

Agilent Technologies

Troubleshooting Frame Relay

Application Note 1323

Testing and Troubleshooting Medium and High Speed Frame Relay Networks



Agilent Technologies

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Introduction

This Application Note will help you get the most out of your Agilent Advisor by showing you how to use it in a number of common frame relay installation and maintenance situations. You'll be exposed to a wide range of frame relay issues that include:

- troubleshooting strategies and techniques
- service provisioning
- equipment installation
- service/equipment configuration
- service/performance characterization
- network management

Agilent has worked with many equipment manufacturers and service providers to develop a wide range of measurements required for the installation and maintenance of frame relay networks. The Advisor simplifies the measurement process, speeding installation and maintenance activities.

Specialized frame relay testing features enhance the use of this versatile network monitoring and analysis tool for field support of frame relay services and equipment. The Advisor's unique combination of multiple interfaces and physical line level monitoring, statistical analysis, detailed decoding of LAN protocols, and simulation and traffic generation capabilities, help you do your job quickly and easily.

How to Use This Application Note

This Application Note focuses on the activities most often encountered in supporting frame relay permanent virtual circuits (PVCs) at the user-network interface (UNI). Each section includes a detailed description of how the Advisor can be used to accomplish a given task, and presents information that outlines the actual steps most often used in testing frame relay.

You can choose a section according to your specific needs and learn how to apply the Advisor to common network maintenance and troubleshooting tasks related to that area. The general testing procedures described can then be adapted to your specific network and service situation.

This Application Note assumes a basic understanding of frame relay and its frame formats, in-channel signaling processes, and primary uses. However, a brief frame relay primer is provided in Appendix A.

Overview of Test Strategies

The test methods demonstrated in this Application Note are straightforward. By breaking a problem or task down into smaller problems and tasks, any element or aspect of the service or equipment can be isolated for installation, maintenance, management, and troubleshooting. While other approaches such as inductive problem solving or input/output analysis can be used, procedural-based, "step-by-step" analysis is used throughout this Note.

Installation

The installation procedures presented here are used to demonstrate service access and service provisioning based on administratively determined reliability, performance, and management expectations. Following the test strategy shown in Figure 1, we break down an installation procedure into smaller, practical steps:

- Show that you can connect to the service (verify physical interface).
- Show that you can send and receive data at the expected line rate (verify physical layer).
- Show that the established link is reliable and that no unacceptable error indications exist (verify link layer).
- Make sure that in-channel signaling procedures are followed correctly (verify in-channel signaling).
- Make sure PVC's are assigned as agreed to (verify PVC assignments).
- Show, to a first level, that the service will perform data transfers as expected (verify data transfer).

Along the way, you need to be aware of any reliability problems, protocol problems, and other error or congestion indications.

Service Characterization

The service characterization procedure serves to assess and measure service performance according to administratively determined factors such as access rate, PVC configuration, and committed information rate (CIR).

Service performance characterization requires you to make measurements over a finite period of time to establish baselines for comparison, and expose trends and patterns. According to the testing strategy, this process is broken down into the steps shown in Figure 2:

- First, you need to know your link usage, reliability, and error indication characteristics.
- Then, you need to assess PVC usage, activity, and performance relative to expectations.
- Finally, you might want to characterize the internetwork by LAN type, in order to tune the service.

Installation Strategy

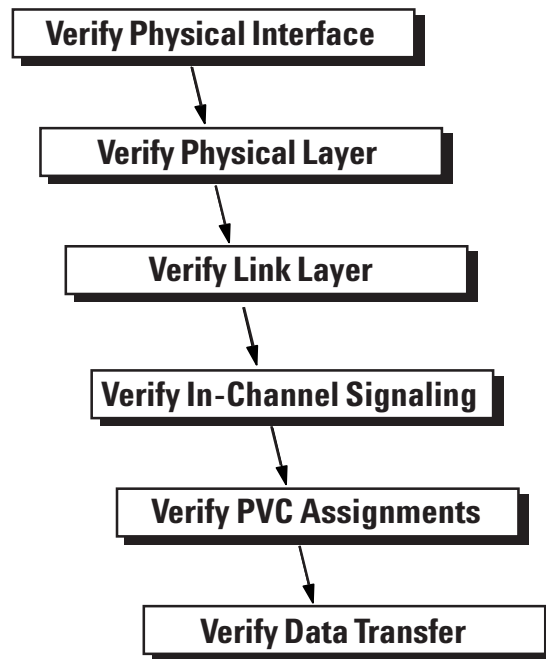


Figure 1.

Service Characterization

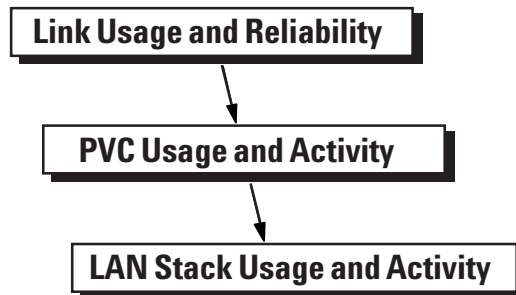


Figure 2.

Troubleshooting

The troubleshooting procedure lets you isolate the cause of a fault and resolve network trouble as quickly as possible. Some faults will be catastrophic while others will be intermittent. Troubleshooting catastrophic failures parallels the procedure used for installation. Troubleshooting intermittent problems will more likely follow the procedure for service characterization.

Frame relay is a link-layer protocol service that depends on a physical connection, a physical layer access port, the data-link layer, in-channel signaling procedures, and proper PVC configuration. Given this, troubleshooting frame relay networks can be summarized:

- First, you need to check the connections and cabling.
- Second, check the clocking and line rate.
- Third, check the integrity of the link itself, making sure that there are no unacceptable error indications.
- Fourth, you need to make sure that in-channel signaling procedures are being followed correctly, that PVCs are assigned as agreed to, and that equipment is configured correctly.

You also need to make note of reliability problems, protocol problems, and other error or congestion indications.

Supplied Tests

Throughout this Product Application Note, we refer to configuration short cuts called *supplied tests*. These supplied tests (or "canned tests" as they are often called) help you set up the network analysis task at hand by configuring the Advisor for a specific test situation. This saves you time by automating the configuration process and by providing a base from which to customize the Advisor's configuration for your unique testing needs. There are supplied tests for monitoring, simulation, traffic generation, and bit error rate testing. You can also create your own customized tests by editing existing ones. Please see Appendix B for more detailed information about the supplied tests referred to in this Application Note.

Connecting the Agilent Advisor to Frame Relay Circuits

This section provides basic connection information for T1, E1, HSSI, DS3, and V-series interfaces used to transport frame relay traffic. In addition, connection information is provided those situations in which frame relay is carried on ISDN Basic Rate S/T and U interfaces.

If you are not familiar with T1, CEPT-E1, DS3, V-series, HSSI, or the ISDN BRI interfaces, you can obtain or refer to information available from the standardizing bodies such as ITU-T, from equipment and service providers, and from tutorials produced by Agilent and other companies. Detailed connection diagrams and additional information can also be found in the Advisor WAN online Help.

Several connection types are commonly encountered in frame relay access circuits. In Europe and other countries conforming to CEPT- E1 primary rate recommendations, frame relay is commonly delivered to the subscriber through a channel service unit (CSU), which terminates the circuit from the central office (CO) and conditions the signals. Access by the user may be through CEPT-E1 directly, or through V-series connections such as V.35 or V.11, particularly if an intermediary data service unit (DSU) that converts the primary rate signals is used. In North America and Japan, frame relay is often delivered over T1 to a combination DSU/CSU, and user access is through V.35. Network backbones, trunks that interconnect ATM and frame relay networks, and connections between high performance enterprise LANs and frame relay switches often rely on higher speed DS3 and HSSI interfaces. Figure 3 shows one example of a frame relay topology.

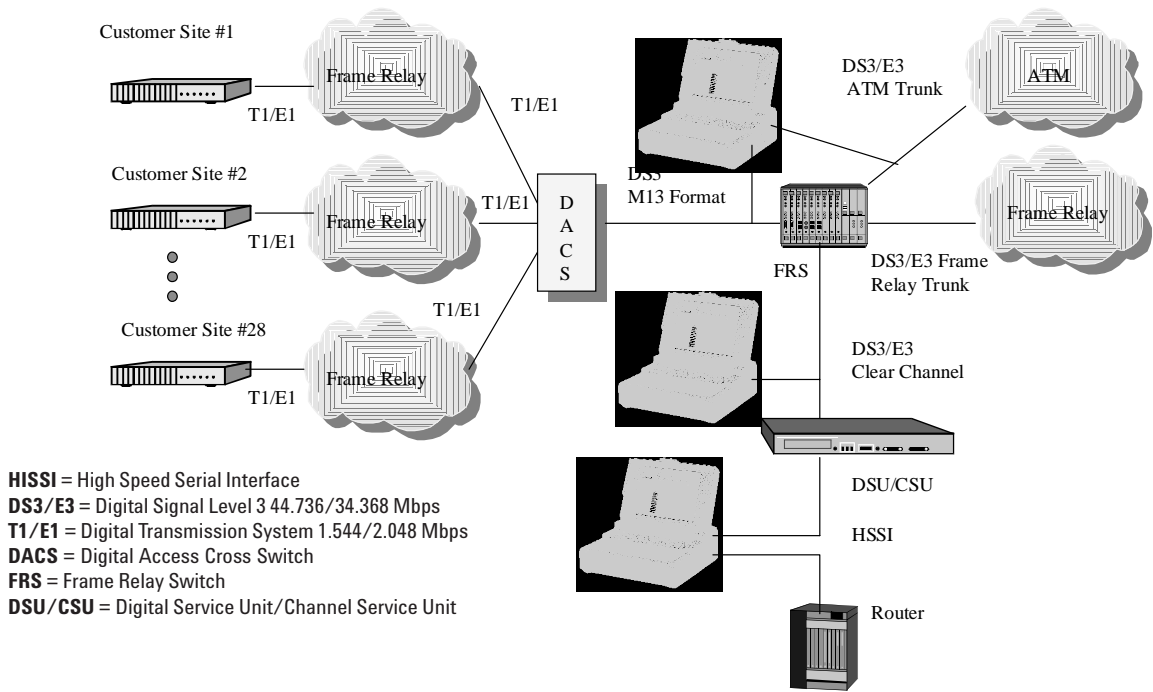


Figure 3.

