from one or more sources to one or more destinations that are tracked as a single entity. (See also *SmartFlow* and *Group*.)

F_Port

Fabric Port. A physical interface within a fabric (switch) that attaches to an N-port (node port) through a point-to-point connection. (See also *N_Port*.)

FL_Port

Fabric Loop Port. An F_port containing arbitrated loop functions.

Frame

The basic (indivisible) fibre channel unit of data transmission.

Frame Check Sequence

See “Cyclic Redundancy Check (CRC)” on page 626.

Frame Loss

In SmartBits applications, this is a test that measures the ability of a device to deliver variably-sized frames at different traffic loads.

Fully-meshed

The test traffic pattern in SmartWindow in which every port transmits to every port.

Gigabit

For fibre channel, 1,062,500,000 bits per second.

Gigabit Interface Converter (GBIC)

A type of port connector. In fibre channel, a removable transceiver module.

Group

A number of flows that have been logically combined for purposes of analyzing test results. Any flow can be included in a group, and the same flow can be included in more than one group.

Initiator

A server or workstation in a fibre channel network that starts transactions to disk or tape. (See also *Target*.)

Iteration

The smallest unit or phase of a test that occurs within the trials of a test. Iterations allow you to see how the performance of the DUT is affected by changes in a particular test parameter. A single trial can have many iterations, depending on the test configuration. (See also *Trial*.)

Jitter

The variation in latency between frames in a flow. This is also known as *latency standard deviation*.

LAN

Local Area Network. A high-speed network of computers and devices typically limited to a relatively small area (such as a single building or campus). It is connected by a link that allows any device (node) on the network to interact with any other device on the network. Typically, it is limited to a small area, such as a floor in a building, a building, or a campus.

Latency

The time interval between the transmission and reception of a frame. In SmartBits applications, this is a test that measures the ability of a device to manage prioritized traffic at different loads.

Latency Distribution

In SmartBits applications, this is a test that measures the latency across a user-defined distribution of eight possible time buckets. Compared to the Latency test, this test provides a more detailed view of latency behavior at the DUT load tolerance limits.

Latency Snapshot

In SmartBits applications, this is a test that provides the most magnified view at the DUT load tolerance limits.

Learning Phase

The initialization process that begins once a test is started. It consists of the following phases: establish hardware connections and configuration information, initialize ports, perform link initialization and device discovery procedures, and run the test.

Link

In fibre channel, the communications channel between two nodes or ports that carry information in to and out of a port.

Load

The rate at which a port transmits traffic as a percentage of full wire rate.

Loop

See *Arbitrated Loop*.

Loop Initialization

Part of the initialization process in a fibre channel arbitrated loop that assigns the Arbitrated Loop Physical Addresses (ALPAs) to new devices in the loop. The process also provides notification of changes in the topology and recovery from loop failure. (See also *Arbitrated Loop* and *Arbitrated Loop Physical Address*.)

Name Server Table

A table of known WWNs and their associated address IDs.

Node

A device that has at least one N_port or one NL_port.

N_Port

Node Port. A physical interface within a node that may attach to an F_port or directly to another N_port through a point-to-point connection. (See also *F_Port*.)

NL_Port

Node Loop Port. The end node ports in an arbitrated loop.

OX_ID

Originator exchange ID. The 16-bit identifier assigned by the exchange originator to a specific operation.

Pairs

The test traffic pattern in SmartWindow that consists of pairs of ports that transmit only within each pair. Traffic can be uni- or bi-directional.

PLOGI

Port Login. The process in which a port sends its port-to-port operating parameters to every port in the network that it needs to communicate with.

Point-to-Point (PT2PT)

A dedicated fibre channel connection (link) between two devices. (See also *Topology.)*

Port

Any type of physical device that connects a node to a network.

Port Name

See *World Wide Name*.

Private Discovery

A task in the learning phase that performs the port login process (PLOGI) for all physical addresses on the loop. (See also *Port Login* and *Learning Phase*.)

Private Loop

A free-standing arbitrated loop with no fabric attachments. (See also *Arbitrated Loop* and *Public Loop*.)

Public Discovery

A task in the learning phase that performs a name server query for remote public devices. (See also *Name Server Registration* and *Learning Phase*.)

Public Loop

An arbitrated loop attached to a (SAN) fabric switch. (See also *Arbitrated Loop* and *Private Loop*.)

R_RDY

An ordered set that is used to control the transmission of frames on a link. It indicates that a receiver has emptied a receiver buffer and is ready to receive another frame.

Request for Comments (RFC)

The document series used as the primary source for communicating information about the Internet.

Rx

The abbreviation for a SmartBits module receiving (destination) port.

SAN

See *Storage Area Network*.

Small Computer System Interface (SCSI)

A high-speed interface used to connect computers to SCSI peripheral devices.

SEQ_CNT

Identifies the location of individual frames within a sequence of multiple frames.

SEQ_ID

Sequence ID. The parameter in the 24-byte fibre channel message header that identifies a sequence of multiple frames.

SmartFlow

The term used in SmartFabric for a trackable entity that contains one or more flows. Each SmartFlow contains a series of frames that travel from one or more sources to one or more destinations and provides the ability to vary addresses and/or port numbers. Each variation comprises one flow. (See also *Flow* and *Group*.)

SmartMetrics

The Spirent Communications performance analysis system that measures how well devices and networks optimize, prioritize, and segment traffic at all network levels.

Source WWN

The world-wide name that identifies the sender of the frame.

Step Test Mode

The search mode used to determine the DUT or SUT maximum transmission rate with no frame loss or acceptable frame loss. This mode increases the rate by the same percentage (step) added to the current rate.

Storage Area Network (SAN)

A collection of servers, clients, switches, and routers that carry data traffic using SCSI and fibre channel (usually SCSI over fibre channel).

Switch

A device that provides full bandwidth per port and high-speed routing of data through logic level addressing. (See also *Topology*.)

System Under Test (SUT)

Multiple DUTs that are configured as a network or a system.

Target

A disk array or tape subsystem in a fibre channel network.

Throughput

In Smartbits applications, this is a test that measures the rate at which frames from flows and groups sent through a device can be sent without frame loss. In the

Throughput test, it measures the maximum transmission rate at which the DUT can forward traffic when not restricted by flow control.

Topology

The logical or physical arrangement of devices in a network configuration. Topology also refers to a specific way of connecting the components, such as point-to-point or arbitrated loop. (See also *Point-to-Point Arbitrated Loop* and *Fabric*.)

Traffic Distribution

The pattern (distribution) of the traffic flow during a test. In SmartWindow, the options are backbone, fully-meshed, and pairs.

Traffic Orientation

The direction of the traffic flow during a test. In SmartWindow, the traffic orientation can be uni-directional or bi-directional.

Trial

The unit or phase of a test run at a constant frame size. A trial allows you to repeat portions of the test at specific frame sizes to check the consistency of the DUT performance.

Tx

The abbreviation for a SmartBits module transmitting (source) port.

World-Wide Name (WWN)

A unique 64-bit address assigned to a fibre channel device during manufacturing. (See also *Source WWN* and *Destination WWN*.)

Test Using the FBC-3601A Module

The test setup for this example is as follows:

- One FBC-3601A module is installed in a SmartBits 6000x chassis.
- The SmartBits 6000x chassis is connected to a PC with SmartWindow using an Ethernet port.
- The two FBC-3601A ports are connected to two ports on the fibre channel switch (termed the DUT).

Note: This test setup uses one FBC-3601A module. Additional modules that support this test include the following:

- One FBC-3602A module can be substituted for the FBC-3601A module.

Figure 13-1 illustrates an example of a test setup using the FBC-3601A and FBC-3602A fibre channel modules.

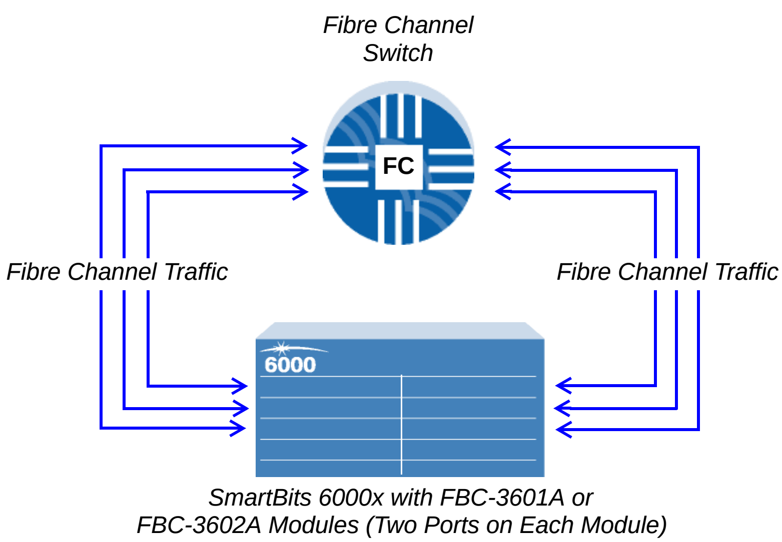


Figure 13-1. Test Setup for Fibre Channel / SAN Performance Analysis

Reserve the Module

To reserve the module:

1 Open SmartWindow.

Note: For the steps to start SmartWindow and connect to the target SmartBits, refer to *"Starting SmartWindow" on page 31*.

2 Reserve each module to be configured. Click anywhere on the module image except the port button, and choose **Reserve This Module** (*Figure 13-2*).

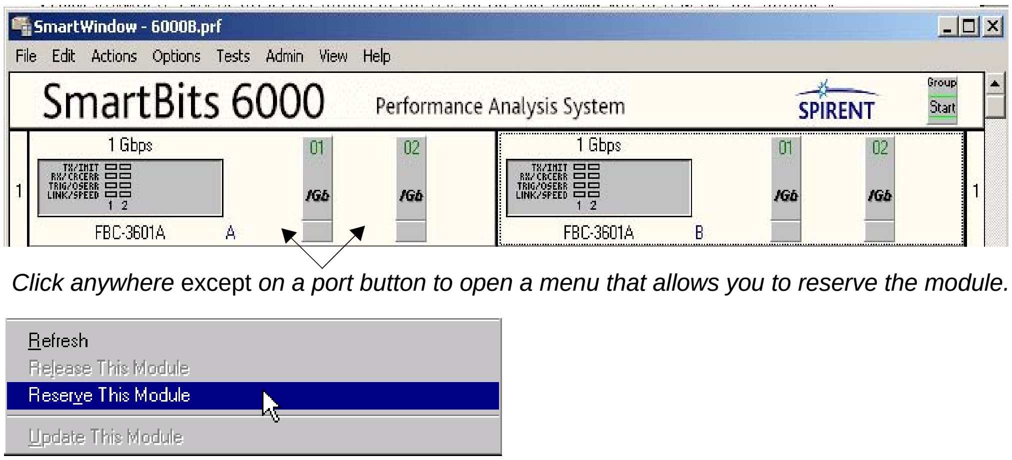


Figure 13-2. Reserving Modules

Before Test Traffic Can be Sent

When a module is reserved, the blue *Reserved for your use* indicator appears (*Figure 13-3*), but the port-button controls used to start or stop traffic are not enabled (or visible).

SmartWindow does not enable these controls until the steps are completed to bring the configuration to the “ready to test” state.

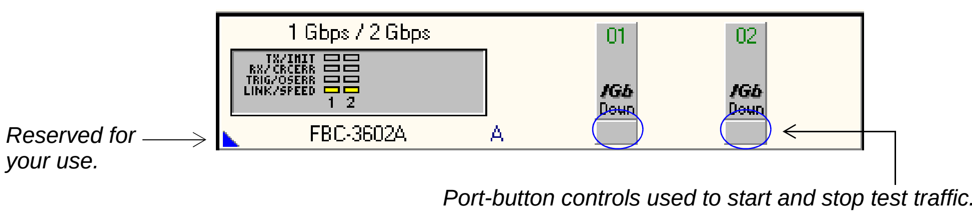


Figure 13-3. Port-button Controls

To make the status “ready to test”:

1 Create at least one stream.
See *“Set up One Stream on the Tx Port” on page 638*.

2 Update the configuration.
See *“Update the Configuration” on page 653*.

3 Send the Fibre Channel commands that bring the SmartBits module, the DUT, and the fabric to the “ready to test” state.
See *“Send Commands to Make “Ready to Test”” on page 656*.

Your configuration may include many other options and choices. After setting up the configuration, in every case you must:

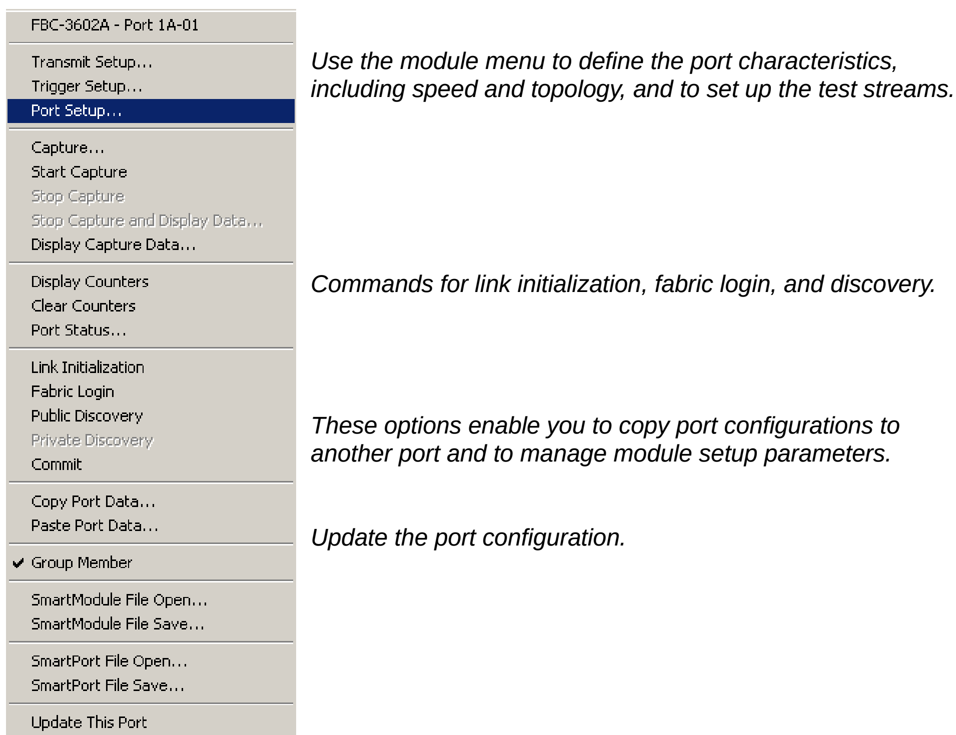
- Update in order to send the configuration to the FBC module and SmartBits chassis.
- Send the commands needed to make the test setup “ready to test.”

Set up the Port

Use port 1A-01 to transmit test frames and port 1A-02 to receive the frames from the switch.

To configure the transmitting port:

1 Click on the port button for port 1A-01 to open the module menu for the Tx port.



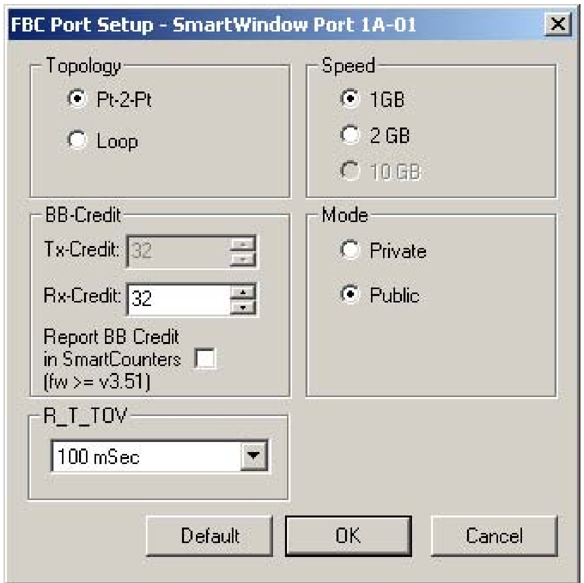
2 Select the **Port Setup** option.

The *FBC Port Setup* dialog box displays (*Figure 13-4 on page 636*) and is used to set up global port characteristics.

3 In the *Topology* pane, select the fibre channel topology. For this example, select the **Loop** checkbox.

The two options are point-to-point (*Pt-2-Pt)* and arbitrated loop (*Loop)*.

When the point-to-point topology is selected, the transmitting and receiving fibre channel ports behave as if they have direct connection through the fibre channel switch (*Figure 13-5*). Only the WWN of the first stream is used (though multiple streams may be sent).



Use the FC Port Setup *dialog to define the test topology, port speed, and other port-related values.*

Figure 13-4. FBC Port Setup Dialog

When the arbitrated loop topology is selected, the transmitting fibre channel port can emulate up to 126 devices communicating through the FC switch to the storage system (*Figure 13-6 on page 637*).

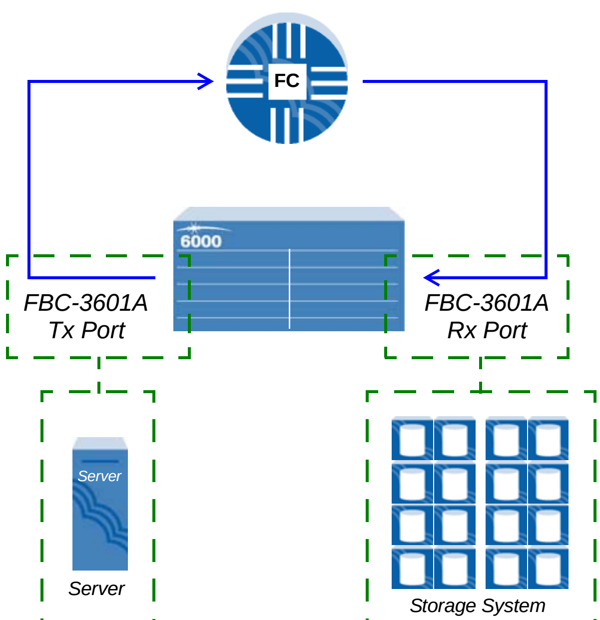


Figure 13-5. Point-to-point Topology

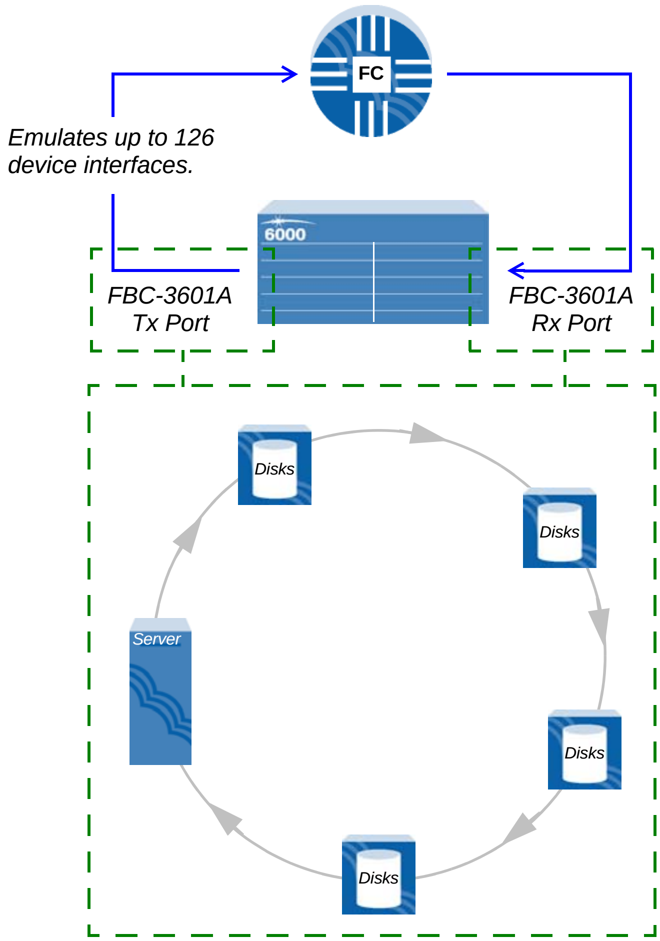


Figure 13-6. Arbitrated Loop Topology

4 Set the BB-credit for the port in the *BB-Credit* pane. BB-credit is the value that the port advertises to the switch for flow control.