CEPT-E1, T1, and DS3 Terminology

Before we discuss specific connections, it is useful to describe some common terminology used in T1, E1, and DS3 environments. Signals that originate in the network and are destined for subscriber or end user equipment are often referred to as **Line** signals (also known as NET signals). Signals that originate in the subscriber or user equipment are often referred to as the **Equipment** signals (also known as Customer Premise Equipment or CPE signals). Monitoring requires a connection that does not degrade or otherwise perturb signal levels. Fortunately, most CSUs and many network switches provide monitor jacks for this purpose. On the other hand, simulation and traffic generation usually requires the Advisor to be connected directly to the data circuit, replacing one side of the circuit (either the Line or Equipment side) entirely. When performing simulation or traffic generation, the Advisor must terminate the received signal and drive the signal belonging to the side being simulated.

To connect to the various interfaces on which frame relay traffic is found, the Advisor provides several slide-in interface modules. The front panels of the most commonly used modules are shown in Figure 4 and use the terms In and Out to describe signal direction. **LINE In** is where you connect the signal that comes in from the network (LINE) to this point, and **LINE Out** is where you connect the signal that comes out of this port to an entry point of the user equipment. **TO LINE** and **TO EQPT** are used to label connectors on the T1 and E1 DB-9 modules. **TO LINE** is where you connect the cable that goes to the network (LINE) to this point. You can find more information about installing interface modules in the Advisor Mainframe Features Manual.

NOTE: ALWAYS turn the Advisor's power off before removing or installing an interface module.

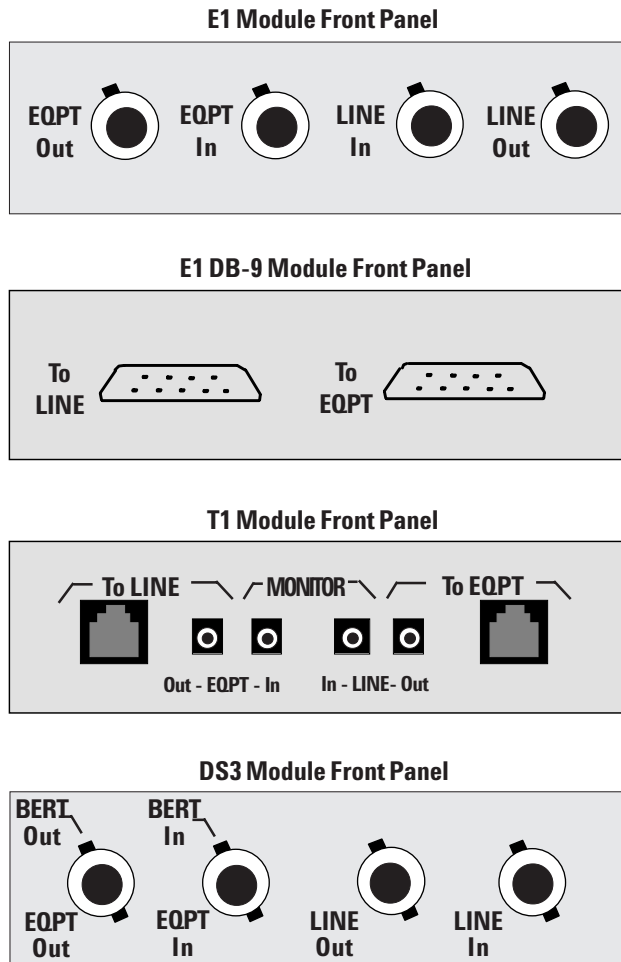


Figure 4.

Connecting the Advisor to T1, E1, and DS3

This section describes generally how to connect the Advisor to T1, E1, and DS3 circuits. The Advisor WAN online Help also provides connection diagrams and information for all supported interfaces.

Figures 5 and 6 show the configurations most often encountered in T1, E1, and DS3 environments. For E1, the user/subscriber's frame relay access device (FRAD) connects to the CSU. The CSU, local loop, and line termination unit (LTU) in the frame-relay switch (FRS) in the central office are completely under the control of, and can be accessed by, the public network operator (such as the PTT). These interfaces may vary widely from country to country, with unique signal level, line coding, and multiplexing implementations. Monitoring CEPT-E1 between the CSU and the customer equipment generally conforms to the ITU-T recommendations. T1 may be accessed inside and outside the central office, between the CSU and the central office, and between terminating equipment such as the DSU or FRAD. DS3 lines are either most often located within a core network or between relatively large frame relay or ATM networks. Dedicated monitor points are often provided in central offices and at major nodes within the network.

Connection Locations for T1 and E1

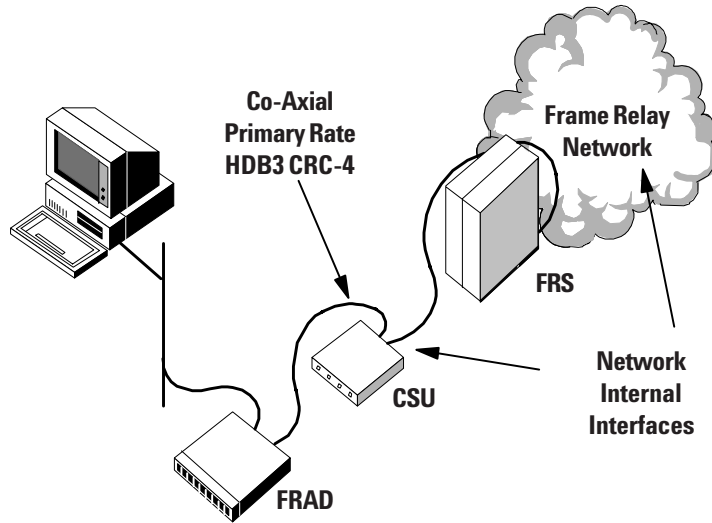


Figure 5.

Connection Locations for DS3

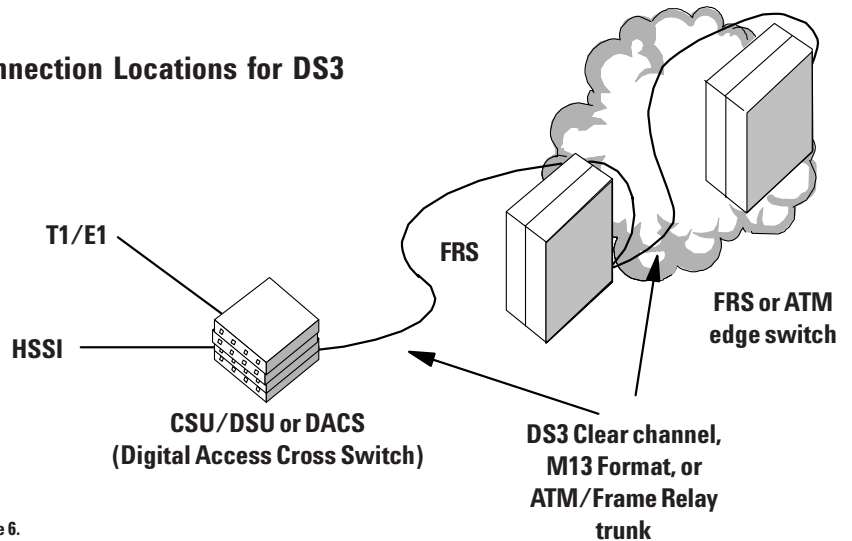


Figure 6.

Monitor Connections

Figure 7 shows the connection you would use (regardless of the connector type) to monitor frame relay traffic when the signals need to be passed through the Advisor. You would use this connection when dedicated monitor jacks are not available. If you were going to monitor at dedicated CSU monitor jacks, you would use just the **EQPT In** and **LINE In** connectors on the module. The CSU connectors will be labeled to indicate which are for the line signals (Out) and for the equipment signals (In), and CPE connectors also will have similar indications as well. **Note:** pay close attention to the labeling on the Advisor's DS3 interface module. Older versions of this interface module differ from newer models.

General Connection for Monitor Bridged or Simulation (Drop and Insert) on E1, T1, or DS3

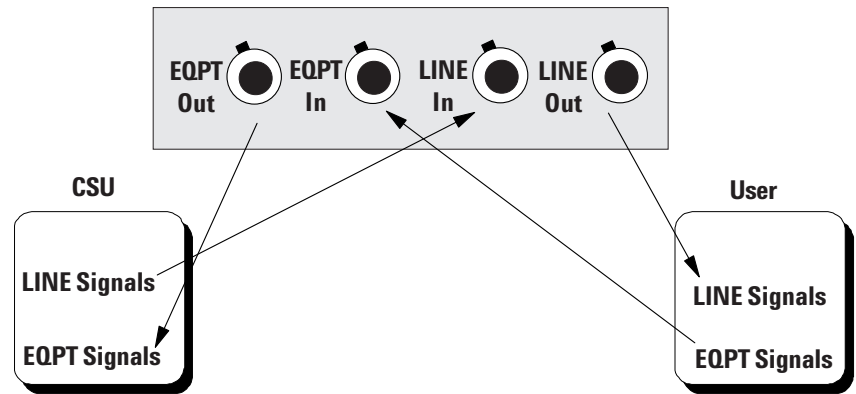


Figure 7.

Connections for monitoring T1 may vary in the central office, in the jack field, and with the CSU and DSU. Monitoring jacks (labeled Line Mon or Eqpt Mon) may or may not be present. Different styles of connectors may be used, typically mini-bantams (sometimes called miniature WECO connectors) or RJ-48C (the familiar phone-jack style) connectors. Some CSUs may be outfitted with a D-type connector for T1 circuit access. If so, a D-type to RJ-48C adapter can be used to connect to the Advisor. Situations may exist where you will actually need to clip-on to the signal leads.

Simulation / Traffic Generation (Drop and Insert) Connections

When you need to simulate or generate traffic on specific T1, E1, and DS3 channels, you would use the connection shown in Figure 7. Using this connection, and depending on how you configure the software, the Advisor will insert specialized traffic onto selected channels while retransmitting received network traffic on to its destination. Please see the Advisor's online Help for details on its 'drop and insert' capabilities.

Simulation / Traffic Generation (User Side) Connections

When the Advisor is used to simulate the frame-relay customer premise equipment (CPE), **Equipment** signals originate from the Advisor, and the **Line** signals coming back from the network are terminated by the Advisor as shown in Figure 8. Depending on whether the Advisor is configured for emulation, it may also respond to the network with appropriate signaling and other messages. Because monitor jacks or other monitor points buffer the signals to protect the operating network, the Advisor is connected directly to the circuits.

General Connection for Simulating End User Equipment on E1, T1, or DS3

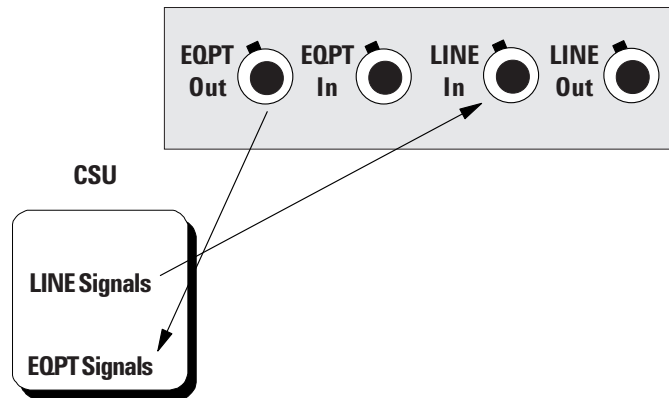


Figure 8.

Simulation / Traffic Generation (Network Side) Connections

When the Advisor is used to transmit data as if from the network side of the connection, the **Line** signals originate from the Advisor, and the **Equipment** signals are terminated by the Advisor as shown in Figure 9.

Note: for frame relay, this connection is used for network side BERT or custom traffic generation only. Network emulation is not performed.

V-series and HSSI Terminology

V-Series and High Speed Serial Interfaces (HSSI) use the terms DTE (Data Terminal Equipment) and DCE (Data Communications Equipment) to refer to the source and direction of network traffic similar to the terms Equipment and Line in T1, E1, and DS3 environments. DTE and DCE are synonymous with Equipment and Line respectively.

General Connection for BERT and Traffic Generation from the Network Side on E1, T1, or DS3

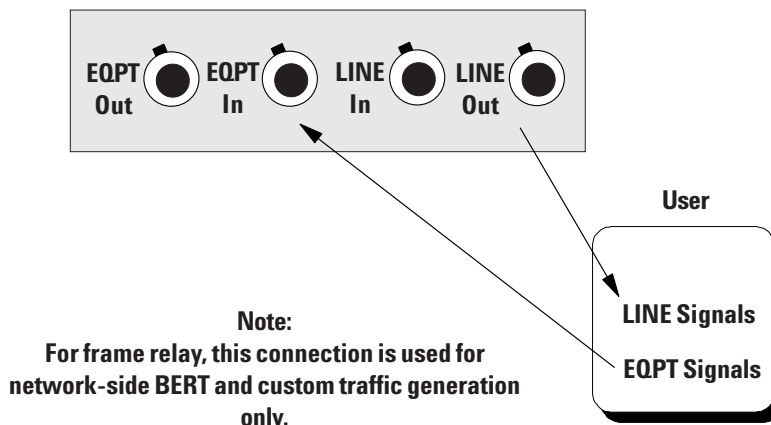


Figure 9.

Connecting to V-series (V.35, V.11, V.36 (RS-449) or V.24 (RS-232))

Connecting the Advisor to V-series interfaces between the DSU or CSU/DSU and the frame-relay equipment (CPE) is straightforward compared to connecting to T1, E1, or DS3. Monitoring V-series between the user equipment and the CSU/DSU requires a Y-cable. Simulating the user equipment or DTE requires connecting the Advisor to the DSU or CSU/DSU, and simulating the network requires connecting the Advisor to the user equipment. V-series connection diagrams can be found in the Advisor's online Help. Cable length for V-series connections can sometimes be an issue. Please refer to Appendix C for more information.

Connecting to High Speed Serial Interfaces (HSSI)

Similar to V-series interfaces, connecting to a High Speed Serial Interface (HSSI) is straightforward. This interface usually occurs between a frame relay access device (FRAD) such as a router and a CSU/DSU at the customer/provider demarcation (see Figure 10). Whether you are connecting to monitor or generate traffic, you will need to momentarily break the physical connection between the FRAD and the CSU/DSU.

Monitoring HSSI

Figure 11 shows the HSSI interface module and the connection used to monitor traffic on a HSSI link. This connection is made using HSSI SCSI II cables connected to the Advisor's female ports. The Advisor regenerates signals in both directions. Normally, the total length of HSSI cable between DTE and DCE devices should not exceed 50 feet. However, because the Advisor regenerates received signals, the cable on either side of the Advisor can be as long as 50 feet resulting in a total cable length between the DTE and DCE of 100 feet.

HSSI Frame Relay Physical Interfaces

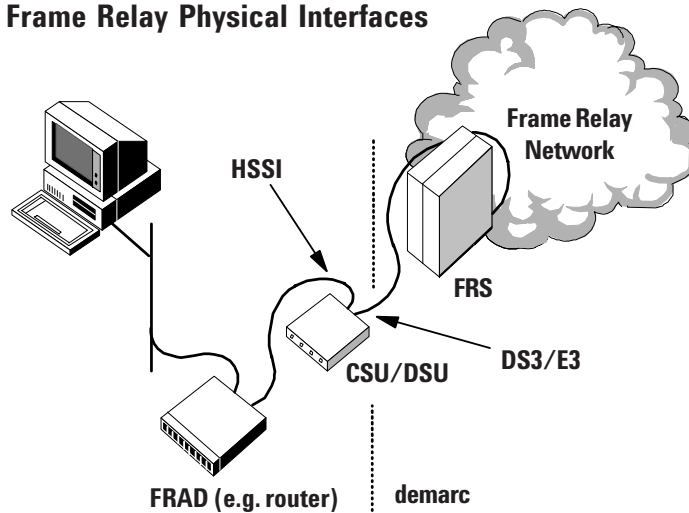


Figure 10.

Generating Traffic on HSSI

If you are going to be using the Advisor's traffic generation capability to simulate either frame relay network equipment (DCE) or user equipment (DTE), you can use the connections shown in the lower portion of Figure 11. This connection provides the appropriate termination for incoming signals. As with the monitor connection discussed previously, HSSI SCSI II cables are used and the cable length between the Advisor and the DTE or DCE must not exceed 50 feet.