When the mode is set to *Private*, both the *Tx-Credit* and *Rx-Credit* fields are enabled. When the mode is set to *Public,* only the *Rx-Credit* field is active.

- The *Tx-Credit* field value represents the total number of buffers available for holding class 2 and class 3 frames to be transmitted to the logged-in Nx_port. This parameter is used for buffer-to-buffer flow control in the direction from the fibre channel port to the logged-in Nx_Port.
- The *Rx-Credit* field value is the maximum number of receive buffers available for holding class 2 and class 3 frames received from the logged-in Nx_port. This parameter is used for buffer-to-buffer flow control in the incoming direction from the logged-in Nx_port to the fibre channel port.

BB-credit values can be reported in SmartCounters by selecting the *Report BB Credit in SmartCounters* checkbox. (Module firmware must be version 3.51 or greater.)

5 Set the port speed to either 1 Gbps (FBC-3601A or FBC-3602A) or 2 Gbps (FBC-3602A only).

6 Set the **Mode** to **Private** or **Public**. Guidelines are as follows:

- *Pt-2-Pt Public* establishes a point-to-point connection between two devices through a switch. This setting can be used to test “active” devices that respond to fibre channel signaling (such as FLOGI and PLOGI).
- *Pt-2-Pt Private* establishes a dedicated connection (link) between two devices. This setting can be used to test “passive” devices that do not respond to fibre channel signaling (such as FLOGI and PLOGI).

7 The Receiver_Transmitter_Timeout Value (R_T_TOV) is used by the receiver logic to detect loss of synchronization. The default value is 100ms. Select one of the defined values from the drop-down menu, if required.

8 When settings are correct, click **OK**.

Set up One Stream on the Tx Port

For this example, two streams are set up: one on the Tx port, and one on the Rx port. (See *“Add a Stream on Port 1A-02” on page 650* for information on the receive port.) The FBC-360*x*A module is connected to a fibre channel switch.

To set up one stream:

Stream on port 1A-01

1 Click the port button and select **Transmit Setup** (*Figure 13-7*).

The *Streams Setup* dialog box opens. The radio buttons in the *Global Settings* pane enable you to define the schedule mode.

2 Select gap-based traffic with the default interframe gap of six fibre channel words by clicking the **IFG** button and accepting the default of **6** in the *Words* field.

Note: See *“Defining the Schedule Mode” on page 639* for a detailed description of how these options are used.

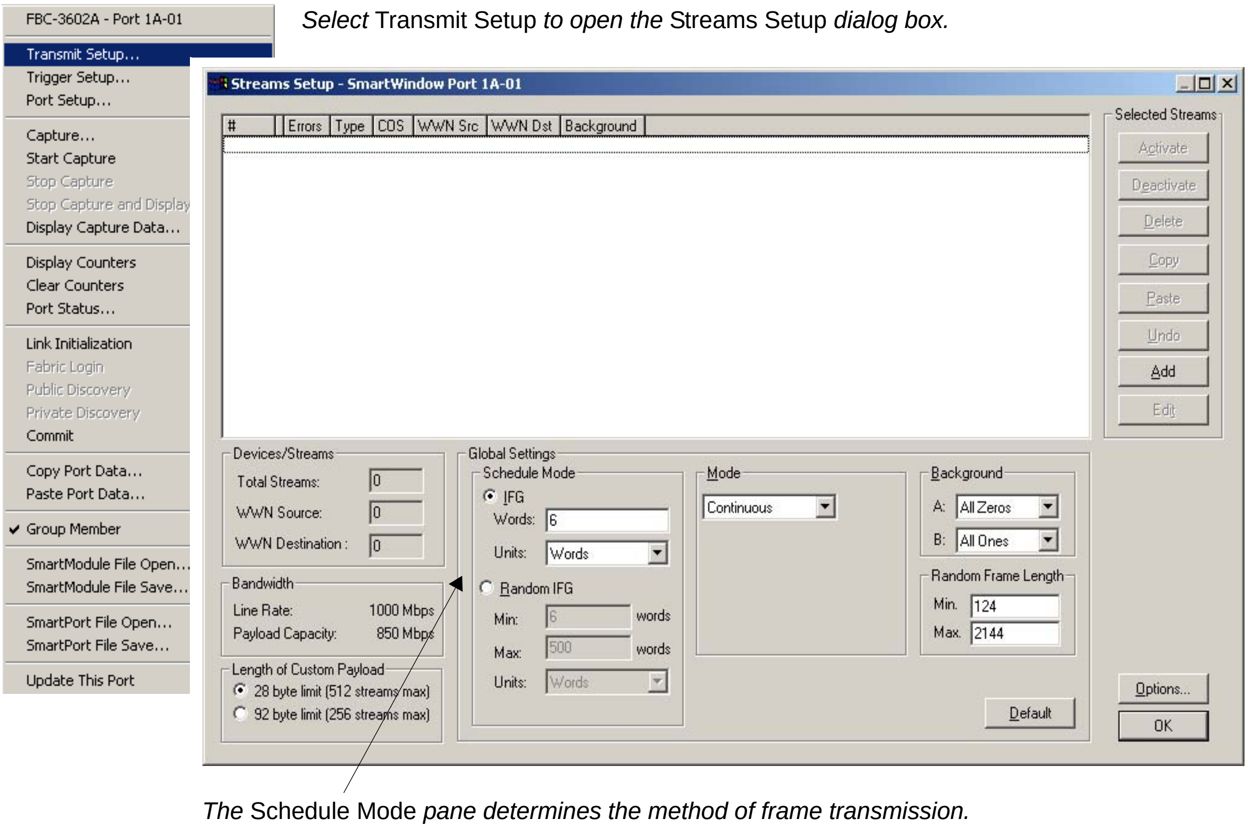


Figure 13-7. Select Transmit Setup

Defining the Schedule Mode

The *Streams Setup* dialog box provides options for defining how the module schedules the streams that it transmits. Set these options before the streams are added, since the defined schedule mode applies globally to all streams sent through the port.

In the *Global Settings* pane of the *Streams Setup* dialog box (*Figure 13-8*), the *Schedule Mode* fields provide options for frame scheduling based on:

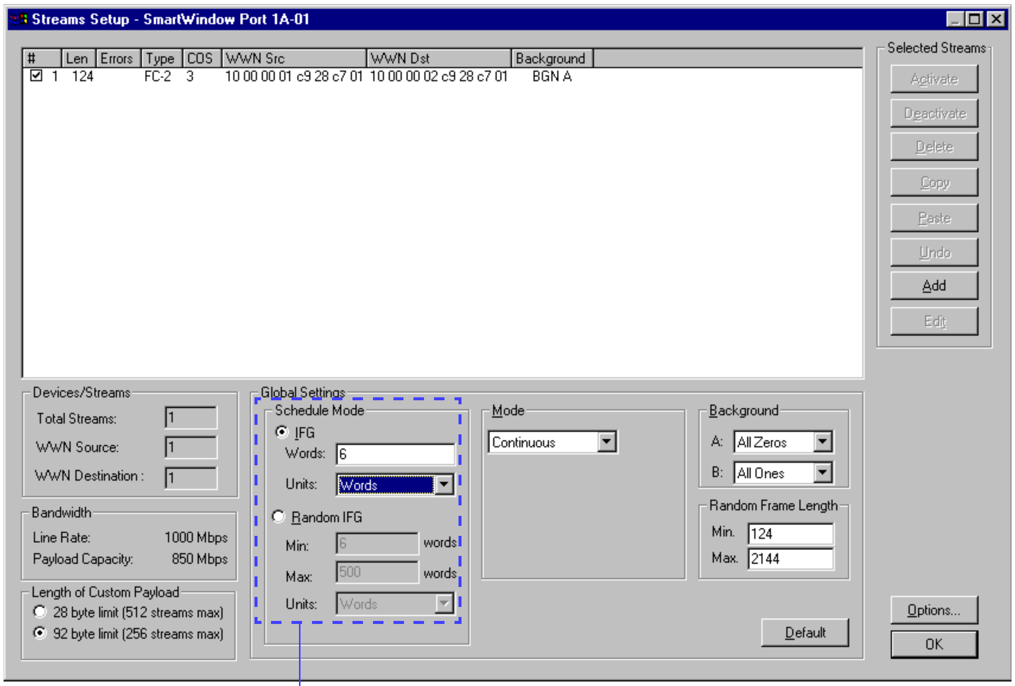
- *IFG* — Interframe Gap: a fixed number of words between frames
- *Random IFG* — A varying number of words between frames.

The selected scheduling mode applies to all streams generated by the port. Test traffic is sent in a round-robin fashion, with one frame from each stream generated in sequence.

About the stream scheduler

The scheduler is a software mechanism that calculates how to allocate line bandwidth to the streams that have been created. It calculates a scheduling table, organizing all streams for transmission before any traffic is sent.

The schedule table is static (i.e., does not vary as test traffic is sent) even though the *Random IFG* option appears to be dynamic in behavior, because it allows varying interframe gaps.



These options set the schedule mode and apply to all streams sent through the port.

Figure 13-8. Schedule Mode Parameters in the Streams Setup Window

Traffic Based on Interframe Gap

The default value for the *IFG* schedule mode sets the minimum legal interframe gap for the transmission medium, which is six FC words. However, a value as low as two FC words can be set. For *Random IFG* mode, the gap can vary between the legal minimum and a maximum that is specified.

Use the *Units* field drop-down list to view the IFG in terms of time values, frames per second, or utilization of line bandwidth.

Selecting the IFG value.

At 1 Gbps, the default IFG (six words) allows 100% utilization of bandwidth. This corresponds to a frame rate of 699015.8 fps (*Figure 13-9 on page 641*).

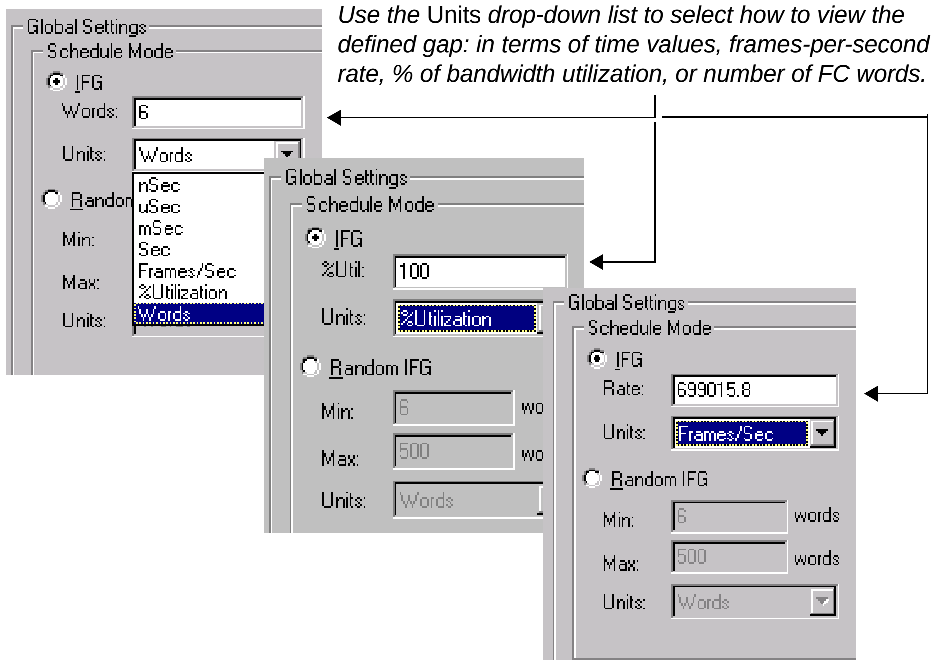


Figure 13-9. Selecting Units for Interframe Gap

Traffic Based on Random Interframe Gap

With *Random IFG* mode, a random number generator on the module produces gaps of varying sizes within the bounds defined using the *Min.* and *Max.* fields in the *Streams Setup* window. The gaps are inserted between frames. Test traffic is then sent with the selected frame size at the maximum line rate.

Use the *Units* field drop-down list to view the selected gap range in terms of time values, frames per second, or utilization of line bandwidth.

Scheduling by Interframe Gap

When *IFG* or *Random IFG* is selected as the schedule mode, the module sends out test frames separated by the interframe gap that is specified. The frames of each stream are sent in a round-robin order.

The default values for *IFG* set the minimum legal interframe gap for the transmission medium. This establishes full load on the transmission medium. For *Random IFG* mode, the gap can vary between the legal minimum and a maximum that you specify.

When *IFG* or *Random IFG* is selected as the mode, the default gap is measured in fibre channel words, with a default setting of six words.

For both fixed and random IFG, the minimum value for word-based gap is two words.

Schedule Mode Selection	Minimum (Words)	Maximum (Words)
IFG	2 (Default=6)	Depends on selected frame length (without FCS) to maintain word boundary.
Random IFG	2 (Default=6)	

To change the unit of measure:

Use the *Units* option to change the unit of measure to a time-based unit, such as nanoseconds.

To convert FC words to nanoseconds:

Use the following formula (given four bytes to a word):

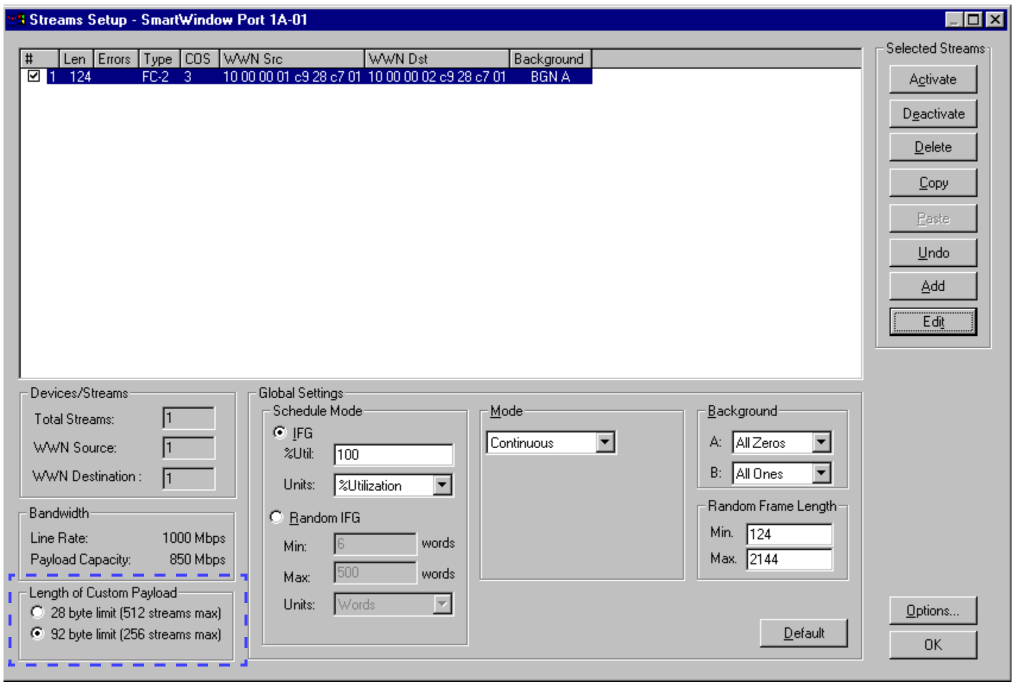
Port Speed	Formula to Convert Words to Nanoseconds
1 Gigabit	Y Words = X nanoseconds / 37.6
2 Gigabit	Y Words = X nanoseconds / 18.8

Set a Custom Payload Length

Select a maximum custom payload length of either 28 bytes or 92 bytes. This is a global setting that applies to all test streams generated through the port. The length (without FCS) that is selected affects the total number of streams that can be active:

- With a 28-byte payload limit, up to 512 active streams are possible.
- With a 92-byte payload limit, up to 256 active streams are possible.

These limits are for active streams. More streams can be created, but only the maximum number of streams may be enabled (i.e., selected in the # column of the *Streams List*).



Select a custom payload length here. This setting applies to all streams sent by the port.

Figure 13-10. Selecting Custom Payload Length

If a 92-byte maximum payload length is selected, the resulting frame length (including the 36-byte fibre channel header) is at least 128 bytes, without signature field. However, the default stream length is 124 bytes. To get the full payload length, be sure to increase the overall frame length (without FCS) when setting up streams. The payload length is reduced if overall frame length (without FCS) is too short to accommodate the specified payload.

Payload length with signature field

In addition, payload length is reduced by 18 bytes when the SmartMetrics *Signature Field* checkbox is selected. The *Signature Field* checkbox is selected by default. If needed, disable it by editing the stream and clearing the *Signature Field* checkbox. (See *Figure 13-12 on page 646*.)

To modify the payload contents:

Edit the payload contents by editing the stream definition.

1. Highlight the stream entry, then click the **Edit** button in the *Selected Streams* pane.
2. When the *Tx Control Panel* window opens, click the **FC-2** button in the *Edit Protocol Stack* pane.
3. In the *SETUP: FC-2 (Fibre Channel-2) Protocol* pane, select the **Customize Payload** checkbox, then click the **Edit** button.
4. Use the Frame Editor to modify the contents of the frame payload.

Payload Length and Frame Length

In *Figure 13-11 on page 645*, the payload length is shown as 68 bytes, even though the maximum length of custom payload was set to 92. (See *Figure 13-10 on page 643*.) This payload length value is calculated as frame length (124 bytes) (without FCS) minus fibre channel frame header (36 bytes) minus the signature field (18 bytes), and rounded up to the four-byte boundary.

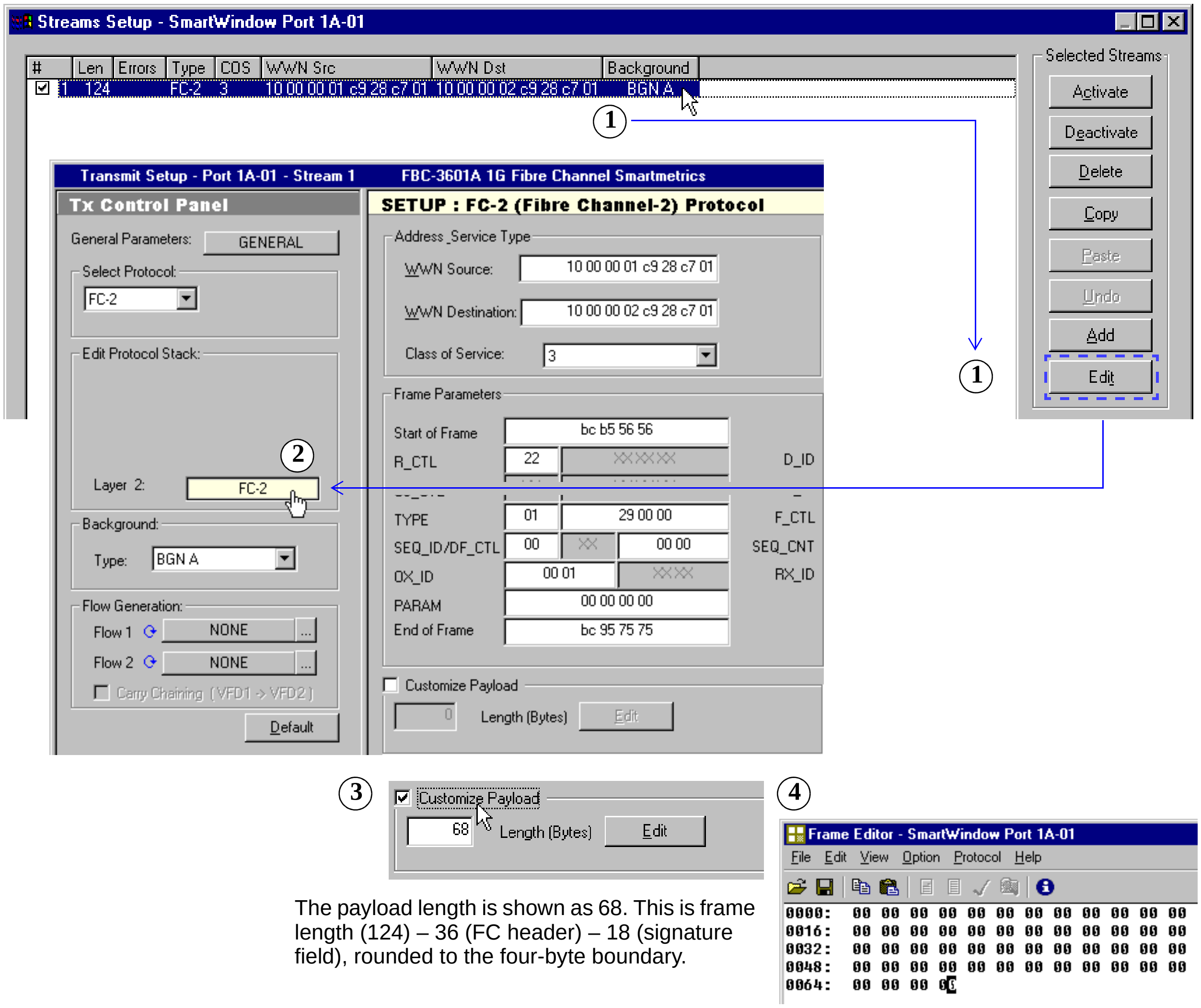


Figure 13-11. Selecting Custom Payload Length

To achieve the maximum possible payload length (92 bytes):

1. In the *Tx Control Panel* window, click the **General** button to open the *General Stream Setup* dialog box. (See *Figure 13-12 on page 646*.)
2. Increase the frame length (without FCS).
3. Clear the *Signature Field* checkbox, if required.

Note: Clearing the *Signature Field* checkbox disables SmartMetrics test results.

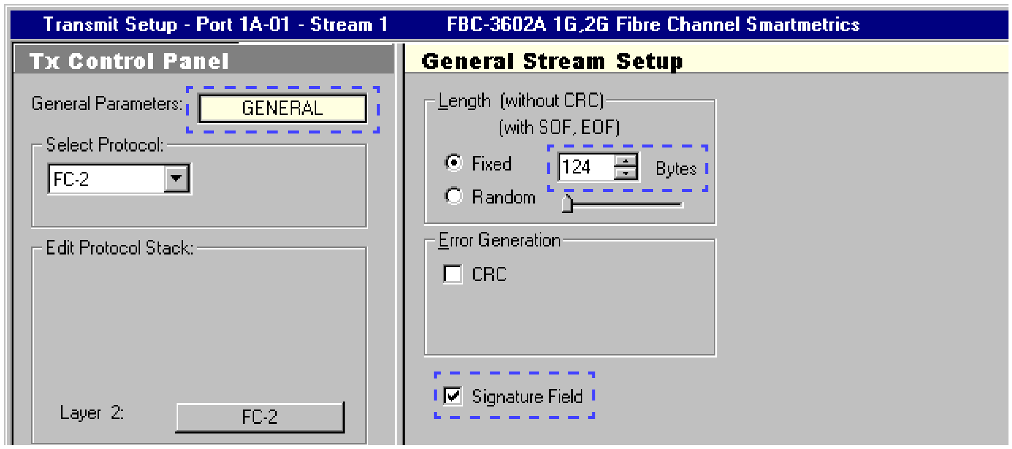


Figure 13-12. Adjusting Frame Makeup to Accommodate Payload Length

Add a Stream on Port 1A-01

To add one stream:

1 Select **IFG** in the *Global Settings* pane of the *Streams Setup* window.

2 Click the **Add** button in the *Selected Streams* pane.
The *Add Streams* dialog box appears (*Figure 13-13*).

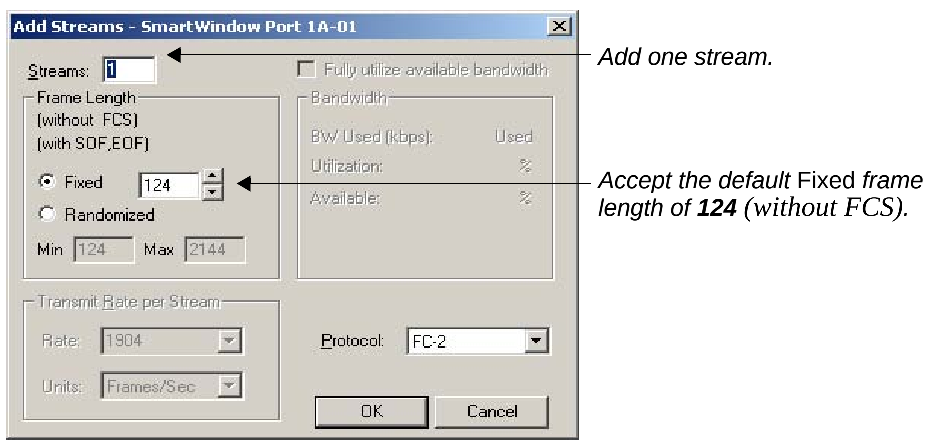


Figure 13-13. Add Streams Dialog

3 Accept fixed frame length (i.e., the *Fixed* radio button is selected) and the default frame length of *124* (without FCS).

4 Accept the default *Protocol* value of *FC-2*.

5 When settings are correct, click **OK**.
The *Streams Setup* window reappears.

How to select frame size for FC tests.

The *Add Streams* dialog box proposes a default frame length (without FCS) of 124 bytes. The smallest frame size allowed is 32 bytes without signature field, or 52 bytes with signature field.

These lengths are based on a minimum fibre channel frame length (without FCS) of 36 bytes, plus 18 bytes for the SmartBits signature field. (A data integrity marker currently cannot be inserted.) In addition, the frame size must be divisible by four.

Thus, the default minimum frame size is:

<u>FC Frame</u>+	<u>Signature Field</u>=	<u>Total</u>
36 +	18 =	54 bytes > *rounded up* > 56 bytes

The fibre channel frame includes the following fields:

4 bytes	24 bytes	4 bytes	4 bytes
Start of Frame	FC2 Protocol Header	CRC	End of Frame

To set a smaller frame size:

Reduce the frame size to 32 bytes by editing a stream and clearing the SmartBits *Signature Field* checkbox after the stream has been added.

1 Add the stream, following *Step 1 on page 646* through *Step 5 on page 647*.

2 Highlight (click) the stream in the *Streams Setup* window.

3 Click the **Edit** button in the *Selected Streams* pane.

4 In the *Tx Control Panel* window, clear the **Signature Field** checkbox.

5 Adjust the frame size downward, as required. (Minimum is 32 bytes.) See *Figure 13-14 on page 648*.)

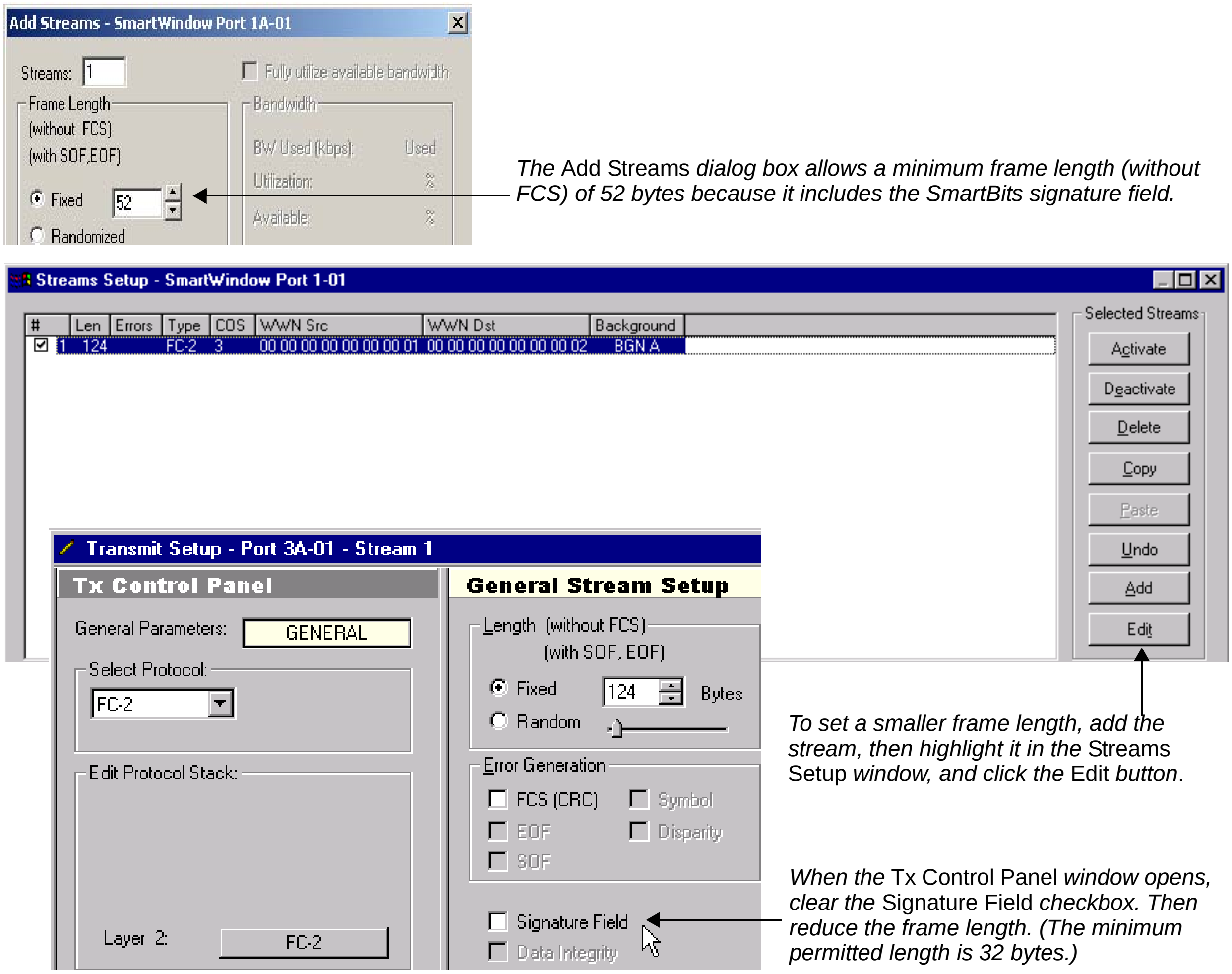


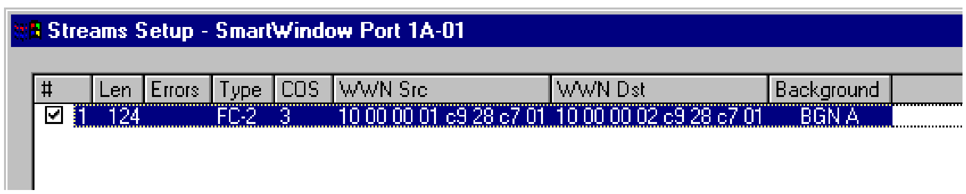
Figure 13-14. Reducing Frame Size

Review WWNs for the Stream on Port 1A-01

Review the World-Wide Name (WWN) source and destination addresses for the stream. SmartWindow sets default WWNs when it adds the stream. These emulate typical values but also include the slot and port location in the chassis. For this example, the sending SmartBits port (1A-01) has the WWNs shown in *Figure 13-15 on page 650*. When the receiving SmartBits port (1A-02) is set up, it automatically has the complementary WWNs needed for communications between the two ports, because it is the second port on the same module. (See *"Review WWNs for the Stream on Port 1A-02" on page 651*.)

To edit the WWN Src and WWN Dst fields:

1 Double-click directly in the field, then enter the desired value or
Click the stream to highlight it, then select the **Edit** button to open the *Tx Control*



Panel window. In this window:

a Click the **FC-2** button in the *Edit Protocol Stack* pane.

b Set the required values in the *SETUP: FC-2 (Fibre Channel-2) Protocol* pane.

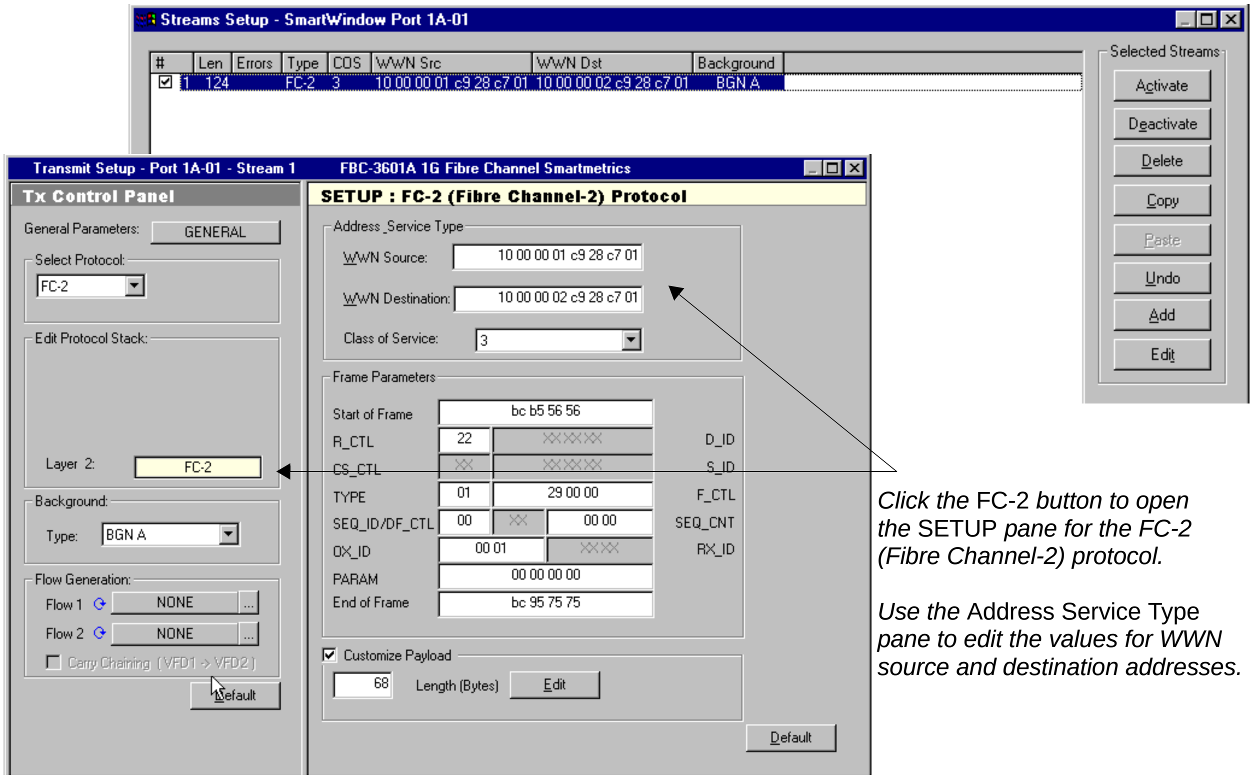


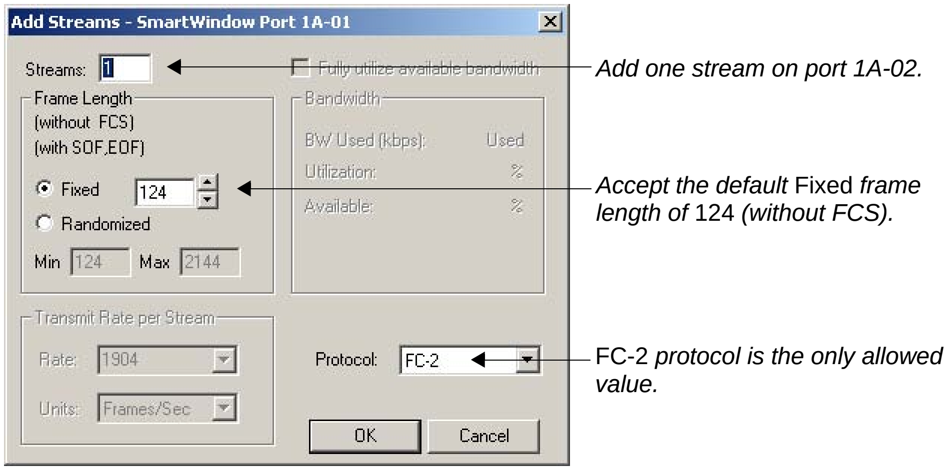
Figure 13-15. Default WWNs for Transmitting Port 1A-01

Add a Stream on Port 1A-02

Configure the port and stream for receiving port 1A-02.

To add a stream on port 1A-02:

1. Click the port button 02 on the FBC-3601A module.
2. Select **Port Setup,** and repeat the port setup that was performed for the transmitting port 1A-01. (See *"Set up the Port" on page 635*.)
3. Select **Transmit Setup** from the module menu to open the *Streams Setup* window.
4. Click the **Add** button in the *Selected Streams* pane.
5. Use the *Add Streams* dialog box to add one stream with the same characteristics that were applied in *"Add a Stream on Port 1A-01" on page 646*.
6. When settings are correct, click **OK** to return to the *Streams Setup* window.



Review WWNs for the Stream on Port 1A-02

SmartWindow assigns default WWNs that resemble "real-world" contents. The WWNs also include the SmartBits slot and port location. As a result, the source and destination WWNs for the stream on the receiving port are correct for this example since they need to be the complement of the WWNs for sending port 1A-01, as shown in *Figure 13-16*. Consequently, the sending and receiving ports "point" to one another.

Note: Edit the default WWNs as appropriate for the test. The only requirement is that the source and destination addresses point to each other between the sending and receiving ports.

On the receiving port, the WWNs need to be the complement of the source and destination WWNs that are set on the transmitting port.