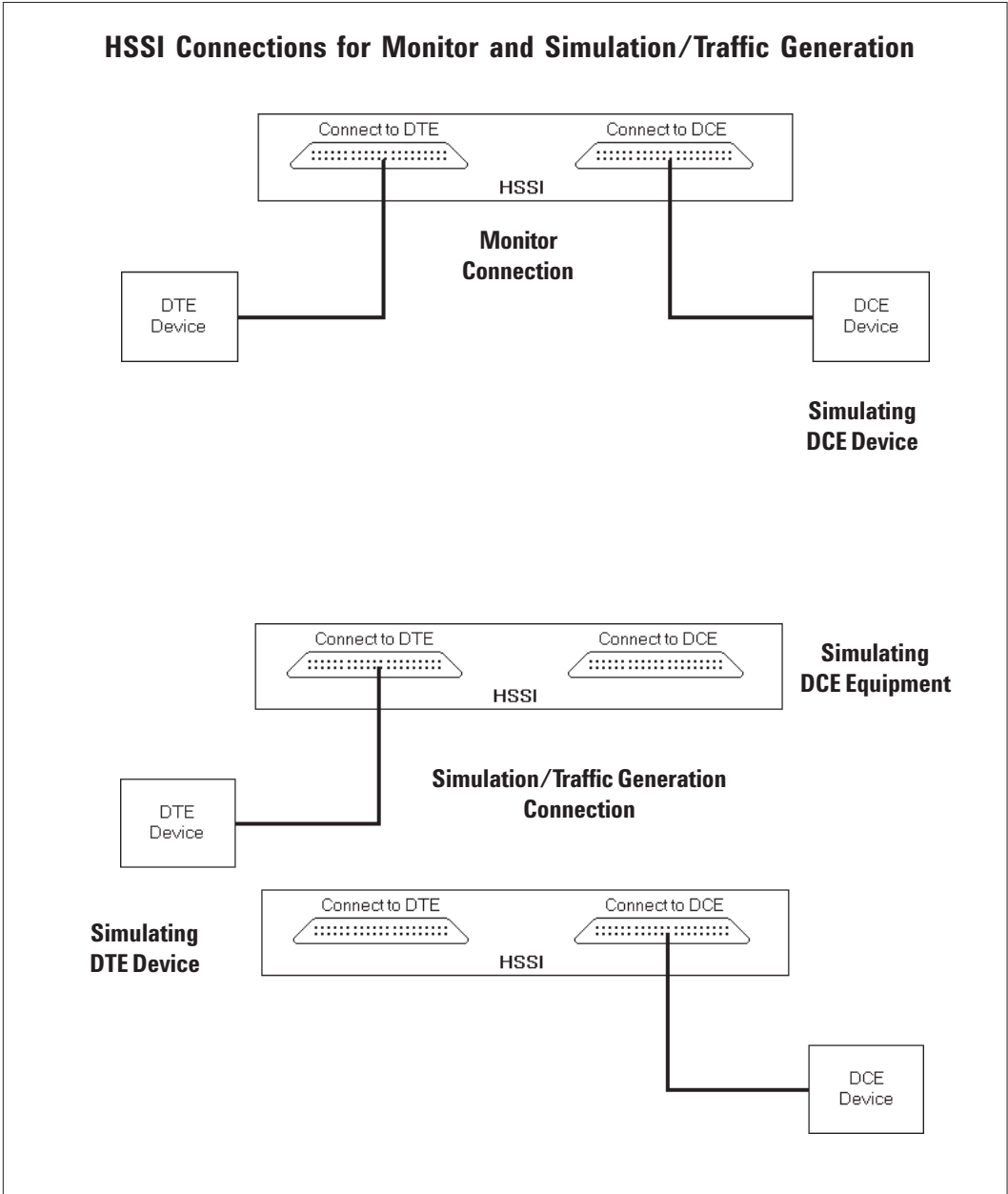


Figure 11.

ISDN BRI S/T and U Terminology

There are specific terms used to identify points within an ISDN network and ISDN equipment. An ISDN primer is beyond the scope of this document, but Figure 12 shows a basic network topology. TE, TA, NT, LT, ET are all classes of ISDN devices that reside at specific places in the network and perform specific functions. Figure 12 also shows where these devices are located relative to interface reference points and the service provider / customer demarcation.

Note: Frame relay traffic is always carried on one or more ISDN B-channels. This Product Application Note covers analysis performed with the Advisor's frame relay application only. To perform ISDN D-channel testing (that is, test ISDN out-of-band signaling), you will need to use the Advisor's ISDN application.

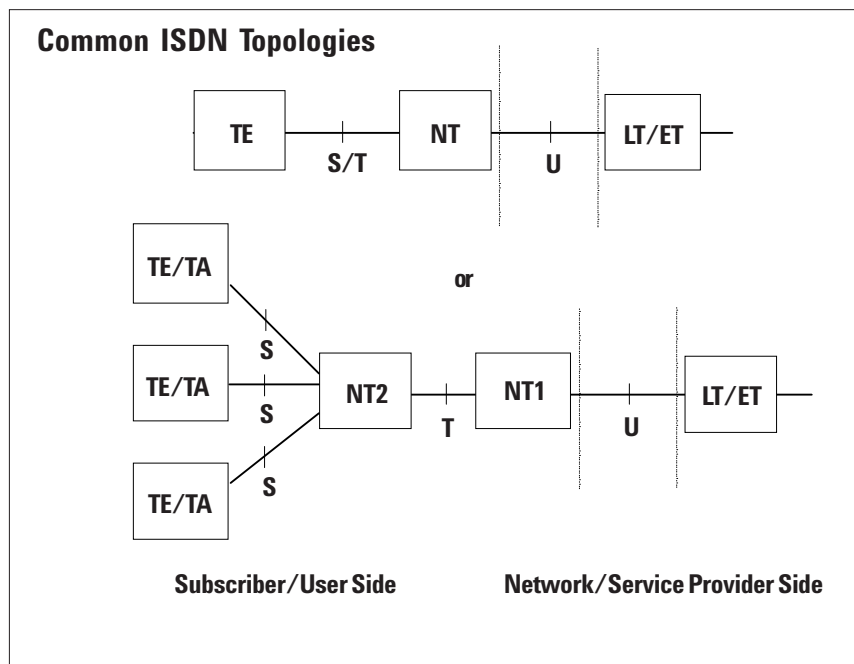


Figure 12.

Connecting to BRI S/T and U Interfaces

Similar to T1, E1, and DS3, the Advisor provides for Basic Rate Interface (BRI) connections through the use of interface modules. There are two basic types: an S/T-only module and a combined S/T and U module (shown in Figure 13). Generally, access to the S/T reference points within an ISDN network is similar world wide usually occurring on the customer premises. Access to the U reference point may be limited depending on which country you are testing in. Typically, in North America and Japan, the U interface is available to customer testing. However, in Europe only the service providers can test at this point. In some cases, reference points may simply not exist because the functionality of TE, NT, or LT devices is combined into a single component.

Monitoring BRI S/T and U

To monitor frame relay traffic at S, T, or U interfaces, you will need to place the Advisor between network devices as shown in Figure 13. For S/T interface connections, both connectors are electrically identical, and either can be connected to TE or NT devices. Network traffic is passed through the Advisor and signal regeneration is not performed. For U interface connections, however, you will need to conform to the labeling on the interface module. In addition, the Advisor regenerates the signals that pass between the NT and LT, but with the Advisor stopped (or even powered down) the U interface allows signals to pass through with no regeneration. What this means is that if the NT and LT are communicating when a monitor run is stopped or started, the connection will be momentarily disrupted. Both connections use RJ-45 cables.

Note: S/T connectors exist on both the S/T-only interface module and the S/T and U interface module. The connections shown here are the same in either case.

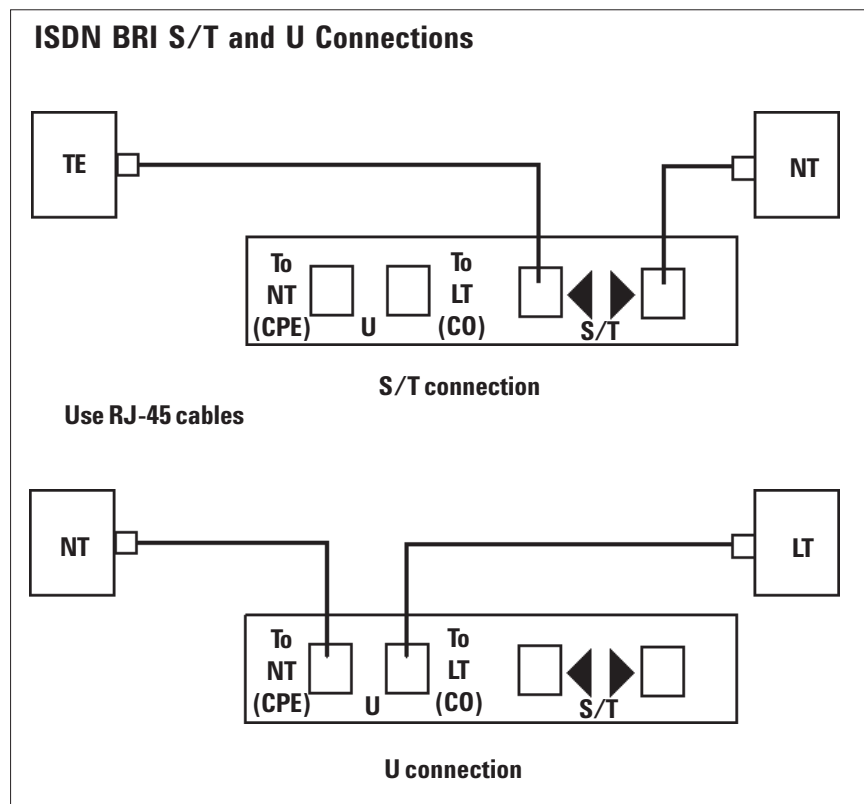


Figure 13.