Transmitting Port 1A-01	Receiving Port 1A-02
WWN Source	**WWN Source**
10 00 00 **01** c9 28 c7 01	10 00 00 **02** c9 28 c7 01
WWN Destination	**WWN Destination**
10 00 00 **02** c9 28 c7 01	10 00 00 **01** c9 28 c7 01

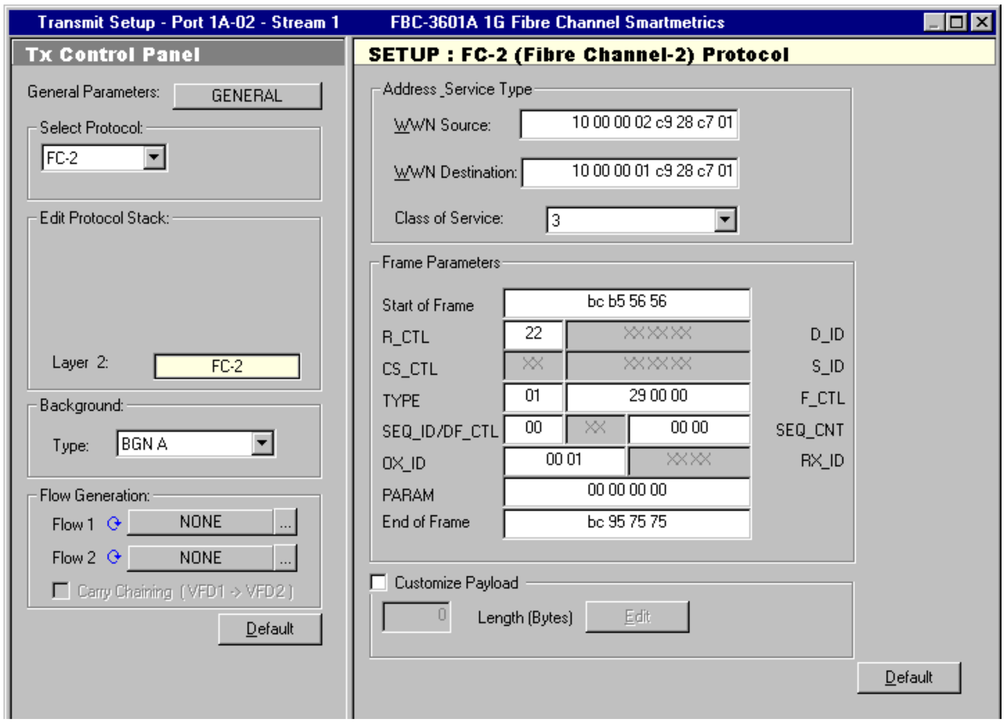
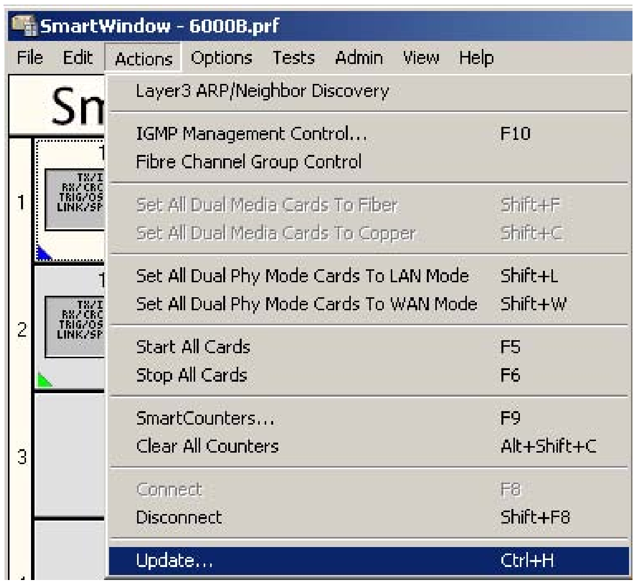


Figure 13-16. WWNs on the Receiving Port 1A-02

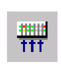
Update the Configuration

To send the configuration to the module:

1 Select **Actions** > **Update** from the main menu.



Or

Click the **Update** button  on the toolbar.

Or

Select **Update This Module** from the module general menu.

(To open this menu, click anywhere on the module image except the port button. See *Figure 13-17 on page 654*.)

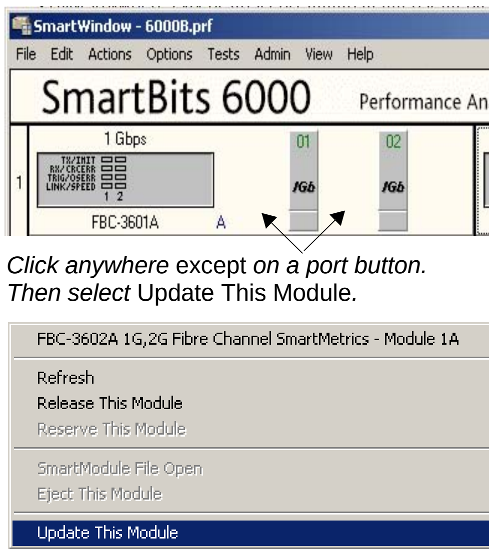


Figure 13-17. Update the Module

Important: Each time the configuration is updated, send the fibre channel commands needed to make the test setup “ready to test”. (See *“Send Commands to Make “Ready to Test”” on page 656*). Exceptions are stated in *“Modify Parameters Immediately, Whenever Needed”*.

Modify Parameters Immediately, Whenever Needed

In general, any time the configuration is modified in a way that affects frame length (without FCS) or content, perform the following:

- Update the module with the new parameter values (*“Update the Configuration” on page 653*) *— and —*
- Send the fibre channel commands needed to bring all test elements to the “ready to test” state (*“Send Commands to Make “Ready to Test”” on page 656*).

Modifying any fields in the *Tx Control Panel* window requires both an update and the fibre channel commands (*Figure 13-18 on page 655*).

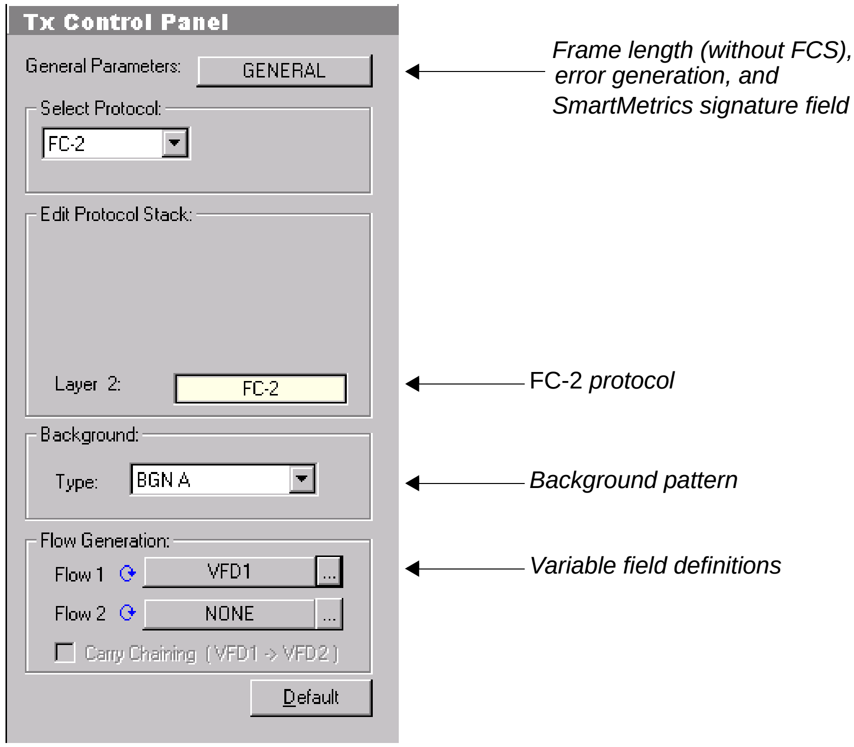


Figure 13-18. Parameters That Require Update and FC Commands

There are exceptions. However, two parameters can be modified immediately, whenever needed:

- Trigger configuration
- Interframe gap.

Modify the values of these parameters, and then proceed with the test, without sending the fibre channel commands.

Send Commands to Make "Ready to Test"

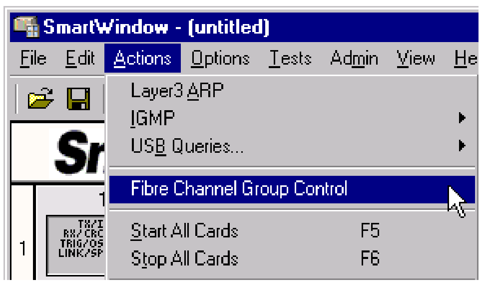
After the configuration has been updated (*"Update the Configuration" on page 653*), bring all test elements to the "ready to test" state by sending specific commands.

Different commands are required depending on the test topology. (See *"Set up the Port" on page 635*.) SmartWindow automatically allows only the commands that are needed for the topology that has been chosen for the test.

The needed commands can be sent in several ways.

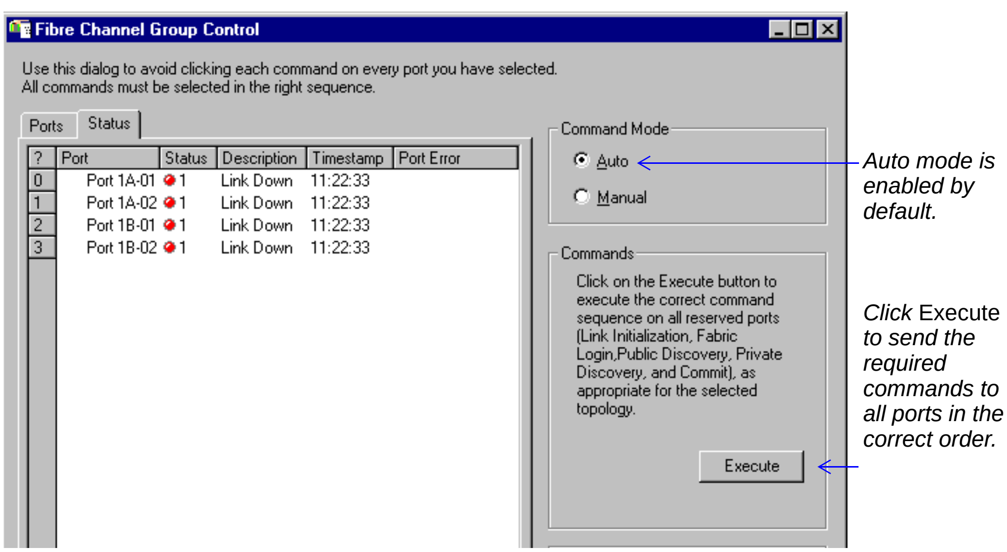
To use the fibre channel group control options:

1. Select **Actions** > **Fibre Channel Group Control** from the SmartWindow main menu. This option is active only when SmartWindow is connected to the chassis.



2. In the *Fibre Channel Group Control* window, the *Command Mode* pane shows the selected mode. The *Auto* mode is enabled by default.

   When *Auto* mode is selected, the needed commands for all reserved ports can be sent, in the correct sequence, by clicking the *Execute* button.



3 If the *Manual* mode is selected, the *Commands* pane presents commands individually. Only the commands required for the selected test topology are enabled. Use this mode to send commands to ports manually.

4 Click each command in sequence, starting at the top, to send each command to all ports shown in the list. Remember that commands not required for the selected topology are not available for execution.

— *or* —

Select a port in the list and click to send the desired command(s).

Important: Be careful to observe status information as each command executes. Wait for each command to finish before sending the next command in the sequence.

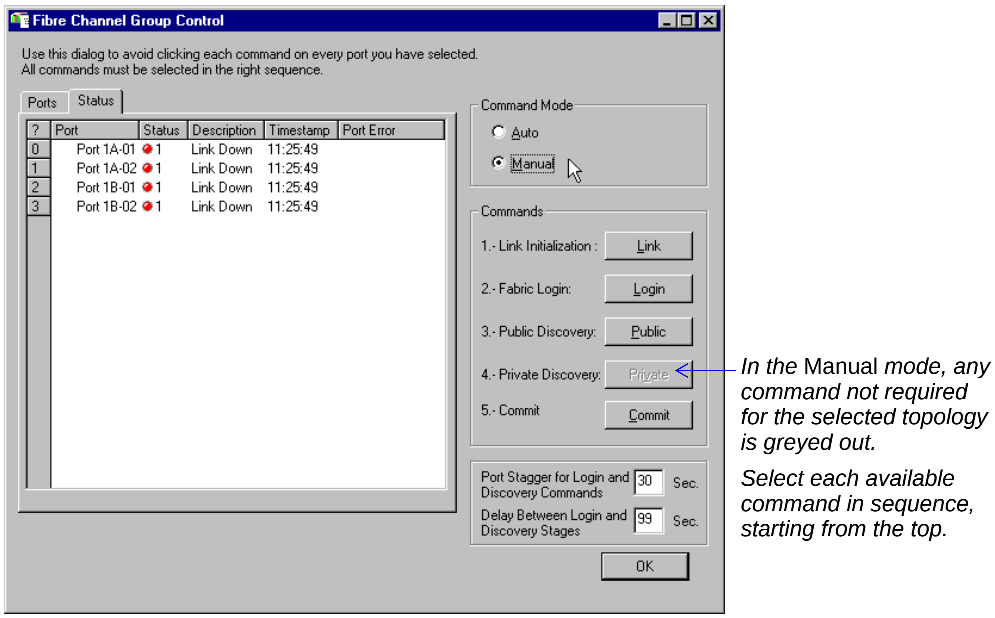


Figure 13-19. Sending Commands Manually

Setting delays on command execution.

Use two option fields in this window to manage the output of FC messages:

- *Port Stagger for Login and Discover Commands* field: Sets an optional pause (port stagger) between the login and discovery commands that the fibre channel module sends to individual DUT ports. In some cases, the FBC module may send these commands faster than the DUT can process them. This delay gives the DUT time to create source WWNs (port addresses). Range: 1 to 30 seconds.
- *Delay between Login and Discovery Stages* field: Sets a delay between the login and discovery stages to ensure that the switch has time to update the rest of the fabric on which ports (WWNs) are connected locally. Range: 1 to 99 seconds.

Using *Figure 13-19* as an example, perform the following steps:

1 Update the configuration (*“Update the Configuration” on page 653*).

2 Open the **Fibre Channel Group Control** dialog box, and click the **Manual** button in the *Command Mode* pane.

3 Click the **Link** button to send the link command.
Watch the *Status/Description* pane for *Link Up* and the indicator on the port button.

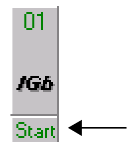
4 Click the **Login** button to send the login command.
Watch the *Status/Description* pane for *Device Login Complete*.

5 Click the **Public** button to send the public command.
Watch the *Status/Description* pane for *Public Discovery Complete*.

6 Click the **Commit** button to send the commit command.
Watch the *Status/Description* pane for *Ready to Test*.

Now the *Start* control appears on the module port button.

You are ready to send test traffic.



To use the port status options from the module menu:

Use this method to send fibre channel commands to an individual port.

1 Select **Port Status** from the module menu.
The *FBC Status* dialog box opens. In the *Commands* pane, SmartWindow enables only the commands that are required for the selected test topology.

2 Click each command button in sequence, by number. The commands are sent to the port.

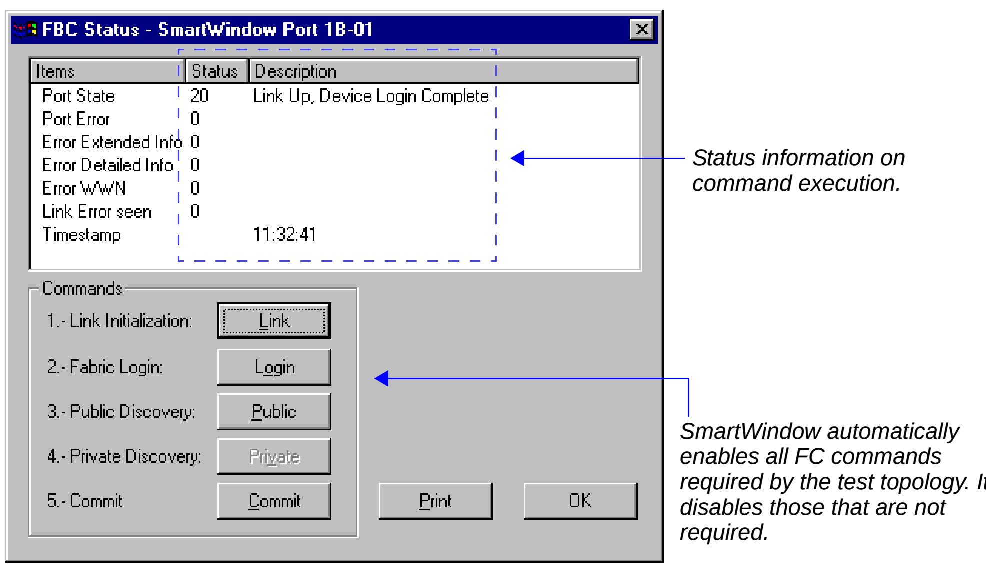


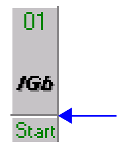
Figure 13-20. Using the FBC Status Window to Send Fibre Channel Commands

Important: Be careful to observe status information as each command executes. Wait for each command to finish before sending the next command in the sequence.

Using *Figure 13-20 on page 658* as an example, perform the following steps:

1. Update the configuration (*"Update the Configuration" on page 653*).
2. Open the *FBC Status* dialog box.
3. Click the **Link** button to send the link command.
   Watch the *Status/Description* pane for *Link Up*.
4. Click the **Login** button to send the login command.
   Watch the *Status/Description* pane for *Device Login Complete*.
5. Click the **Public** button to send the public command.
   Watch the *Status/Description* pane for *Public Discovery Complete*.
6. Click the **Commit** button to send the commit command.
   Watch the *Status/Description* pane for *Ready to Test*.

Now the *Start* control appears on the module port button.



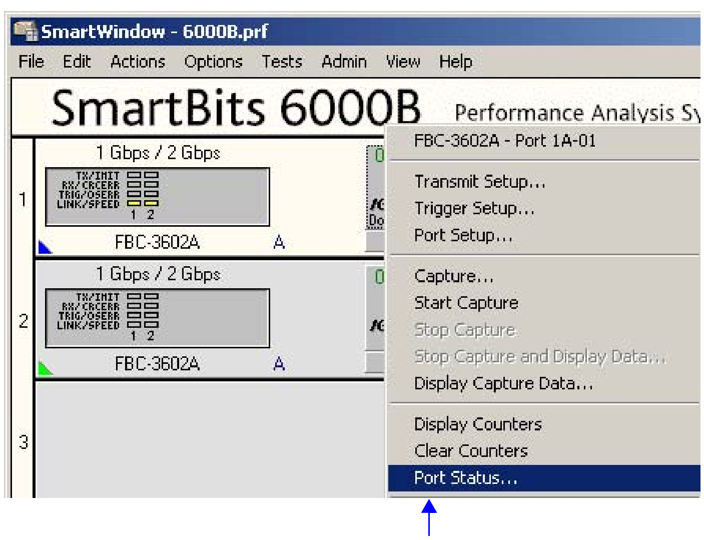
You are ready to send test traffic.

To send commands from the module menu:

Fibre channel commands can be sent directly from the module menu.

Important: Be careful to enter the required commands and to follow the order of commands as shown on the menu. Be sure to observe status information as each command executes.

1. Open the *Port Status* window by selecting the option from the port menu.
2. Wait for each command to finish before sending the next command in the sequence.



Open the *Port Status* window to observe command execution.

Send Traffic and View Counters

For complete information on SmartCounters, see *Table 13-2* for a listing of locations in this manual that describe how to display, configure, and run SmartCounters.

Table 13-2. Information on SmartCounters

Information	Location
Design of SmartCounters	*"SmartCounters Structure" on page 416*
Pre-defined views	*"Results Framework" on page 417*
Setting formulas	*Step 4 on page 427*
Running SmartCounters	*"Running SmartCounters" on page 435*

Choosing *Actions* > *SmartCounters* enables you to view SmartCounters.

After you've completed the necessary set up and configuration steps, initiate the test and review the initial data. As the test is run, watch the counters on the receive port.

Note: In fibre channel transmissions, frame sizes can be up to 16,384 bytes, including CRC. This value is displayed in the counters using the constructs described in *Table 13-3*.

On the receive port, the frame count includes frames greater than 2,152 bytes (with CRC) as Rx oversize frames and not as Rx frames. Received oversized frames are not counted as Rx frames but counted as Rx oversize frames. If the received frame size is less than 2,152 bytes, then it is counted as an Rx frame.

Table 13-3. Fibre Channel Frame Sizes for Oversized Frames

Frame Construct	Description
Tx frames	Tx frames and no Rx frames
Tx frame rate	Tx frame rate and not Rx frame rate
Tx class 2/3 frames	Tx class 2/3 frames and no Rx Class 2/3 frames
Rx oversize frames	Rx oversized frames and no Tx oversized frames

To begin transmission of the SmartWindow front panel:

1 Click the **Start** button on the transmitting FBC port 1A-01.

2 To view statistics on the receiving port 1A-02, click the port button, then choose **Display Counters** from the menu. This opens the *Results Framework* window. (See *Figure 13-21* and *Figure 13-22*.)

Refer to *"Configuring Transmit Streams on TeraMetrics Modules" on page 392* and *"Running SmartCounters" on page 435* for a complete description of how to access, configure, and analyze SmartCounter data using the *Results Framework* window and other SmartCounter windows.

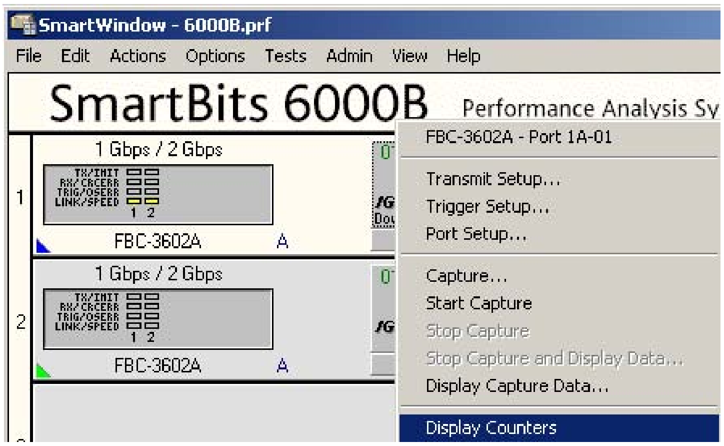


Figure 13-21. Display Counters

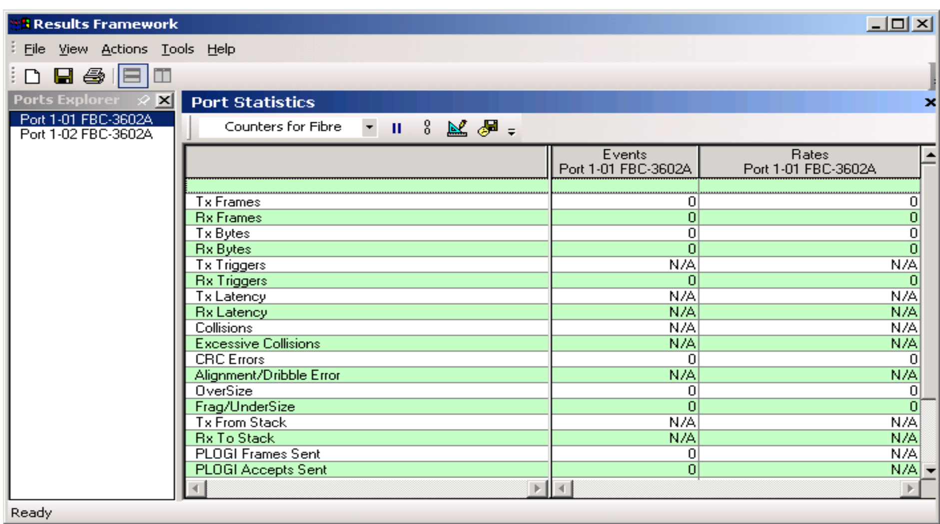
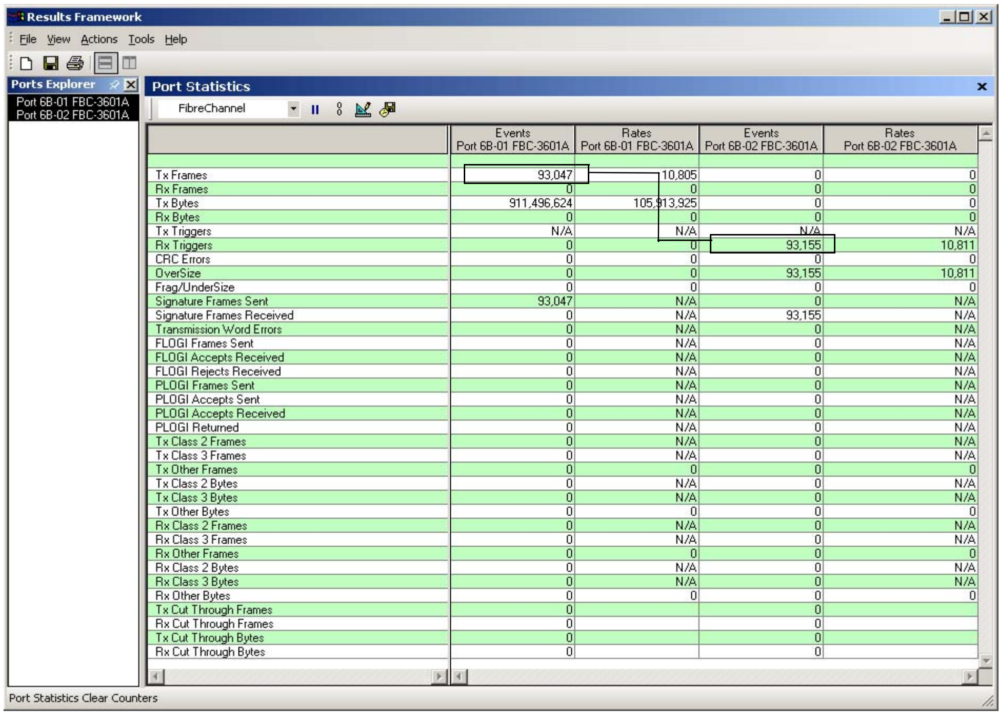


Figure 13-22. SmartCounters Results Framework

Oversize Frames in Fibre Channel Tests

A fibre channel port can transmit jumbo frames of up to 16,384 bytes with FCS. The receiving port truncates any frames larger than 2,152 bytes (with FCS) to the largest legal frame size (2,148 bytes). It counts the frames as Rx oversize frames, not as Rx frames.

See *Figure 13-23*. In this example, port 6B-01 is sending jumbo frames of 16,380 bytes to port 6B-02. In the reverse direction, port 6B-02 is sending 124-byte frames to port 6B-01.



	Events Port 6B-01 FBC-3601A	Rates Port 6B-01 FBC-3601A	Events Port 6B-02 FBC-3601A	Rates Port 6B-02 FBC-3601A
Tx Frames	93,047	10,805	0	0
Rx Frames	0	0	0	0
Tx Bytes	911,496,624	105,913,925	0	0
Rx Bytes	0	0	0	0
Tx Triggers	N/A	N/A	N/A	N/A
Rx Triggers	0	0	93,155	10,811
CRC Errors	0	0	0	0
OverSize	0	0	93,155	10,811
Frag/UnderSize	0	0	0	0
Signature Frames Sent	93,047	N/A	0	N/A
Signature Frames Received	0	N/A	93,155	N/A
Transmission Word Errors	0	N/A	0	N/A
FLOGI Frames Sent	0	N/A	0	N/A
FLOGI Accepts Received	0	N/A	0	N/A
FLOGI Rejects Received	0	N/A	0	N/A
PLOGI Frames Sent	0	N/A	0	N/A
PLOGI Accepts Sent	0	N/A	0	N/A
PLOGI Accepts Received	0	N/A	0	N/A
PLOGI Returned	0	N/A	0	N/A
Tx Class 2 Frames	0	N/A	0	N/A
Tx Class 3 Frames	0	N/A	0	N/A
Tx Other Frames	0	0	0	0
Tx Class 2 Bytes	0	N/A	0	N/A
Tx Class 3 Bytes	0	N/A	0	N/A
Tx Other Bytes	0	0	0	0
Rx Class 2 Frames	0	N/A	0	N/A
Rx Class 3 Frames	0	N/A	0	N/A
Rx Other Frames	0	0	0	0
Rx Class 2 Bytes	0	N/A	0	N/A
Rx Class 3 Bytes	0	N/A	0	N/A
Rx Other Bytes	0	0	0	0
Tx Cut Through Frames	0		0	
Rx Cut Through Frames	0		0	
Tx Cut Through Bytes	0		0	
Rx Cut Through Bytes	0		0	

Figure 13-23. Oversize Frames in Fibre Channel Tests

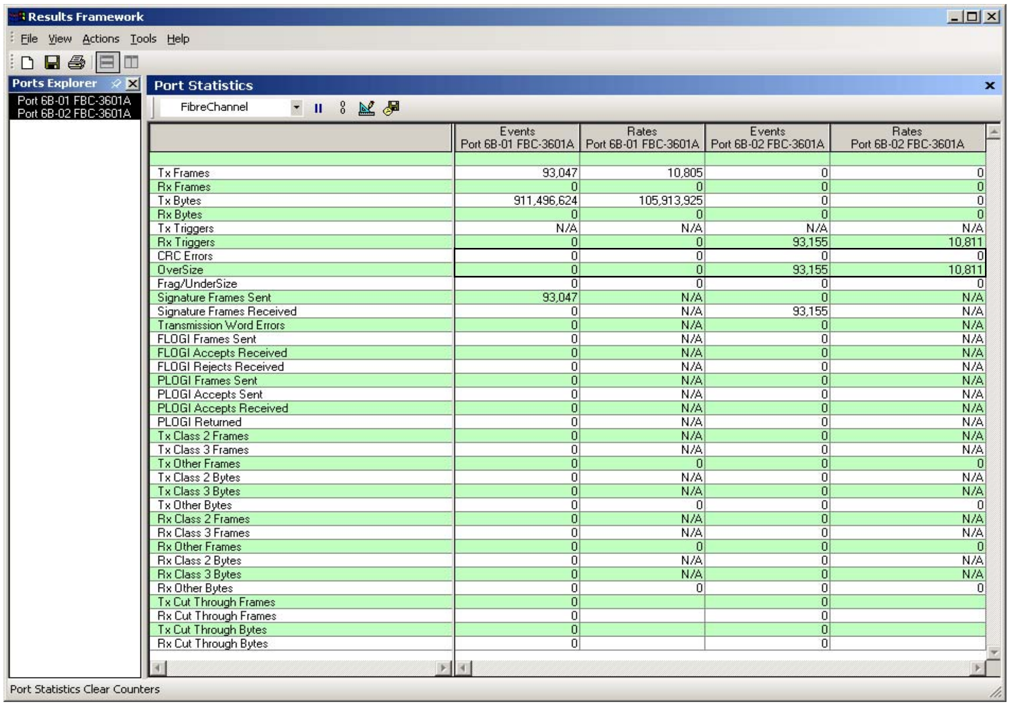
For the jumbo frames sent from port 6B-01 to port 6B-02, the SmartWindow counters show tallies for the following:

- Tx frames (port 6B-01), but not corresponding Rx frames (port 6B-02)
- For Tx frame rate (Port 6B-01), but not Rx frame rate (port 6B-02)
- Rx oversize frames, but not Tx oversize frames.

Other counters include Tx bytes, Rx bytes, Tx byte rate, Rx byte rate, Tx signature frames, and Rx signature frames.

Jumbo Frames with CRC Errors

If FCS errors are introduced into the transmitted oversize frames, the frames are counted as CRC errors and not as oversize. (See *Figure 13-24*.) The oversize counter is zero; the CRC errors counter gives the frame count.



	Events Port 6B-01 FBC-3601A	Rates Port 6B-01 FBC-3601A	Events Port 6B-02 FBC-3601A	Rates Port 6B-02 FBC-3601A
Tx Frames	93,047	10,805	0	0
Rx Frames	0	0	0	0
Tx Bytes	911,496,624	105,913,925	0	0
Rx Bytes	0	0	0	0
Tx Triggers	N/A	N/A	N/A	N/A
Rx Triggers	0	0	93,155	10,811
CRC Errors	0	0	0	0
OverSize	0	0	93,155	10,811
Frag/UnderSize	0	0	0	0
Signature Frames Sent	93,047	N/A	0	N/A
Signature Frames Received	0	N/A	93,155	N/A
Transmission Word Errors	0	N/A	0	N/A
FLOGI Frames Sent	0	N/A	0	N/A
FLOGI Accepts Received	0	N/A	0	N/A
FLOGI Rejects Received	0	N/A	0	N/A
PLOGI Frames Sent	0	N/A	0	N/A
PLOGI Accepts Sent	0	N/A	0	N/A
PLOGI Accepts Received	0	N/A	0	N/A
PLOGI Returned	0	N/A	0	N/A
Tx Class 2 Frames	0	N/A	0	N/A
Tx Class 3 Frames	0	N/A	0	N/A
Tx Other Frames	0	0	0	0
Tx Class 2 Bytes	0	N/A	0	N/A
Tx Class 3 Bytes	0	N/A	0	N/A
Tx Other Bytes	0	0	0	0
Rx Class 2 Frames	0	N/A	0	N/A
Rx Class 3 Frames	0	N/A	0	N/A
Rx Other Frames	0	0	0	0
Rx Class 2 Bytes	0	N/A	0	N/A
Rx Class 3 Bytes	0	N/A	0	N/A
Rx Other Bytes	0	0	0	0
Tx Cut Through Frames	0		0	
Rx Cut Through Frames	0		0	
Tx Cut Through Bytes	0		0	
Rx Cut Through Bytes	0		0	

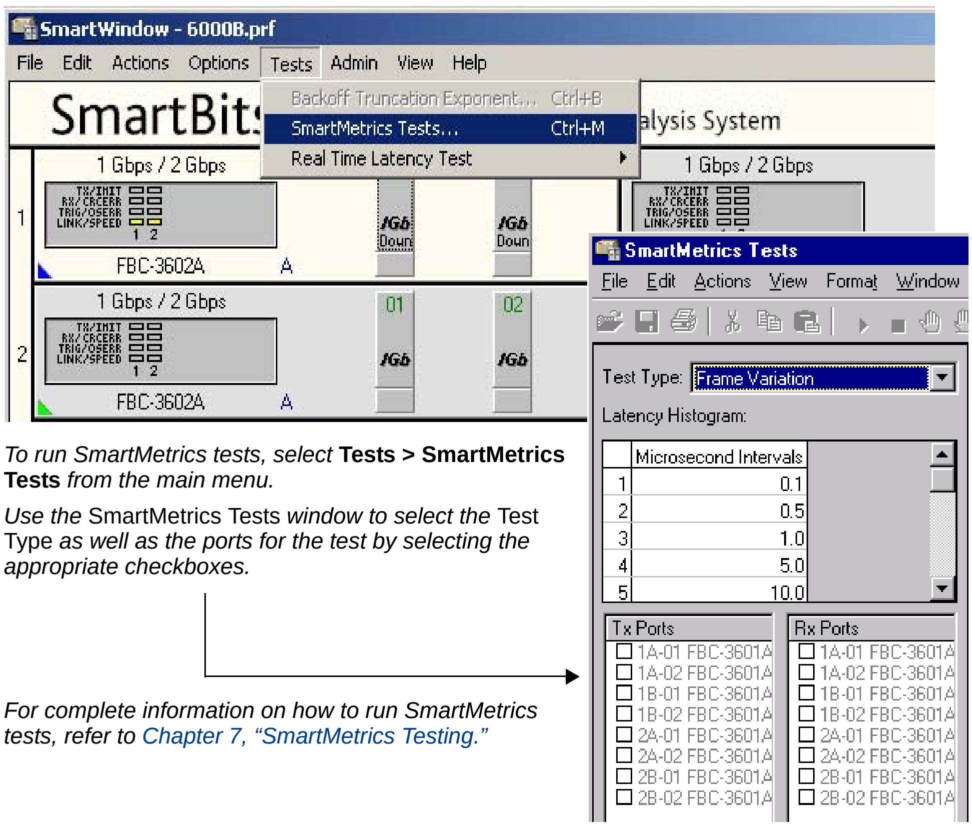
Figure 13-24. Oversize Frames with CRC Errors

Running SmartMetrics Tests

For complete information on SmartMetrics testing, refer to *Chapter 5, “Advanced Operational Theory.”* SmartMetrics tests can be run using the fibre channel modules.

To run SmartMetrics tests:

1. Choose **Tests** > **SmartMetrics Tests** from the SmartWindow main menu.
2. Select the ports for the test.
3. Select **Actions** > **Start**, or click the **Start** button at the bottom of the window to begin the test.
4. When the test ends, click the **Results** button to view data for the Rx port. (Halt the test by clicking the *Stop* button.) All test results are saved to an Excel spreadsheet.



To run SmartMetrics tests, select **Tests > SmartMetrics Tests** *from the main menu.*

Use the SmartMetrics Tests *window to select the* Test Type *as well as the ports for the test by selecting the appropriate checkboxes.*

For complete information on how to run SmartMetrics tests, refer to *Chapter 7, “SmartMetrics Testing.”*

Data Capture

Perform data capture using the fibre channel modules.

Notes:

- See *"Captured Frames Are Shorter Than Transmitted Frames" on page 666* for important information on capture results.
- For complete information about setting up and using data capture, refer to *"Using Triggers and Capture" on page 145* in *Chapter 5, "Advanced Operational Theory."*
- See *"Oversize Frames in Fibre Channel Tests" on page 662* for information on how the receiving port handles oversize frames. A fibre channel port can transmit frames of up to 16,384 bytes (with FCS), but the receiving port truncates any frame larger than 2,152 bytes (with FCS) to the largest legal frame size (2,148 bytes). These truncated frames are displayed in the *Capture* window.

To perform data capture:

1 Select **Capture...** from the module menu, then specify the capture parameters in the *Fibre Channel Capture Setup* dialog box (*Figure 13-25*).