Verifying the Physical Interface and Physical Layer for T1, CEPT-E1, and DS3 Circuits

One of the first and most important tasks in installing, maintaining, or troubleshooting a frame relay network is to verify that the physical layer of the T1, CEPT-E1, or DS3 access ports operates correctly. An inactive access port in the equipment, CSU, or network may indicate a bad cable, a bad connector, or a bad port. The Advisor provides the tools to verify a T1, CEPT-E1, or DS3 circuit quickly.

Note: throughout this section and the remainder of this Product Application Note, all testing that requires the Advisor to transmit traffic is referred to as simulation. This includes both network emulation and pure traffic generation. Regardless of the test you intend to perform, you need to make sure the physical layer and interface is operating correctly. This insures that the Advisor is connected correctly and that upper layer processes are not adversely affected by problems at the physical layer.

Starting the Advisor WAN Application

Connect the Advisor to the network so you can perform either monitor or simulation tests. If you are verifying an existing frame relay service, connect for monitoring. If you are installing or troubleshooting the frame relay network interface, connect for user/equipment-side simulation. Connection diagrams are available earlier in this document and in the Advisor's online Help.

To start the Advisor frame relay application, click the Start button in the lower left corner of the Windows desktop. Select the supplied test that most closely matches your testing needs. See Appendix B for more information about the Advisor's supplied tests.

Once the Advisor WAN application is started, you may still need to fine-tune the configuration for your connection and the analysis you intend to perform. It is important that the Advisor's physical interface configuration match the conditions at the connection point so that physical layer problems are not falsely reported. Configuration issues for the E1, T1, and DS3 interfaces are covered next. Use the Advisor's online Help to learn about the individual parameters you will need to set.

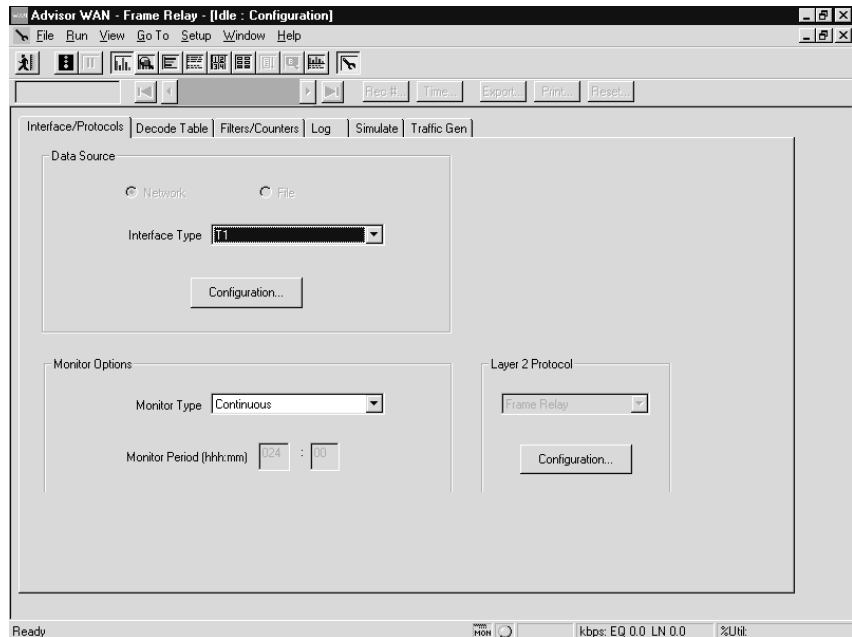


Figure 14.

Fine-tuning the Configuration

You need to take the following issues into account as you configure the Advisor for the T1, E1, or DS3 interfaces. You will find all of the Advisor's configuration parameters in the Configuration view (see Figure 14). This view contains a number of folders, each concerned with a specific aspect of the Advisor's set up. Please refer to the Advisor's online Help for specific parameter and procedural information.

- **Two Main Areas to Configure**

When you verify or fine-tune the Advisor's configuration, you need focus on two main areas. The first is the physical interface configuration which affects whether the Advisor will correctly interpret and format the characteristics of the electrical signal and bit stream detected and transmitted at the connection point. You access these parameters by clicking the Configuration button in the Interface/Protocols folder (see Figure 14). The other area of configuration affects the kind of data the Advisor collects or the kind of traffic it transmits. These characteristics are controlled in the other folders in the Configuration view and are described in more detail below.

- **Run Mode**

The Run Mode, found in the T1, E1, and DS3 Configuration dialog boxes, defines the main type of testing the Advisor will perform. This parameter affects the other parameters you must set (or verify) and the measurements that are available.

- **Other Common and Important Parameters**

For T1, E1, and DS3, the main physical interface parameters you need to be concerned with are: Receiver Mode, Type (T1 only), Line Code, Framing, Transmit Clock, and Data Channelization. The settings provided by the supplied tests are correct for most test situations, but sometimes one or more of the above parameters need to be adjusted. For example, the Advisor can be configured to monitor (or transmit) on full T1, E1, or DS3 frames, or on one or more channels within them. Of particular interest is the Advisor's ability to distinguish between both DS1 (T1) and DS0 channels within the full DS3 frame. While in the physical interface Configuration dialog box, press F1 for more information.

- **T1 and E1 Auto Config**

For T1 and E1, the Advisor can automatically determine the appropriate settings for Receiver Mode, Line Code, and Framing. This is useful when you are testing in an unknown or unfamiliar environment. Auto Config is available in the T1 and E1 Configuration dialog boxes.

- **T1 and DS3 Line Build Out**

For T1 and DS3 interfaces, you can control the transmit signal levels for specific cable lengths or conditions at specific connection points. This parameter is found in the T1 or DS3 Configuration dialog boxes.

- **Analysis Type Configuration**

While most of this configuration is done for you when you select a supplied test, you can alter the kinds of data the Advisor gathers by configuring parameters found in folders in the Configuration view. For example, hardware filters/counters can be set to control exactly what is captured, decoding characteristics can be defined, statistics logs can be created, simulation scripts can be altered or built, and specialized traffic can be constructed and transmitted. See the Advisor's online Help for more detail.

Starting the test and interpreting physical layer results are covered next.

Starting the Test and Verifying the Physical Interface

To start a test, click the Start tool bar button in the Advisor's tool bar. Generally, the first thing you will want to do is look at the front panel LEDs and the Line Status view to evaluate signal, frame synchronization, alarm, and error conditions. Problems at this level should be addressed before any other troubleshooting can occur. The DS3 version of the Line Status view is shown in Figure 15. The T1 and E1 Line Status views look very similar and work essentially the same way. Press F1 while in any of these views to get detailed information.

If the T1, E1, or DS3 circuits are correctly terminated, either by user equipment, a CSU, network repeaters, or line termination units, the Advisor indicates good Signal and Frame Sync with green indicators on both Eqpt and Line in the Line Status view and the front panel LEDs. This indication generally means that the signal levels on the circuits are adequate for reliable communications.

If **signal loss** is indicated by a red Signal LED, the connections to the circuit may be wrong, the circuit itself may be disconnected or broken, the access ports may be down or bad, or the signals transmitted may be too small to be received. Once you eliminate the connections to the circuit as the cause of the problem, you need to check the circuit cable for continuity. If it checks out, then you need to test at the access ports to isolate the problem to one of them.

If you have an adequate signal, but **frame synchronization** problems are indicated (with a red Frame Sync LED), the signal levels may be marginal or the framing type and configuration could be other than that expected for frame relay. If, after checking the framing (typically ESF for T1, CRC-4 for E1, and C-Bit for DS3), you still get framing errors, you may want to check the signal conditioning and the basic reliability of the line. One condition that often affects signal and frame synchronization for T1 and DS3 interfaces is a configuration parameter called Line Build Out. This parameter controls the transmit levels of the Advisor. You may need to adjust this if you are simulating and are a long way from the CSU or DSU (or equipment).

Along with the important signal and frame synchronization indications, the front panel LEDs and the Line Status view both show **other physical layer operation and performance parameters**.

- For T1: Alarm Indication Signal (AIS), Yellow Alarm, and ESF Cyclic Redundancy Check (CRC).
- For E1: Frame Alignment Signal (FAS), AIS, Remote Alarm (similar to Yellow Alarm), and CRC.
- For DS3: Far End Alarm Channel (FEAC) , AIS, Yellow Alarm, Idle, P1/P2 Parity Error, C-bit Parity Error.

Line Status Statistical History

If you are not sure whether you have physical layer reliability problems, you can monitor the line for extended periods of time to see if any framing errors, frame slips, or other errors have occurred. These types of statistics are displayed in the spreadsheet in the lower portion of the Line Status view (see Figure 15). The following kinds of statistics are displayed:

- **General Line Status statistics** - the frequency and state of most of the conditions reported by the front panel LEDs and the 'soft' LEDs in the upper part of the Line Status view..
- **T1 ESF Facility Data Link (FDL)** - the Advisor is capable of decoding facility data link messages. When the messages are in use, the lower portion of the T1 spreadsheet will be used. These messages provide an additional way to check the T1 ESF circuit.
- **DS3 Far End Alarm Channel (FEAC)** - statistics related to alarms, errors, and states detected on the DS3 Far End Alarm Channel are displayed.

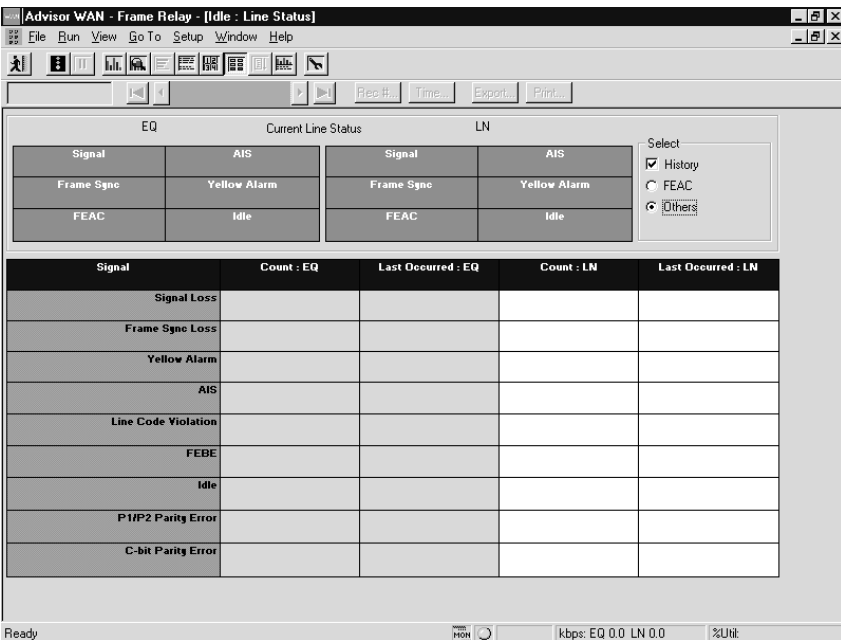


Figure 15.

Checking Reliability Using BERT

Physical circuit reliability is often expressed in terms of the bit error rate exhibited on the line and is determined by running a bit-error-rate test (BERT). BERT is usually run when the line (the physical wire) is pulled to qualify it for service provisioning. If this has not been done, or if you suspect that the line itself has become unreliable, the Advisor WAN provides BERT measurements for T1, E1, and V-series interfaces. The Advisor's ATM application provides BERT for DS3 interfaces.

Verifying Channelization and Port Access Rate

Once you know that you have good signal and frame synchronization, and that other error or alarm conditions are not an issue, you can examine other aspects of data transmission. Frame relay supports fractional channel services based on using the T1 and E1 time slots as well as DS1 (T1) and DS0 channels within the full DS3 frame. You may need to check the channelization of the data to be sure that the Advisor monitors or simulates on the correct channel. The number of time slots or channels used also determines the port access rate. For example, if six T1 (or DS0) time slots are used, the port access rate is 384 kbps (6 x 64 kbps) for most frame relay services.

You can use the Line Vital Statistics view shown in Figure 16 to gather more information about channelization and line rates. This measurement view displays frame and octet counts, utilization percentages, throughput, and counts of Abort and Short frames and FCS errors. If you see that almost all frames are aborted, you will want to check your channelization. Either the Advisor channelization is set incorrectly or the channelization of the data is other than expected. If you see that all or the vast majority of frames that are counted are good frames, then the Advisor channelization and line channelization are set correctly. Also notice the throughput. If these rates are different from what you expect, then either the Advisor is not configured for the correct channels or an administrative error associated with network and/or equipment (DSU) configuration is possible.

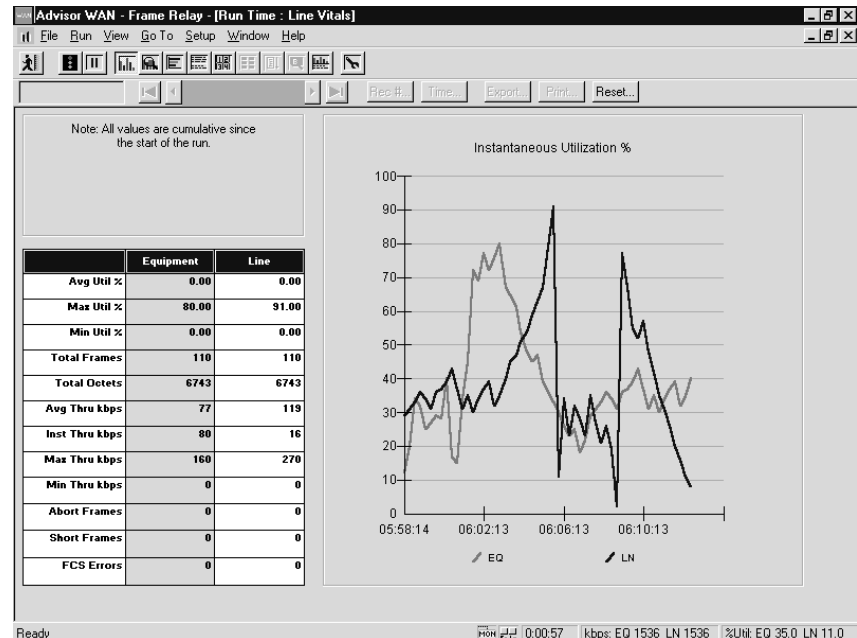


Figure 16.

Verifying the Physical Interface and Layer for V-Series Circuits

The user-side access to frame-relay service is often a V-series interface. As with T1, E1, or DS3 interfaces, the V-series access port must operate properly for the frame relay service to meet expectations. If the access port of the Equipment or DSU is not operating, you may have a faulty cable, connector, or port. The Advisor WAN provides the tools you need to test the V-series interface.

Starting the Advisor WAN Application

Connect the Advisor for monitoring or simulation. If you are testing an existing frame relay service, use a monitor connection. If you are installing or troubleshooting the frame relay network interface, connect so that the Advisor can emulate user/subscriber equipment. You can find connection diagrams earlier in this document or in the Advisor's online Help.

To start the Advisor frame relay application, click the Start button in the lower left corner of the Windows desktop. Select the supplied test that most closely matches your testing needs. See Appendix B for more information about the Advisor's supplied tests.

Once the Advisor WAN application is started, you may still need to fine-tune the configuration for your connection and the analysis you intend to perform. It is important that the Advisor's physical interface configuration match the conditions at the connection point so that physical layer problems are not falsely reported.

Fine-tuning the Configuration

The following information is useful as you fine-tune the Advisor for V-series interfaces. You will find all of the Advisor's configuration parameters in the Configuration view which contains a number of folders, each used for a specific aspect of the Advisor's setup. Please refer to the Advisor's online Help for specific parameter and procedural information.

- **Two Main Types of Configuration**

There are two types of configuration with which you need to be concerned. The first is the physical interface configuration which affects how the Advisor interprets and formats the characteristics of the electrical signal and bit stream. You access these parameters by clicking the Configuration button in the Interface/Protocols folder. The second type of configuration affects the kind of data the Advisor collects or the kind of traffic it transmits. These characteristics are controlled in the other folders of the Configuration view.

- **Run Mode**

The Run Mode, found in the V-Series Configuration dialog boxes, defines the main type of testing the Advisor will perform. The Run Mode you select affects other configuration parameters.

- **Other Common and Important Parameters**

Other aspects of the physical interface configuration are DTE Clock, Data Sense, Auto Seq Nums, Bits/Sec, and Baud Rate. If you are simulating, you probably want to set the Auto Seq Nums parameter to On so that the Advisor will generate and respond to Send Sequence and Receive Sequence numbers during in-channel signaling. For DCE simulation or traffic generation, you can set bits/sec and baud rate parameters.

- **Analysis Type Configuration**

While most of this configuration is done for you when you select a supplied test, you can alter the kinds of data the Advisor gathers by configuring parameters found in folders in the Configuration view. For example, hardware filters/counters can be set to control exactly what is captured, decoding characteristics can be defined, statistics logs can be created, simulation scripts can be altered or built, and specialized traffic can be constructed and transmitted. See the Advisor's online Help for more detail.

Starting the test and verifying the physical interface is covered in the next section.

Starting the Test and Verifying the Physical Interface

Start the test by clicking the Start tool bar button in the Advisor's tool bar. If the V-Series circuits are correctly driven by customer premise equipment (CPE), a DSU, or both, front panel LEDs will indicate transitions on the Data and Clock leads; that is, you will see both red and green Data and Clock LEDs indicating both Off and On states. Depending on what is happening on the interface, the Control LEDs will show either On or Off, or will transition as is necessary.

If any of the pairs of red and green Data and Clock LEDs are not both lighted, the signal is stuck in one state or the other, or is not connected. The connections to the circuit may be incorrect, the circuit itself may be disconnected or broken, the access ports may be inactive or malfunctioning, or the signals transmitted may be too small to be received. Once you've eliminated the connections to the circuit as the cause of the problem, you'll need to check the circuit cable for continuity. If the cable is sound, then you must test at the access ports to isolate the problem to one of the ports.

Port Access Rate, Throughput, and Common Errors

The Advisor measures the clock rate on V-Series interfaces at the start of each run. The measured line rate is displayed in kbps in the Status Bar at the bottom of the screen. You can also see frame and octet counts, throughput and utilization, and common errors in the Line Vital Statistics view.