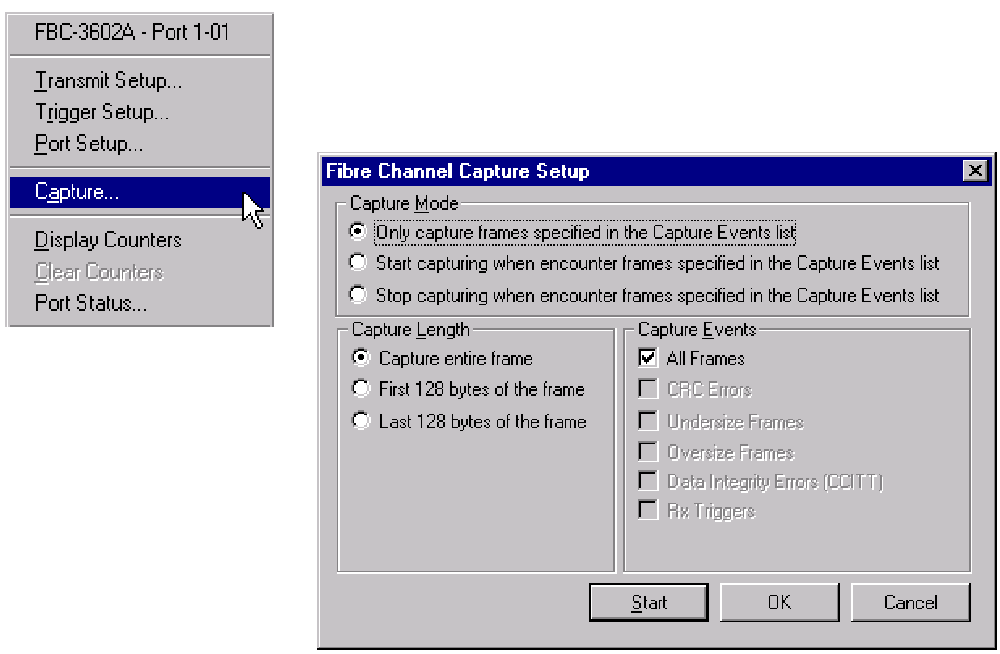


Figure 13-25. Fibre Channel Capture Setup Dialog

Capture buffer

The FBC-3601A and FBC-3602A modules can display up to 2 Kbytes of captured data. [Total frame length (without FCS) for FC test frames can be up to 16,380 bytes.]

The 4-byte FCS is included in the total frame length field. It is displayed in the capture if it fits within the 2-Kbyte limit on capture display length.

Captured Frames Are Shorter Than Transmitted Frames

The displayed length (without FCS) of captured frames differs from the defined length of the transmitted frames by 4 bytes. This is owing to the behavior of the sending port and receiving port in handling the FCS and Start of Frame (SOF)/End of Frame (EOF) fields.

The explanation is as follows:

- Each transmitted test frame includes the fibre channel SOF field (4 bytes) and EOF field (4 bytes). These two fields are counted as part of the defined frame length (without FCS) at the transmitting port.

4 bytes	24 bytes	4 bytes
Start of Frame	FC2 Protocol Header	End of Frame

- When the transmitting port sends a test frame, it appends a 4-byte FCS to the frame. This increases the frame length (without FCS) by 4 bytes.

4 bytes	24 bytes	**4 bytes**	4 bytes
Start of Frame	FC2 Protocol Header	**FCS**	End of Frame

- At the receiving port, the 4-byte FCS is included in the captured data that is displayed in the *Capture* window.
- Both the SOF and EOF frames are stripped off the frame, and are not counted in the length displayed in the *Capture* window.

24 bytes	**4 bytes**
FC2 Protocol Header	**FCS**

As a result, each transmitted test frame gains by 4 bytes, but loses by 8 bytes, and so displays in the *Capture* window as 4 bytes less than its defined length when transmitted.

Figure 13-26 on page 667 illustrates these differences.

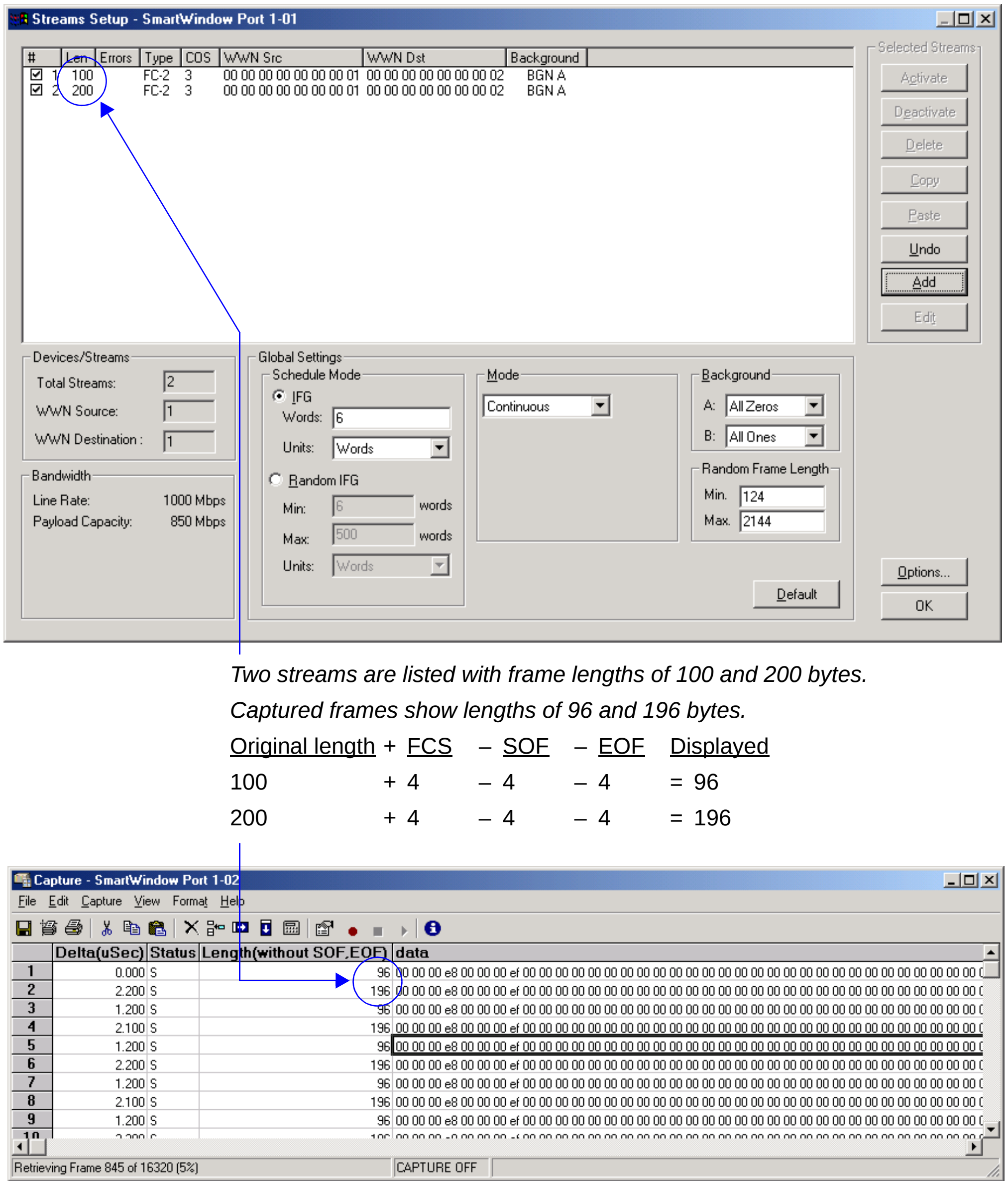


Figure 13-26. Data Capture with the Fibre Channel Modules

Appendix A

Supported Cards and Modules

SmartWindow currently supports and manages the SmartCards and modules itemized in this appendix.

Detailed Card and Module Information

For more complete system hardware information, refer to:

- *SmartBits System Reference Guide*
- *SmartBits 600x/6000x Getting Started*
- *SmartBits 200/2000 Installation Guide*.

Firmware Requirements

Refer to the *Release Notes* included with your product for the latest information on required firmware versions for chassis, cards, and modules.

Card Designations

Card and module names are keyed to the SmartBits chassis in which the card is used.

Card Designation	Chassis	Example of Card or Module Name
AB-*xxxxN*	SmartBits 200/2000	ML-7710
ABC-3*xxxN*	SmartBits 600x/6000x	POS-3505AR/AS

ATM

AT-9015	ATM DS1, 1-port
AT-9020	ATM E1, 1-port
AT-9025	ATM 25.6, 1-port
AT-9034B	ATM E3, 1-port
AT-9045B	ATM DS3, 1-port
AT-9155C	ATM OC-3c (STM-1c), 1-port, multi-mode, 1300nm
AT-9155Cs	ATM OC-3c (STM-1c), 1-port, multi-mode, 1310nm
AT-9622	ATM OC-12c (STM-4c), 1-port, multi-mode, 1300nm
AT-9622s	ATM OC-12c (STM-4c), 1-port, multi-mode, 1310nm

Ethernet

10Mbps Full Duplex Ethernet

ST-6410	10Base-T Ethernet, Full Duplex, 1-port
SX-7210	10/100Base-TX Ethernet, MII, 1-port
SX-7410/B	10/100Base-TX Ethernet, 1-port
SX-7411	100Base-FX Ethernet, 1-port

Ethernet SmartMetrics

ML-5710A	10Base-T Ethernet/USB, 2-port, SmartMetrics
ML-7710	10/100Base-TX Ethernet, 1-port, SmartMetrics
ML-7711	100Base-FX Ethernet, 1-port, multi-mode, 1300nm, SmartMetrics
ML-7711s	100Base-FX Ethernet, 1-port, single mode, 1310nm, SmartMetrics
LAN-3100A	10/100Base-T Ethernet, 8-port
LAN-3101A/B	10/100Base-T Ethernet, 6-port, SmartMetrics
LAN-3102A	10/100Base-T Ethernet, 2-port, SmartMetrics
LAN-3111A	100Base-FX Ethernet, 6-port, multi-mode, 1300nm, SmartMetrics
LAN-3111As	100Base-FX Ethernet, 6-port, single mode, 1310nm, SmartMetrics
LAN-3150A	100Base-T Ethernet, RMII/SMII, 8-port
LAN-3300A	10/100/1000Base-T Ethernet, Copper, 2-port, SmartMetrics
LAN-3301A	10/100/1000Base-T, Ethernet, Copper, 2-port, TeraMetrics
LAN-3302A	10/100Base-TX Ethernet, Copper, 2-port, TeraMetrics
LAN-3306A	10/100Base-TX Ethernet, Copper, 4-port, TeraMetrics

Gigabit Ethernet

GX-1405B	1000Base-SX Ethernet, 1-port, multi-mode, 850nm
GX-1405Bs	1000Base-SX Ethernet, 1-port, single mode, 1310nm
GX-1420B	10/1000Base Ethernet Copper, 1-port
GX-1421A	10/1000Base-T Ethernet, GMI/MII, 1-port
LAN-3200A	1000Base-SX Ethernet, 2-port, multi-mode, 850nm
LAN-3200As	1000Base-LX Ethernet, 2-port, single mode, 1310nm
LAN-3201B/C	1000Base-X Ethernet, GBIC, 1-port, SmartMetrics
LAN-3310A	1000Base-X Ethernet, GBIC, 2-port, SmartMetrics
LAN-3311A	1000Base-X Ethernet, GBIC, 2-port, TeraMetrics
LAN-3710AE	10GBase-ER Ethernet, 1-port, 2-slot, single mode, 1550nm
LAN-3710AL	10GBase-LR Ethernet, 1-port, 2-slot, single mode, 1310nm
LAN-3710AS	10GBase-SR Ethernet, 1-port, 2-slot, single mode, 850nm
XLW-3720A	10GBase Ethernet XENPAK MSA, 1-port, 2-slot, SmartMetrics
XLW-3721A	10GBase Ethernet XENPAK MSA, 1-port, 2-slot, SmartMetrics
XFP-3730A	10GBase Ethernet XFP MSA, 1-port, 1-slot,SmartMetrics
XFP-3731A	10GBase Ethernet XFP MSA, 1-port, 1-slot, TeraMetrics

Ethernet Dual Media

LAN-3320A	10/100/1000 Mbps and Gigabit Ethernet Fiber, 2-port, SmartMetrics XD
LAN-3321A	10/100/1000 Mbps and Gigabit Ethernet Fiber, 2-port, TeraMetrics XD
LAN-3324A	10/100/1000 Mbps and Gigabit Ethernet Fiber, 4-port, SmartMetrics XD
LAN-3325A	10/100/1000 Mbps and Gigabit Ethernet Fiber, 4-port, TeraMetrics XD
LAN-3327A	10/100/1000 Mbps and Gigabit Ethernet Fiber, 1-port, TeraMetrics XD

Fibre Channel

FBC-3601A	SAN 1G Fibre Channel, 2-port SmartMetrics
FBC-3602A	SAN 1G and 2G Fibre Channel, 2-port SmartMetrics

WAN

WN-3405	WAN V.35, 6/8 Mbps, Frame Relay/ PPP, 1-port, SmartMetrics
WN-3415	WAN T1/FT1, Frame Relay/PPP, 1-port, SmartMetrics
WN-3420A	WAN E1/FT1, Frame Relay/PPP, 1-port, SmartMetrics
WN-3441A	WAN T1, Frame Relay/PPP, channelized, 4-port, SmartMetrics
WN-3442A	WAN E1, Frame Relay/PPP, channelized, 4-port, SmartMetrics
WN-3445A	WAN DS3, Frame Relay/PPP, 1-port, SmartMetrics

POS

POS-3500A	POS OC-12cm (STM-4), SmartMetrics
POS-3500B	POS OC-3c/OC-12c (STM-1c/STM-4c), 1-port, multi-mode, 1300nm, SmartMetrics
POS-3500Bs	POS OC-3c (STM-1c/STM-4c), 1-port, multi-mode, 1310nm, SmartMetrics
POS-3502A	POS OC-3c (STM-1c), 1-port, multi-mode, 1300nm, SmartMetrics
POS-3502As	POS OC-3c (STM-1c), 1-port, single mode, 1310nm, SmartMetrics
POS-3504As	POS OC-48c (STM-16c), 1-port, single mode, 1310nm, SmartMetrics
POS-3504Ar	POS OC-48c (STM-16c), 1-port, single mode, 1550nm, SmartMetrics
POS-3505As	POS OC-48c (STM-16c), 1-port, single mode, 1310nm, TeraMetrics
POS-3505Ar	POS OC-48c (STM-16c), 1-port, single mode, 1550nm, TeraMetrics
POS-3510A	POS OC-3c/OC-12c (STM-1c/STM-4c), 2-port, multi-mode, 1300nm, SmartMetrics
POS-3510As	POS OC-3c/OC-12c (STM-1c/STM-4c), 2-port, single mode, 1310nm, SmartMetrics
POS-3511A	POS OC-3c/OC-12c (STM-1c/STM-4c), 2-port, multi-mode, 1300nm, TeraMetrics
POS-3511As	POS OC-3c/OC-12c (STM-1c/STM-4c), 2-port, single mode, 1310nm, TeraMetrics
POS-3518As	POS OC-192c (STM-64c),1-port, 2-slot, single mode, 1310nm, SmartMetrics
POS-3518Ar	POS OC-192c (STM-64c),1-port, 2-slot, single mode, 1550nm, SmartMetrics
POS-3519As	POS OC-192c (STM-64c),1-port, 2-slot, single mode, 1310nm, TeraMetrics
POS-3519Ar	POS OC-192c (STM-64c),1-port, 2-slot, single mode, 1550nm, TeraMetrics

Appendix B

Frame Rate Calculation

This appendix describes the method used to calculate the bandwidth utilization in the POS-35xx and LAN-3201B/C modules. Its intent is to provide readers with an understanding of how accurately these modules behave under certain load conditions. This description does not include the details of how the hardware operates.

In this appendix...

About POS Wire Speed

Wire speed for POS can best be defined as the ability to transmit frames onto the physical media with a single HDLC flag between each frame. In POS, a flag is the signaling device (Hex 7E; Binary 0111110) that denotes the end of a frame. If only one flag occurs between two PPP frames, then true wire rate is achieved.[1] To better visualize this, refer to *Figure B-1* where larger than legal frame size is used to illustrate the case of an OC-12c SONET payload.

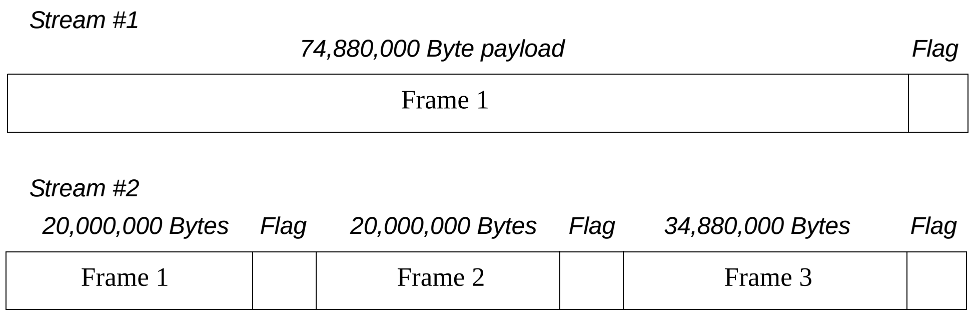


Figure B-1. Theoretical Calculation of Wire Speed

Stream #1

Wire speed = *(BytesPerSecond – NumberOfFlags)*
= *(74,880,000 – 1)*
= *74,879,999 Bps*

Stream #2

Actual payload capacity = *(20,000,000 + 20,000,000 + 34,880,000 – 3)*
= *74,879,996 Bps*

Wire rate varies according to frame size. For a stream with 3,000 frames, theoretical wire speed is:

Wire speed = *(74,880,000 – 3000)*
= *74,877,000 Bps*

In practice, the number of actual flags that occur between two frames is a function of how the transmit byte clock is synchronized to the SONET clock. See *"Optimizing Utilization" on page 690* for hints on optimizing.

1. See *Table B-2, "Computing Requested Rate," on page 677* for the wire speed values according to selected bandwidth.

POS Frame Rate Calculation

The POS-35xx modules operate at two speeds: OC-3c and OC-12c. Each speed has been described independently for clarity. The OC-3c speed is 155.52 Mbps, and the OC-12c speed is 622.08 Mbps.

POS OC-12 Payload Capacity Calculation

The OC-12c SONET framing structure consists of 1,080 bytes: nine rows of 120 octets each. Forty of these octets are allocated to SONET overhead carrying SONET physical layer and error information. The OC-12c bit rate is 622.08 Mbps. Thus, the available payload capacity is:

Available payload capacity = *((1040 / 1080) * 622.08 Mbps)*
= *599.04 Mbps*
= *74.88 Mbps*

The actual payload capacity is then calculated from the available payload capacity by factoring in the tolerance of the clock carrying the SONET data. The worst case tolerance allowed by the SONET specification occurs with stratum-4 clock, with a minimum accuracy of 32 ppm. The actual payload capacity range that uses this value is shown here:

Max. actual payload capacity = *(1 + 0.000032) * 74.88 Mbps*
= *74.88239616 Mbps*

Min. actual payload capacity = *(1 – 0.000032) * 74.88 Mbps*
= *74.87760384 Mbps*

POS OC-3c Payload Capacity Calculation

The OC-3c payload capacity values are calculated here. The OC-3c bit rate is 155.52 Mbps. The available payload capacity is shown here:

Available payload capacity = [*(1040 / 1080) * 155.52 Mbps*]
= *149.76 Mbps* = *18.72 Mbps*

The range of actual payload capacity values is shown here:

Max. actual payload capacity = *(1 + 0.000032) * 18.72 Mbps*
= *18.72059904 Mbps*

Min. actual payload capacity = *(1 – 0.000032) * 18.72 Mbps*
= *18.71940096 Mbps*

Payload Capacity Utilization

The payload capacity utilization is calculated on how frequently frames are generated: the higher the frame rate, the higher the payload capacity utilization. The maximum frame rate is achieved with the minimum interframe gap. In SONET, the minimum gap allowed is 1 byte. Thus, the maximum payload capacity utilization (measured in bytes per second) for a given frame size is:

*Max. payload capacity utilization (Bps) = (max. frame rate) * [frame size + 1 (inter-frame gap) + CRC[1]]*

Conversely, the frame rate can be calculated from the payload capacity utilization as follows:

(Max. frame rate) = Max. payload capacity utilization (Bps) / [frame size + 1 (inter-frame gap) + CRC]

Note: This calculation does not account for octet stuffing performed by the HDLC protocol layer. Octet stuffing is data dependent and the worst-case scenario may almost double the number of bytes sent, thereby reducing the capacity by half.

Capacity Utilization by Streams

In the POS-35xx modules, the frames are generated by individual streams. Each stream has its own frame generation definition and each stream utilizes part of the total payload capacity available. So, capacity utilization by any stream is:

*Stream capacity utilization (Bps) = (stream frame rate) * (stream frame size + 1 [inter-frame gap) + CRC]*

and

Aggregate stream capacity utilization = sum of individual stream capacity utilization

Even though streams are independent of each other, the stream capacity utilization of one stream may affect the stream capacity utilization of another stream, especially if the frames rates are different.

1. 2-byte or 4-byte CRC, depending on frame type

Formula for Requested Rate

Table B-1 and *Table B-2* contain information pertaining to rate.

Table B-1. Bandwidth by Transmission Bit Rate*

BW_OC12 = 599.04×10^6	Bandwidth for OC-12 speed
BW_OC3 = 149.76×10^6	Bandwidth for OC-3 speed

* CRC either 4 bytes or 2 bytes

Formula: requested rate

$$RequestedRate = \frac{\frac{(PercentUtilization) \times \left(\frac{BandWidth\overline{OCx}}{8}\right)}{100}}{FrameLength + CRC + 1}$$

Examples of Requested Rate

Table B-2. Computing Requested Rate*

Frame length (without FCS)	**Percent Utilization (%)**	**Bandwidth (Payload)**	**CRC (Bytes)**	**Rate**
60	100	OC-12c	4	1,152,000
60	100	OC-12c	2	1,188,571
60	100	OC-3c	4	288,000
60	100	OC-3c	2	297,142

* Calculated with *"Formula for Requested Rate" on page 677*.

Algorithm for Calculated Rate (POS-35xx Modules)

The frame rates for the POS-35xx modules fall into four categories, each with an independent clock source. *Table B-3* lists the frame rates and the corresponding clock source.

To calculate rate:

1. Identify lowest frame rate for all streams.
2. Identify clock rate based on lowest frame frate.

Table B-3. Frame Rate Related to Clock Rate

Frame Rate (fps)	Clock Rate (Hz)
>=239	31,250,000
>=120	15,625,000
>=60	7,812,500
>=31	3,906,250

3. For each stream, calculate interframe time:
   If decimal value > 0.5
   Interframe Time = *Truncate* (*LowestClockRate* / *ReqFrameRate*)+1;
   Else
   Interframe Time = *Truncate* (*LowestClockRate* / *ReqFrameRate*);
4. For each stream, compute calculated rate:
   Calculated Rate = *Truncate* (*LowestClockRate / Interframe Time*)

Example of Calculated Rate

The following procedure contains a calculated rate example.

To calculate rate:

1. Identify lowest frame rate for all streams. (See *Table B-4 on page 679*.)

Table B-4. Identifying Lowest Frame Rate

Stream	Requested Rate	Calculated Rate	Clock Assigned
1	100,000	/	31,250,000
2	50,000	/	31,250,000
3	25,000	/	31,250,000
4	239	/	15,625,000
5	119	/	7,812,500
6	40	/	3,906,250
7	60	/	7,812,500

2 Identify clock rate based on lowest frame rate (stream #6).
Lowest Rate = 40 fps   Clock Assigned = 3,906,250

3 For each stream, compute interframe time.
Clock = Lowest Rate;
Clock = 3,906,250

Stream 1

Interframe Time = 3,906,250 / 100,000
= 39.0625 Truncate
= 39

Stream 5

Interframe Time = 3,906,250 / 119
= 32,825.63 Truncate
= 32,825 + 1
= 32,826

4 For each stream, compute calculated rate. (See *Table B-5 on page 680*.)

Stream 1 required rate: 100,000 fps

Calculated Rate = 3,906,250 / 39
= 100,160.25 Truncate
Calculated Rate = 100,160 fps

Stream 5 required rate: 119 fps

Calculated Rate = 3,906,250 / 32,826
= 118.99865 Truncate
Calculated Rate = 118 fps

Table B-5. Compute Calculated Rate for Each Stream

Stream	Enable	Requested Rate	Calculated Rate
1	ON	100,000	100,160
2	ON	50,000	50,080
3	ON	25,000	25,040
4	ON	239	239
5	ON	119	118
6*	ON	40	40
7	ON	60	60

* Selected clock based on *Table B-4 on page 679*.

More Examples of Calculated Rates

As streams are disabled, the lowest available clock changes. (See *Table B-6*, *Table B-7 on page 681*, *Table B-8 on page 681*, and *Table B-9 on page 682*.)

Table B-6. One Stream Disabled

Stream	Enable	Requested Rate	Calculated Rate
1	ON	100,000	100,160
2	ON	50,000	50,080
3	ON	25,000	25,040
4	ON	239	239
5	ON	119	118
6	OFF	40	–
7*	ON	60	60

* Selected clock

Table B-7. Two Streams Disabled

Stream	Enable	Requested Rate	Calculated Rate
1	ON	100,000	100,160
2	ON	50,000	50,080
3	ON	25,000	25,040
4	ON	239	239
5*	ON	119	119
6	OFF	40	–
7	OFF	60	–

* Selected clock

Table B-8. Three Streams Disabled

Stream	Enable	Requested Rate	Calculated Rate
1	ON	100,000	100,160
2	ON	50,000	50,000
3	ON	25,000	25,000
4*	ON	239	239
5	OFF	119	–
6	OFF	40	–
7	OFF	60	–

* Selected clock

Table B-9. Five Streams Disabled

Stream	Enable	Requested Rate	Calculated Rate
1	ON	100,000	100,160
2*	ON	50,000	50,000
3	OFF	25,000	–
4	OFF	239	–
5	OFF	119	–
6	OFF	40	–
7	OFF	60	–

* Selected clock

Gigabit Frame Rate Calculation

The LAN-320x modules operate at 1000 Mbps.

Payload Capacity Utilization

The payload capacity utilization is calculated on how frequently frames are generated. In other words, the higher the frame rate, the higher the payload capacity utilization. The maximum frame rate is achieved with the minimum interframe gap. In SmartMetrics gigabit, the minimum gap allowed is 12 bytes and the preamble minimum is 8 bytes.

The maximum payload capacity utilization (measured in bytes per second for a given frame size) is:

*Max. payload capacity utilization (Bps) = (max. frame rate) * [frame size + 12 (inter-frame gap) + 8 (minimum preamble) + 4 (CRC)]*

Conversely, the frame rate can be calculated from the payload capacity utilization as follows:

(Max. frame rate) = max. payload capacity utilization (Bps) / [frame size + 12 (inter-frame gap) + 8 (minimum preamble) + 4 (CRC)]

Capacity Utilization by Streams

In the LAN-320x modules, the frames are generated by individual streams. Each stream has its own frame generation definition and each stream utilizes part of the total payload capacity available. So, capacity utilization by any stream is:

*Stream capacity utilization (Bps) = (stream frame rate) * (frame size + 12 [interframe gap) + 8 (minimum preamble) + 4 (CRC)]*

and

Aggregate stream capacity utilization = sum of individual stream capacity utilization

Even though streams are independent of each other, the stream capacity utilization of one stream may affect the stream capacity utilization of another stream, especially if the frames rates are different.

The frame rates for the LAN-320x modules fall into four categories, each with an independent clock source. *Table B-11 on page 685* lists the frame rates and the corresponding clock source.

Formula for Requested Rate

This is the formula for requested rate:

$$RequestedRate = \frac{\dfrac{(PercentUtilization) \times \left(\dfrac{BandWidth\overline{1000Mb}}{8}\right)}{100}}{FrameLength + 4(CRC) + 8(Preamble) + 12(Gap)}$$

Example of Requested Rate

Refer to *Table B-10* for an example of requested rate.

Table B-10. Computing Maximum Allowed Rate*

Frame length (without FCS)	**Percent Utilization (%)**	**Bandwidth (Payload)**	**CRC(Bytes)**	**Rate**
60	100	1000 Mb	4	1,488,095

* Calculated with the formula in *"Formula for Requested Rate"*.

Algorithm for Calculated Rate (LAN-3201B/C Module)

The frame rates for the LAN-3201B/C module fall into four categories, each with an independent clock source. *Table B-11* lists the frame rates and the corresponding clock source.

To calculate rate:

1. Identify lowest frame rate for all streams.
2. Identify clock rate based on lowest frame rate.

Table B-11. Frame Rate Related to Clock

Frame Rate (fps)	Clock Rate (Hz)
>=239	31,250,000
>=120	15,625,000
>=60	7,812,500
>=31	3,906,250

3. For each stream, calculate interframe time:
   If decimal value > 0.5
   Inteframe Time = Truncate (LowestClockRate / ReqFrameRate)+1;
   Else
   Interframe Time = Truncate (*LowestClockRate / ReqFrameRate*);
4. For each stream, compute *Calculated Rate:*
   Calculated Rate = Truncate (*LowestClockRate / Interframe Time*)

Example of Calculated Rate

The following procedure contains a calculated rate example.

To calculate rate:

1 Identify lowest frame rate for all streams. (See *Table B-12*.)

Table B-12. Identifying Lowest Frame Rate

Stream	Requested Rate	Calculated Rate	Clock Assigned
1	100,000	/	31,250,000
2	50,000	/	31,250,000
3	25,000	/	31,250,000
4	239	/	15,625,000
5	119	/	7,812,500
6	40	/	3,906,250
7	60	/	7,812,500

2 Identify clock rate based on lowest frame rate (stream #6).
Lowest Rate = 40 fps   Clock Assigned = 3,906,250

3 For each stream, compute interframe time.
Clock = Lowest Rate;
Clock = 3,906,250

Stream 1

Interframe Time = 3,906,250 / 100,000
= 39.0625 Truncate
= 39

Stream 5

Interframe Time = 3,906,250 / 119
= 32,825.63 Truncate
= 32,825 + 1
= 32,826

4 For each stream, compute calculated rate. (See *Table B-13 on page 687*.)

Stream 1 required rate: 100,000 fps

Calculated Rate = 3,906,250 / 39
= 100,160.25 Truncate
Calculated Rate = 100,160 fps

Stream 5 required rate: 119 fps

Calculated Rate = 3,906,250 / 32,826
= 118.99865 Truncate
Calculated Rate = 118 fps

Table B-13. Compute Calculated Rate for Each Stream

Stream	Enable	Requested Rate	Calculated Rate
1	ON	100,000	100,160
2	ON	50,000	50,080
3	ON	25,000	25,040
4	ON	239	239
5	ON	119	119
6*	ON	40	40
7	ON	60	60

* Selected clock based on *Table B-12 on page 686*.

More Examples of Calculated Rates

As streams are disabled, the lowest available clock changes. (See *Table B-14*, *Table B-15 on page 688*, *Table B-16 on page 688*, and *Table B-17 on page 689*.)

Table B-14. One Stream Disabled

Stream	Enable	Requested Rate	Calculated Rate
1	ON	100,000	100,160
2	ON	50,000	50,080
3	ON	25,000	25,040
4	ON	239	239
5	ON	119	119
6	OFF	40	–
7*	ON	60	60

* Selected clock

Table B-15. Two Streams Disabled

Stream	Enable	Requested Rate	Calculated Rate
1	ON	100,000	100,160
2	ON	50,000	50,080
3	ON	25,000	25,040
4	ON	239	239
5*	ON	119	119
6	OFF	40	–
7	OFF	60	–

* Selected clock

Table B-16. Three Streams Disabled

Stream	Enable	Requested Rate	Calculated Rate
1	ON	100,000	100,160
2	ON	50,000	50,000
3	ON	25,000	25,000
4*	ON	239	239
5	OFF	119	–
6	OFF	40	–
7	OFF	60	–

* Selected clock

Table B-17. Five Streams Disabled

Stream	Enable	Requested Rate	Calculated Rate
1	ON	100,000	100,160
2*	ON	50,000	50,000
3	OFF	25,000	–
4	OFF	239	–
5	OFF	119	–
6	OFF	40	–
7	OFF	60	–

* Selected clock

Optimizing Utilization

If full 100% utilization is requested for one stream but the result is a lower utilization rate (e.g., 98.43751%), use 10 streams with each set to 10% utilization.

Or

Change the frame size. Some frame sizes allow for a higher utilization when using only a single stream. (See *Table B-18*.)

Table B-18. Calculated Rate

Frame Length (bytes) (without FCS)	**Requested Rate**	**Calculated rate**
40	100%	99.6965%
124	100%	98.1507%
1000	100%	99.9008%

Appendix C

Managing the ET-1000 Controller

The ET-1000 controller was a precursor to the SmartBits 1000 and SmartBits 2000 chassis. A few configuration features of the ET-1000 controller that may be useful under certain circumstances were dropped from the standard Ethernet menus. Using specified Ethernet SmartCards, these features can still be accessed with configuration adjustments made through the SmartWindow ET-1000 menu.

Note: SmartWindow 6.50 was the last version to support the ET-1000 controller.

In this chapter...

SmartCards that Support ET-1000 Functions

Only the following SmartCards support ET-1000 functions:

- SE-6205/SC-6305/ST-6405/6410 10 Mbps Ethernet SmartCards
- ST-6410 10 Mbps Full Duplex Ethernet SmartCard.

Other SmartCards, including the TokenRing and the 100 Mbps Ethernet SmartCards, *do not* support ET-1000 functions.

When to Use ET-1000 Functions

The ET-1000 controller supports some functions for 10 Mbps Ethernet that are not provided by the SmartWindow user interface. These functions include:

- Advanced collision generation capabilities
- Frame capture
- Preamble control and measurement.

Note: The SmartWindow ET-1000 EtherWindows menu can be used to configure the above tasks. See *“Accessing ET-1000 Functions” on page 695*.

Configuring SmartCards for Use with ET-1000 Controller

Before working with the ET-1000 functions, the SmartBits system must be configured for the SmartCards that act as ET-1000 based transmitters and receivers.

Configuring SmartCards for ET-1000 transmit and receive consists of setting up the SmartCard connections to the SmartBits backplane. The ET-1000 transmit stream can be connected to any number of supported SmartCards in the SmartBits system. Since only a single receive port is available in the ET-1000 controller, only one SmartCard at a time can be configured as the ET-1000 receive port.

Note: When using the SmartBits system with an external ET-1000 controller, port B of the ET-1000 is routed to the port setup as described in this section. In the case of an integrated ET-1000 (i.e., SmartBits 1000), port B of the integrated ET-1000 controller is the only port available for operation.

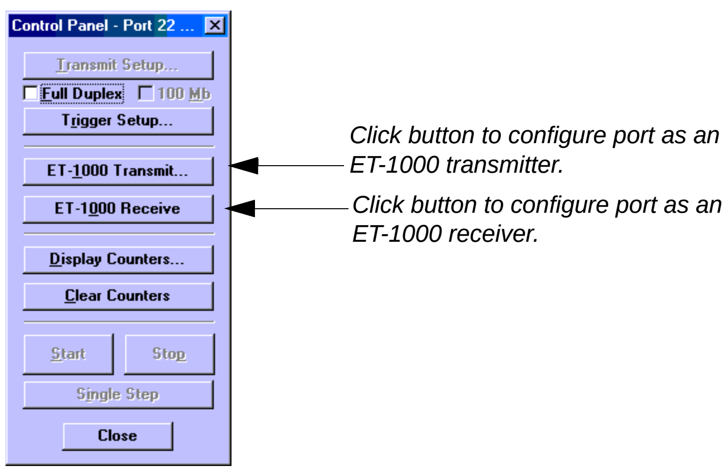
A port can be set up for ET-1000 transmission or reception as follows.

To set up:

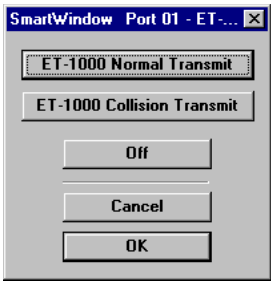
1 Choose **Options** > **Preferences.**

2 Clear (i.e., do not select) **Use left-click popup menu over SmartCards**.

3 Left-click on the image of a ET-1000 compatible SmartCard.



4 Click the **ET-1000 Transmit** button.
The following window appears:



Two transmit modes are supported:

- ET-1000 Normal Transmit
  Used when transmitting frames without collision generation.
- ET-1000 Collision Transmit
  Used when ET-1000 is to generate collisions.

5 To select the ET-1000 transmission mode, click the corresponding button and then click **OK**.

6 To disable ET-1000 transmit functions on the port and revert back to normal Smart-Card transmit specifications, click the **Off** button.

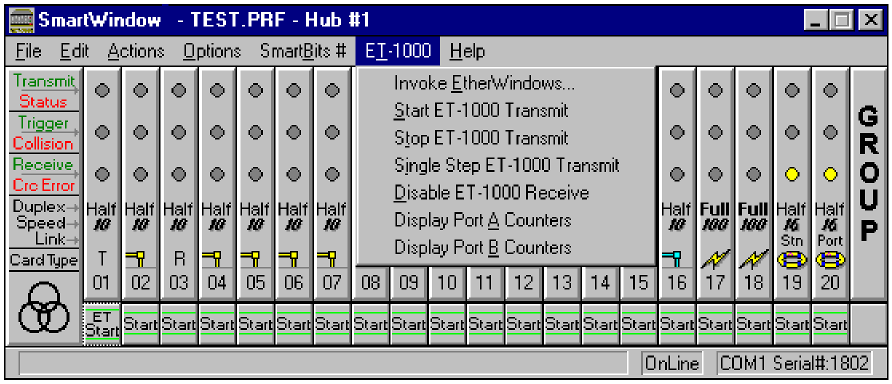
7 To configure a port as the ET-1000 receiver, click the **ET-1000 Receive** button on the *Control Panel* dialog box.

8 To stop a port from being the ET-1000 receiver, clear **ET-1000 Receive** on the menu or select another port to be the ET-1000 receiver.

Note: The ET-1000 collision transmit mode works in conjunction with the ET-1000 Receive mode. A SmartCard in the ET-1000 collision mode transmits a colliding packet fragment upon receipt of a packet at the ET-1000 receive SmartCard port. (See *“Setting up Collision Packets” on page 697*.)

Accessing ET-1000 Functions

To access the ET-1000 functions, a drop-down menu is available under the ET-1000 menu.



Invoking EtherWindows

When this option is selected, the SmartWindow session is put on hold and EtherWindows becomes the active foreground application and runs the ET-1000 controller. When EtherWindows is terminated, control returns to SmartWindow.

Note: EtherWindows and SmartWindow cannot execute simultaneously. In SmartBits applications, the ET-1000 controller must be set to receive and transmit from port B. This is accomplished on the EtherWindows main window by clicking *B* in the vertical A, A/B, B array in the upper right-hand corner.