Verifying the Physical Interface and Layer for HSSI Circuits

Before you can perform any protocol testing at the High Speed Serial Interface, you need to verify that this physical layer is operating correctly. Typically, HSSI connects high traffic frame relay access devices (FRADs) with the CSUs/DSUs that condition the signals before placing them on a DS3 or E3 trunk. Occasionally, HSSI is used for router-to-router or switch-to-switch connectivity as well.

Connect to the Network and Start the Application

Connect the Advisor for monitoring or simulation using the connection diagrams in the previous section. If you are testing an existing frame relay service, you will likely need to use a monitor connection. If you are installing or troubleshooting new frame relay service, connect for user/subscriber simulation.

From the Windows® Start menu, select the supplied test that most closely matches your testing needs. This will start the Advisor WAN application.

Once you have started the Advisor WAN frame relay application, you may need to fine-tune the configuration provided by the supplied test. This is covered next.

Fine-tuning the Configuration

The following information is useful as you fine-tune the Advisor for High Speed Serial Interface (HSSI) testing. You will find all of the Advisor's configuration parameters in the Configuration view which contains a number of folders each used for a specific aspect of the Advisor's setup.

- **Two Main Types of Configuration**

There are two types of configuration with which you need to be concerned. The first is the physical interface configuration which affects how the Advisor interprets and formats the characteristics of the electrical signal and bit stream. You access these parameters by clicking the Configuration button in the Interface/Protocols folder. The second type of configuration affects the kind of data the Advisor collects or the kind of traffic it transmits. These characteristics are controlled in the other folders of the Configuration view.

- **Run Mode**

The Run Mode, found in the HSSI Configuration dialog box, defines the main type of testing the Advisor will perform. The Run Mode you select affects other configuration parameters.

- **Other Common and Important Parameters**

If the Run Mode is set to Monitor, you need only to set/verify that the Data Sense parameter matches that of the network. If the Run Mode is set to Traffic Generation or Simulation, you will need to set/verify the Kilobits/sec and Baud Rate parameters, one or both loopback parameters, and one or more user-configurable lead states. All of these physical interface parameters affect the results of your testing. For example, if the Data Sense parameter is set incorrectly, the front panel LEDs will show faulty operation. While in the HSSI Configuration dialog box, press F1 to learn more.

- **Analysis Type Configuration**

While most of this configuration is done for you when you select a supplied test, you can alter the kinds of data the Advisor gathers by configuring parameters found in folders in the Configuration view. For example, hardware filters/counters can be set to control exactly what is captured, decoding characteristics can be defined, statistics logs can be created, simulation scripts can be altered or built, and specialized traffic can be constructed and transmitted. See the Advisor's online Help for more detail.

Starting the test and verifying the physical interface is covered in the next section.

Starting the Test and Verifying the Physical Interface

To start the test, click the Start tool bar button in the Advisor's tool bar. A normally functioning HSSI circuit will show front panel LED transitions (both red and green LEDs) for the data leads (SD and RD) and the clock leads (ST, RT, and TT). If any of the LEDs are showing just one color, this means that no transitions are occurring on that lead and that data and/or clock signals are not being detected or transmitted. If this is the case, the connections to the circuit may be incorrect, the circuit itself may be disconnected or broken, the access ports may be down or bad, or the signals transmitted may be too small to be received. You also need to look at the control lead LEDs, TA and CA. For normal physical layer operation, these LEDs must be green indicating that both the DTE and DCE are available and able to transmit and receive data. Software LEDs that display the same information are also displayed in the HSSI Line Status view shown in Figure 17.

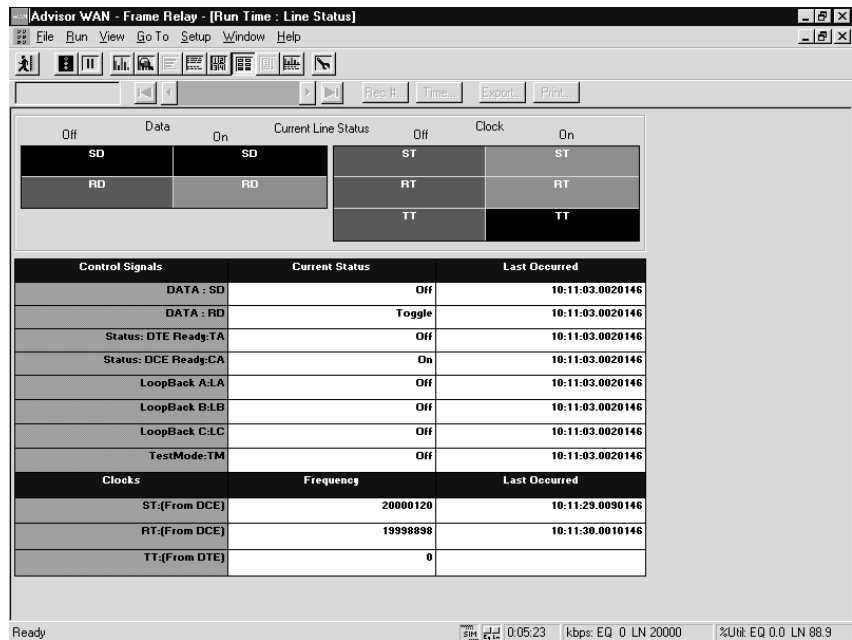


Figure 17.

In addition to the data, clock, and TA/CA control LEDs, you need to verify the state of the loopback leads as indicated by the LA, LB, and LC LEDs. Under normal circumstances, these LEDs will show red indicating that no loopback signals have been asserted by either side of the connection. However, if one side or the other sets a loopback lead, the corresponding LED will show green. Also, if you are doing simulation or traffic generation testing and have set one or more of the leads in the Advisor's Configuration dialog box, one or more of these LEDs will show green. During physical layer testing, you need to verify that the loopback LEDs correctly reflect the conditions you expect.

The HSSI Line Status view in the Advisor's user interface also shows real time LEDs, and provides other useful physical interface operation information as well. While in this view, press F1 for more information.

Along with the lead states, you can also check the HSSI line rate by looking in the lower right corner of the Advisor's display. The measured line rate is displayed in kbps in the status bar.

Verifying the Physical Interface and Layer for BRI S/T and U Circuits

An exhaustive description of ISDN Basic Rate S/T and U physical layer testing is beyond the scope of this Application Note. However, we will present some basic guidelines that will help you to know whether the physical interface is operating correctly and whether the Advisor is correctly connected and configured.

Note: in the context of frame relay, ISDN Primary Rate Interface (PRI) testing falls under T1 and E1 testing covered earlier in this document.

To begin, connect the Advisor at one of the Basic Rate Interfaces (BRI) S, T, or U so that you can monitor the traffic between TE and NT (for S/T) or NT and LT (for U) devices. The S/T and U interfaces use the same type of cable and connectors, so be sure which interface you are testing before connecting. As shown in an earlier section, this usually requires you to temporarily break the connection to place the Advisor into the signal path. You can also find connection diagrams in the Advisor's online Help.

To start the Advisor application, select a frame relay supplied test designed for monitoring. Remember, you will be monitoring frame relay traffic carried on one or more ISDN B-channels, so a likely test choice is the Frame Relay on ISDN Calls test. Please see Appendix B for more information about supplied tests.

Starting the Test and Verifying the Physical Interface

Start the test by clicking the Start tool bar button in the Advisor's tool bar. For S/T interfaces, the front panel LEDs indicate the status of the interface as soon as you connect the cables and before you start the test. However, the U interface LEDs will indicate line status only after the run is started. For U interfaces, it can take up to 30 seconds for LED status to be displayed after test is started.

S/T Interface

ISDN devices connected via an S/T interface must exchange a series of 'handshake' signals called Info States before the data link layer (D-channel) can be established. The Advisor's front panel LEDs show which Info State the two devices have reached. For correct S/T interface operation, the Info 3 4 LEDs must show green. This also implies that the signal level is acceptable. The next thing to check are the Data LEDs. These LEDs show green when traffic is detected on the D and B channels. Look for occasional D-channel activity and more frequent B-channel activity. If you do not see D-channel activity, calls are not being established or maintained and therefore no frame relay traffic will be transmitted. Finally, check to see that at least one of the NT Power LEDs is green to indicate that the interface is powered. **Note:** the Advisor does not supply power to TE devices to which it is connected.

U Interface

At a minimum, correct U interface operation is shown when the Loss, Frame Sync, and Activation LEDs are green for both the NT and LT sides of the test connection. You then need to look at the Error LEDs to make sure that no CRC, FEBE, or AIB errors are present. Finally, look at the D-channel LED to make sure D-channel signaling appears to be occurring (occasionally lighted green) and that the B-channel LEDs are showing data transfer (that is, frame relay data moving across interface).

Note: to perform ISDN D-channel signaling and B-channel BERT, you will need to use the Advisor ISDN application.

Installing and Verifying Frame Relay PVC Service

In the previous two sections you learned how to connect the Advisor for monitoring or simulation/traffic generation at the user-network interface. In addition, you learned how to use the front panel LEDs, the Status Bar, and the Line Status view to verify that the physical interface reliably transmits data. You also learned about failure symptoms and some of their potential causes.