Starting ET-1000 Transmit

Choosing the *Start ET-1000 Transmit* option from the drop-down menu activates ET-1000 packet transmission. All SmartCards that have been set up in the ET-1000 transmit mode now transmit.

Note: The ET-1000 controller must be set to transmit through port B when used to transmit through SmartCards.

Stopping ET-1000 Transmit

This option on the ET-1000 menu halts packet transmission from the ET-1000 controller.

Note: Because ET-1000 transmit configuration is not controlled by SmartWindow, *Start/ Stop/Step* commands are unpredictable. If the ET-1000 controller is in a mode where port A is selected and the mode being used is unknown, starting or stepping may transmit no packets or perhaps only half of the expected packets.

Single Step Transmission

Set a SmartCard to transmit a single packet instead of a burst. All types of SmartCards can single step.

To single step transmit, perform one of the following steps:

- Select **Single Step ET-1000 Transmit** from the ET-1000 menu on the main window. When this option is selected, the ET-1000 controller transmits one packet through each SmartCard configured as an ET-1000 transmitter.
  Or
- Right-click on the **Start** button at the bottom of the SmartCard on the main window, and choose **Single Step**.

Note: The ML-7710 SmartCard single-steps a packet out with the traditional configuration parameters, even if the card is set to SmartMetric mode.

Disabling ET-1000 Receive

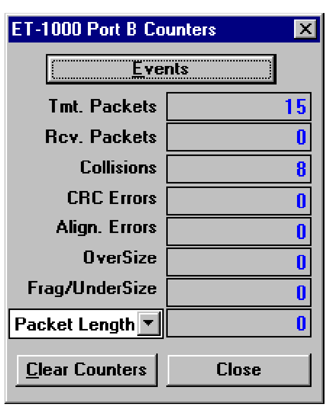
This option disables ET-1000 port B from receiving data from one of the SmartCards designated as an ET-1000 receive card. Only one SmartCard can be designated as the receiver for ET-1000 port B.

Displaying Port A Counters

The selection *Display Port A Counters* is only valid when working with an external ET-1000 controller. This option is similar to *Display Port B Counters.*

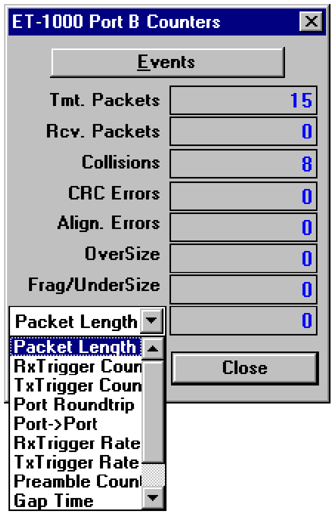
Displaying Port B Counters

To display the counters for ET-1000 port B, select **Display Port B Counters**. The following window is displayed.



As with port counters for SmartCards, the results can be displayed in either event, rate, or event and rate form.

The last counter area can be configured by using the drop-down menu.



Any of the counters in the pull-down list can be selected for display in the last field. As with other counters in the SmartBits system, even though a counter is not actively being displayed, the counter is still active within the SmartCard or the ET-1000 controller and can be displayed at a later time without losing any events.

Setting up Collision Packets

The parameters for the colliding packet fragment are manually set in the ET-1000 controller through the front panel controls or via EtherWindows.

To set collision parameters in EtherWindows:

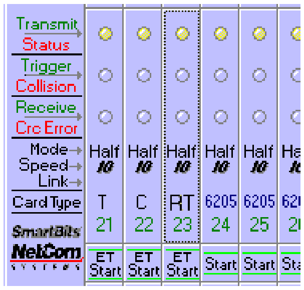
1 Choose **Setup** > **Collisions**.

2 Select the *On receive Packet B* option in the *Collisions* dialog box.
The lower portion of the dialog box is reserved for setting up the collision fragment parameters *Offset* and *Duration*.

The *Offset* parameter refers to the number of bits that the ET-1000 controller receives before transmitting the colliding fragment. The *Duration* parameter refers to the length of the colliding fragment (in bits).

Note: Generally, the ET-1000 receive port is also chosen as the ET-1000 collision port, so that the colliding fragment collides with the received packet.

Once SmartCards are configured as ET-1000 transmitter or receivers, port images and control icons change accordingly.



Frame Capture with the ET-1000 Controller

The ET-1000 controller offers the only method for capturing receive data within the SmartBits system. As with other ET-1000 functions, this feature is only supported for those cards offering ET-1000 capabilities.

To capture data with the ET-1000 controller:

1. Within SmartWindow, setup an appropriate port to be the ET-1000 receiver.
2. Select the **EtherWindows** option from the ET-1000 drop-down menu.
3. Within the EtherWindows user interface, click the **Capture** button in the lower right corner of the main window.
4. Select **Port B** as the capture data source using the *Setup/Capture Criteria* pull-down menu in the *Capture* dialog box.
5. Click the **Start Capture** button in the *Capture* dialog box.
   The SmartCard is now set to route receive data to the capture buffer.
6. Exit EtherWindows, and control returns to SmartWindow.
   The port is now ready to capture data.
7. Run the test that produces the receive data to be captured.
8. Select the **EtherWindows** option again to access the *Capture* data window.
   The captured frames are displayed.

Appendix D

Data Integrity on TeraMetrics

The data integrity function allows the SmartBits modules to send and receive a frame with a marker (called the data integrity marker) as an additional means of verification that the user payload was received correctly. This feature is used to determine if packet corruption occurred internal to a router where the packet is not protected with a Layer 2 CRC. The data integrity function requires that the configuration be set up in a specific manner to operate properly. This appendix provides configuration information for the SmartBits modules that are used as well as answers to frequently asked questions regarding this function.

Module Information

The data integrity function applies only to the following SmartMetrics and TeraMetrics modules:

- LAN-3300A 10/100/1000Base-T Ethernet Copper, 2-port, SmartMetrics
- LAN-3301A 10/100/1000Base-T Ethernet Copper, 2-port, TeraMetrics
- LAN-3302A 10/100Base-T Ethernet Copper, 2-port, TeraMetrics
- LAN-3310A 1000Base-X Ethernet, GBIC, 2-port, SmartMetrics
- LAN-3311A 1000Base-X Ethernet, GBIC, 2-port, TeraMetrics
- POS-3504As POS OC-48c, 1-port, single mode, 1310nm, SmartMetrics
- POS-3504AR POS OC-48c, 1-port, single mode, 1550nm, SmartMetrics
- POS-3505As POS OC-48c, 1-port, single mode, 1310nm, TeraMetrics
- POS-3504AR POS OC-48c, 1-port, single mode, 1550nm, TeraMetrics
- POS-3510A POS OC-3c/OC-12c, 2-port, multi-mode, 1300nm, SmartMetrics
- POS-3510As POS OC-3c/OC-12c, 2-port, single mode, 1310nm, SmartMetrics
- POS-3511A POS OC-3c/OC-12c, 2-port, multi-mode, 1300nm, TeraMetrics
- POS-3511As POS OC-3c/OC-12c, 2-port, single mode, 1310nm, TeraMetrics
- POS-3518As POS OC-192c, 1-port, 2-slot, single mode, 1310nm, SmartMetrics
- POS-3518AR POS OC-192c, 1-port, 2-slot, single mode, 1550nm, SmartMetrics
- POS-3519As POS OC-192c, 1-port, 2-slot, single mode, 1310nm, TeraMetrics

- POS-3519AR POS OC-192c, 1-port, 2-slot, single mode, 1550nm, TeraMetrics
- XLW-3720A 10 Gigabit Ethernet, XENPAK MSA, 1-port, SmartMetrics
- XLW-3721A 10 Gigabit Ethernet, XENPAK MSA, 1-port, TeraMetrics

Design Principles

SmartBits modules use the trigger logic on the receive side to recognize the _NETCOM_ pattern in the frame and start data integrity calculations. SmartBits modules do not "scan" packet contents for the data integrity marker. Instead, the pattern matching logic in the Rx trigger circuit examines a specified byte offset in the frame to determine if a marker is present or not.

A data integrity frame has a marker that displays as _NETCOM_ in ASCII immediately following the last protocol header. In hexadecimal, the marker is 5f 4e 45 54 43 4f 4d 5f. Immediately after the marker, there is a two-byte byte-count field, the user payload, and the CRC-16 followed by the signature field and the FCS for the frame. The format shown below is the definition of data integrity within a SmartMetric or TeraMetric frame.

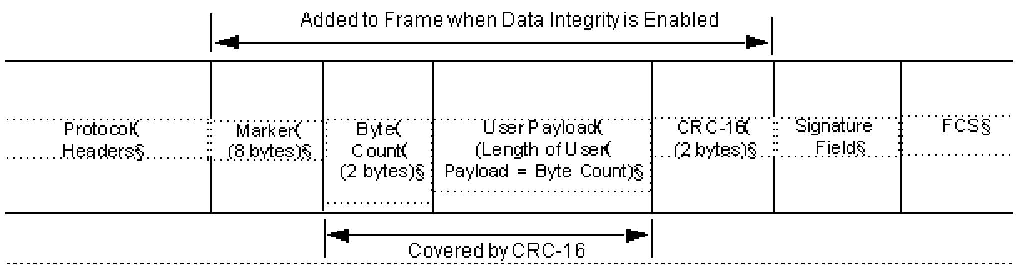


Figure D-1. Data Integrity Format

Transmit Configuration

To transmit data integrity frames for a stream on a TeraMetrics module, select *Enable Data Integrity* via SmartWindow or SmartLib.

Important:

- When streams are configured in SmartWindow 7.50, they are set to transmit the data integrity marker by default.
- Data integrity can be enabled or disabled in the *Streams Configuration* window or you can select a stream, choose the edit function, and select the *Data Integrity* checkbox.
- Only frames that contain the signature field can have the data integrity function enabled. In other words, data integrity works only when the module is in SmartMetrics mode and the signature field is enabled.
- The modules statically calculate TCP checksums during stream configuration, prior to real-time generation of packets. Data integrity calculations are performed in real-time. Therefore, the data integrity feature cannot be used with TCP protocol. Data integrity does work with IP and UDP protocol.

Note: TeraMetrics modules do not support error injection in this feature. However, it is possible to send erred data integrity frames using the custom protocol by imitating a faulty data integrity frame.

When data integrity is enabled, it modifies the modules as follows:

- Places the start of data integrity immediately after the protocol headers. This start position can vary, depending on the specifics of the protocol stack in the packet.
- Includes the marker, length, and CRC-16 fields.

Receive Configuration

To count or measure data integrity frames on a TeraMetrics module, first set a receive trigger on the data integrity marker.

To set a receive trigger on the data integrity marker using SmartWindow or SmartLib, set trigger 1 to match the last six bytes of the eight-byte data integrity marker. The byte offset for the trigger must be set to point to the E in _NETCOM_ and the trigger value should be set to ETCOM_ (hexadecimal 45 54 43 4f 4d 5f).

For example, when receiving in an Ethernet frame with an IP header only, the offset should be set to byte 36, corresponding to the E (ASCII 45).

Important:

- There are two receive triggers: Rx trigger 1 and Rx trigger 2.
- Receive trigger 1 must be correctly configured to recognize the data integrity marker.
- When receive trigger 1 is used for data integrity marker detection, the other trigger must not interfere. In SmartWindow receive trigger setup, select the *Only trigger 1, ignore trigger 2* option.
- A receive trigger offset is a static value. It can only point to a fixed number of bytes beyond the beginning of a packet. This is a “per port” parameter. The byte offset of the receive trigger needs to be based on the received frame type, not the transmitted frame type.

Counter Interpretation and Results

When the transmit and receive settings are set according to this document, the data integrity counter shows data integrity errors received on the port. Frames with data integrity errors are counted in the frame receive statistics, both counters and histograms.

Note: The byte pointer is used to locate the length field. Any trigger MATCH causes the data integrity logic to check the packet. Therefore, data integrity errors can be indicated any time the Rx trigger is asserted.

Capture Information

Capture displays data integrity errors only if you capture on data integrity errors. Capture status shows “D” only if capture filtering is enabled on data integrity errors.

To capture on data integrity errors:

1. In SmartWindow, select **Capture**.
2. Set the *Capture Events* field value to **Data Integrity Errors**.
   If this field value is not selected, the frames are listed as triggered frames, and no mention of data integrity occurs.

Note: When trigger frames are received, the Rx engine automatically checks data integrity on the frame. Marking these frames in the *Capture* window as data integrity errors works only when the trigger is set up to point to the data integrity marker. However, if the *Capture Events* field value is *Data Integrity Errors* and the trigger is pointing to somewhere else in the frame, a trigger match causes all of the frames in the capture buffer to show as if they have data integrity errors, even when they do not have such errors.

More Details on Rx Functionality

The trigger/match logic is implemented as described previously in this appendix. However, it conveys only MATCH or NO_MATCH information. If there is a MATCH, it provides a byte pointer where the match occurred to the receive engine.

The receive engine performs the following actions for data integrity:

- If MATCH = TRUE, then the LENGTH field is used to re-calculate the CRC-16 and compare to the CRC-16 in the packet.
- If it is a signature frame and the CRC-16 is errored, then the data integrity ERROR counter is incremented.
- If it is not a signature frame, then the data integrity errors are ignored.

Note: The byte pointer is used to locate the length field. Any MATCH causes the data integrity logic to check the packet. Therefore, data integrity errors can be indicated any time the Rx trigger is asserted.

Rx Trigger Configuration and Resource

In regards to Rx trigger configuration and resource:

- There is no *always on* detection of the data integrity marker. The Rx trigger must be configured to see the marker.
- The Rx trigger resource is consumed when running data integrity tests.

Appendix E

ESD Requirements

Spirent Communications manufactures and sells products that require industry standard precautions to protect against damage from electrostatic discharge (ESD). This document explains the proper process for handling and storing electrostatic discharge sensitive (ESDS) devices, assemblies, and equipment.

The requirements presented in this document comply with the EIA Standard, *ANSI/ESD S20.20-1999: Development of an Electrostatic Discharge Control Program*, and apply to anyone who handles equipment that is sensitive to electrostatic discharge. Such equipment includes, but it not limited to:

- All electronic assemblies manufactured by Spirent Communications
- Discrete and integrated circuit semiconductors
- Hybrid microcircuits
- Thin film passive devices
- Memory modules

Caution: Failure to comply with the requirements explained in this document poses risks to the performance of ESDS devices, as well as to your investment in the equipment.

General Equipment Handling

Whenever you handle a piece of ESDS equipment, you must be properly grounded to avoid harming the equipment. Also, when transporting the equipment, it must be packaged properly. Follow the requirements below to help ensure equipment protection.

- Wrist straps must be worn by any person handling the equipment to provide normal grounding.
- The use of foot straps is encouraged to supplement normal grounding. If foot straps are used exclusively, two straps (one on each foot) should be used. Note that foot straps are only applicable in environments that use ESD flooring and/or floor mats.
- Hold ESDS equipment by the edges only; do not touch the electronic components or gold connectors.
- When transporting equipment between ESD protected work areas, the equipment must be contained in ESD protective packaging. Equipment that is received in ESD protective packaging must be opened either by a person who is properly grounded or at an ESD protected workstation.

- Any racks or carts used for the temporary storage or transport of ESDS equipment must be grounded either by drag chains or through direct connection to earth ground. Loose parts that are not protected by ESD-safe packaging must not be transported on carts.

Workstation Preparation

The ideal setup for working with ESDS equipment is a workstation designed specifically for that purpose. *Figure E-1* illustrates an ESD protected workstation. Please follow the requirements listed below to prepare a proper ESD protected workstation.

- The ESD Ground must be the equipment earth ground. Equipment earth ground is the electrical ground (green) wire at the receptacles.
- An ESD protected workstation consists of a table or workbench with a static dissipative surface or mat that is connected to earth ground. A resistor in the grounding wire is optional, providing that surface resistance to ground is $\geq 10^5$ to $\leq 10^9\ \Omega$.
- The workstation must provide for the connection of a wrist strap. The wrist strap must contain a current limiting resistor with a value from $\geq$ 250K Ω to $\leq$ 10M Ω.
- ESD protective flooring or floor mats are required when floor-grounding devices (foot straps/footwear) are used or when it is necessary to move in between ESD protected workstations when handling ESDS equipment.

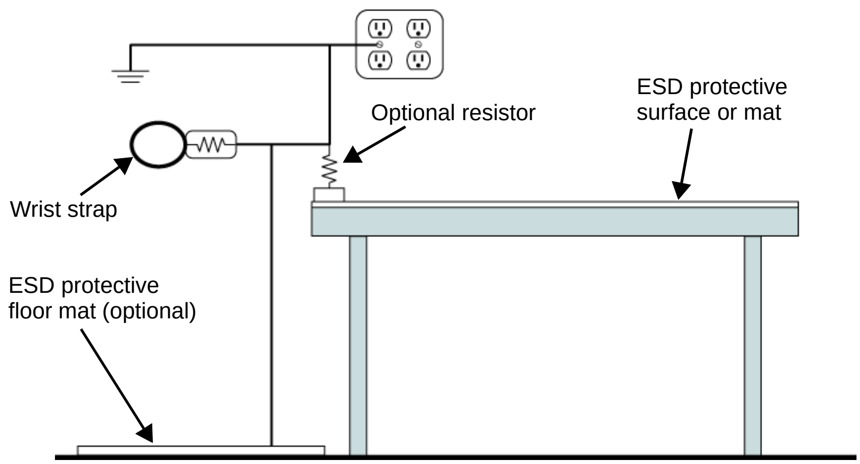


Figure E-1. ESD Protected Workstation

Note: The equipment needed for proper grounding is available in ESD service kits, such as the ESD Field Service Kit available from Spirent Communications (P/N 170-1800). Additional information on ESD can be found on the following website: http://www.esda.org/aboutesd.html

Appendix F

Fiber Optic Cleaning Guidelines

Spirent Communications manufactures and sells products that contain fiber optic components, including fiber optic transmitters and receivers. These components are extremely susceptible to contamination by particles of dirt or dust, which can obstruct the optic path and cause performance degradation. To ensure optimum product performance, it is important that all optics and connector ferrules be kept clean.

This document presents guidelines for maintaining clean fiber optic components. Spirent Communications recommends that these guidelines be followed very closely.

Caution:

- Failure to comply with the guidelines explained in this document poses risks to the performance of fiber optic-based devices, as well as to your investment in the equipment.
- Whenever you handle a piece of equipment that contains fiber optic components, you must be properly grounded to avoid harming the equipment. See the Appendix in this document titled *ESD Requirements* for more details on ESD.

Cleaning Guidelines

To ensure the cleanliness of fiber optic components, follow the guidelines below:

- Use fiber patch cords (or connectors if you terminate your own fiber) only from a reputable supplier. Low-quality components can cause many hard-to-diagnose problems during an installation.
- Dust caps are typically installed on fiber optic components to ensure factory-clean optical devices. These protective caps should not be removed until the moment of connecting the fiber cable to the device. Ensure that the fiber is properly terminated, polished, and free of any dust or dirt. Also make sure that the location of installation is as free of dust and dirt as possible.
- Should it be necessary to disconnect the fiber device, reinstall the protective dust caps.
- If you suspect that the optics have been contaminated, alternate between blasting with clean, dry, compressed air and flushing with methanol to remove particles of dirt.

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