This section continues where the previous two sections ended and shows you how to use the Advisor to install new frame relay service. That is, you will verify/troubleshoot service access and service provisioning at the user interface making sure that these conditions coincide with administratively determined reliability, performance, and management expectations.

Using the test strategy described earlier, we break the new service installation process down into several practical steps:

- First you need to show that you can connect to the service, that you can send and receive data at the expected line rate, that the established link is reliable, and that no unacceptable error indications exist.
- Then you need to make sure that in-channel signaling procedures are followed correctly, that PVCs are assigned as agreed to, and that data is transferred as expected.

Along the way, you need to note any reliability problems, protocol problems, and other error or congestion indications. Since the main objective for service installation testing is to activate the service access port, you will be using the frame relay in-channel signaling procedures that you expect the switch or customer premise equipment (CPE) to support.

Note: If you are unfamiliar with frame relay and its in-channel signaling procedures, please see Appendix A — *Overview of Frame Relay* — or refer to other information and standards on frame relay.

If you are a service provider, you may be installing a CSU and/or DSU or a device that combines these functions. If so, you may want to perform the tests described in this section at the network interface first, then at intermediary interfaces, and finally, at the actual user interface. Figure 18 shows an example of the sequence of test points that may be used for T1 circuits, where a service provider starts closest to the switch and verifies each interface prior to turning service over to the end user. **If you are an end user,** you may be installing your own DSU or CSU/DSU, and if so, you may want to perform these tests at each of the interfaces outlined in Figure 18 before attaching any equipment.

Note: since you will be installing frame relay service, these testing procedures describe how to simulate or emulate customer premises equipment (CPE). This type of frame relay emulation is not available for BRI S/T or U interfaces where D-channel signaling must be maintained.

Connect the Advisor, Select a Test, and Verify the Physical Interface

To begin, connect the Advisor such that you can simulate or generate traffic as if from customer premises equipment (CPE). Remember, what you are doing is verifying that the CPE can connect to and access newly provisioned frame relay service. You can find connection diagrams earlier in this Note and in the Advisor's online Help.

T1 Frame Relay Physical Interfaces

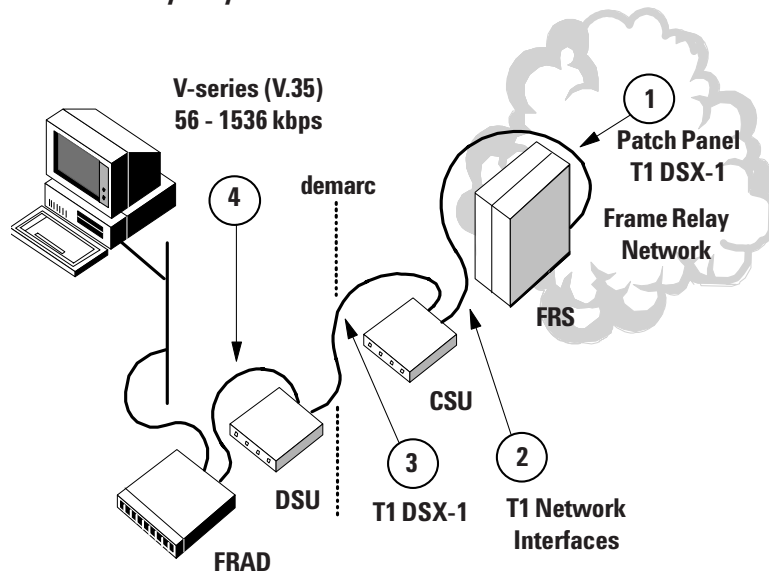


Figure 18.

Select the frame relay Auto User LMI simulation test that corresponds to the physical interface to which you are connected. This test will configure the Advisor to emulate customer premises equipment. You may need to fine-tune the physical interface configuration to match the conditions at the connection point. You would do this in the Configuration dialog box accessed from the Interface/Protocols folder. You may also want to alter the analysis configuration set up in the other Configuration folders to suit very specific measurement needs. Press F1 in any of these folders to learn more. Configuration issues are also covered earlier in this Note.

Start the test by clicking the Start tool bar button in the Advisor's tool bar. When the test starts, the Simulation Results view will be displayed automatically. If you see a screen similar to that shown in Figure 19, then the physical interface and basic LMI processes are probably operating correctly, and you can go on to the subsection *Verifying Link Integrity Verification (LIV) Procedures by Examining Decoded Frame Relay Traffic* to evaluate the details of LMI signaling. Otherwise, continue by using the procedures in the *Verifying the Physical Interface* sections earlier and those below to verify that there are no problems with the physical interface and physical layer.

Go to the Line Vitals Statistics view and check for Abort Frames, Short Frames, and FCS Errors. These statistics can provide additional help in determining whether the physical layer is operating as expected. If any of these errors are shown, you either have a physical layer problem that did not show up in the Line Status view or something is incorrectly configured. Depending on where you are testing, several likely causes exist: the T1, E1, or DS3 channel is not set correctly; the CSU/DSU or the switch is misconfigured (the settings are wrong); or a failure has occurred in either the CSU/DSU, the line, the repeaters, or the switch. As stated earlier, the advantage of starting these tests at the interface closest to the switch is that you can isolate problems in the network more quickly and easily.

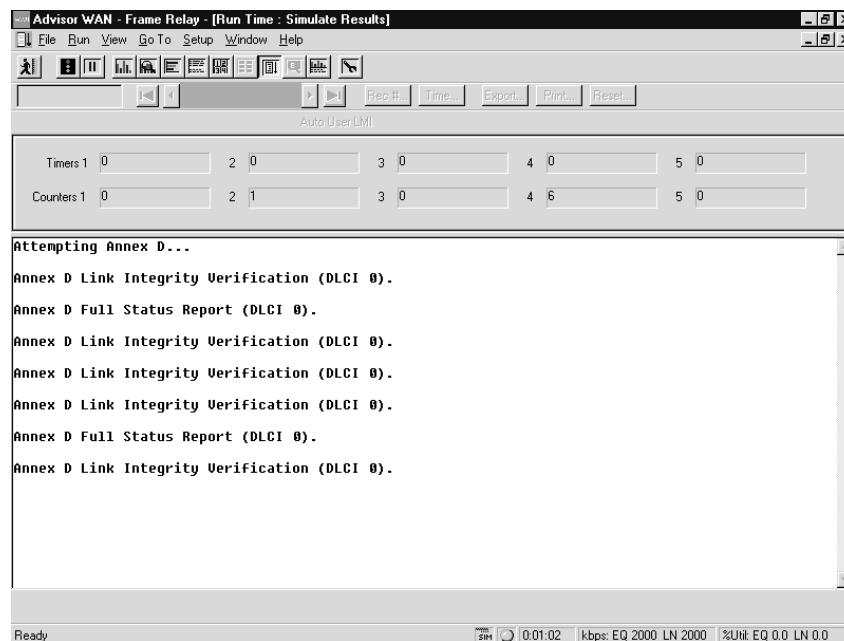


Figure 19.

Checking the Data Link Layer and In-Channel Signaling Procedures

Frame relay signaling procedures are such that signaling messages (known as Link Integrity Verification or LIV messages) are generated approximately every ten seconds. The Auto User LMI test that you selected to start the Advisor application uses the timing defaults specified in the ANSI and ITU-T recommendations and generates one Status Enquiry every ten seconds. If the frame relay service has been provisioned correctly, the network will respond with a Status message. This sub-section shows how to verify this Status Enquiry / Status message exchange.

Starting where you left off in the last sub-section, look at the Line Vital Statistics view. **If you see counts of both Eqpt and Line frames**, the network is probably responding to the Advisor as expected and you have successfully activated the network access port. **If you see zero Eqpt frames**, the Advisor may not be generating frames or there is a bad connection. If this is the case, double check the connections, the Advisor's interface configuration, and whether or not the Advisor is indeed configured to simulate user equipment. **If you see zero Line frames**, the network is not responding to the Advisor's Status Enquiry messages. In this case, you may need to check to see whether the network is correctly configured for the service you expect to be provisioned.

Another way to get more detail about what is happening on the link is to go to the **Filters/Counters Statistics** view shown in Figure 20. The supplied test you selected configured a number of filters/counters which count the Status and Status Enquiry messages passed between the Advisor (which is emulating customer premise equipment) and the network. There are several groups of these filters/counters sorted according to in-channel signaling versions Annex A, Annex D, or Original LMI. Only one of the groups will show increasing counts.

The counts shown in the **Filters/Counters Statistics** view (Figure 20) verify that the network is responding to each Status Enquiry sent by the Advisor with a Status message from the network access port; that is, the in-channel signaling procedure Link Integrity Verification (LIV) appears to be functioning properly. If the number of Status Enquiry messages sent and Status messages received is approximately equal, the network access port is generally responding as expected. If there is a relatively large difference between these numbers, stop and restart the run. After a minute or so, these counts should be equal, indicating that the switch is responding normally. You may want to repeat this procedure for each interface indicated by the numbers in Figure 18 until you have also verified the user interface itself. Once the user interface (the interface to which the CPE will be attached) is verified, then you may want to verify the PVC assignments and the ability to interchange data (covered later in this Application Note).

The next sub-section shows how to examine and verify the details of the LMI messaging between the Advisor and the network.

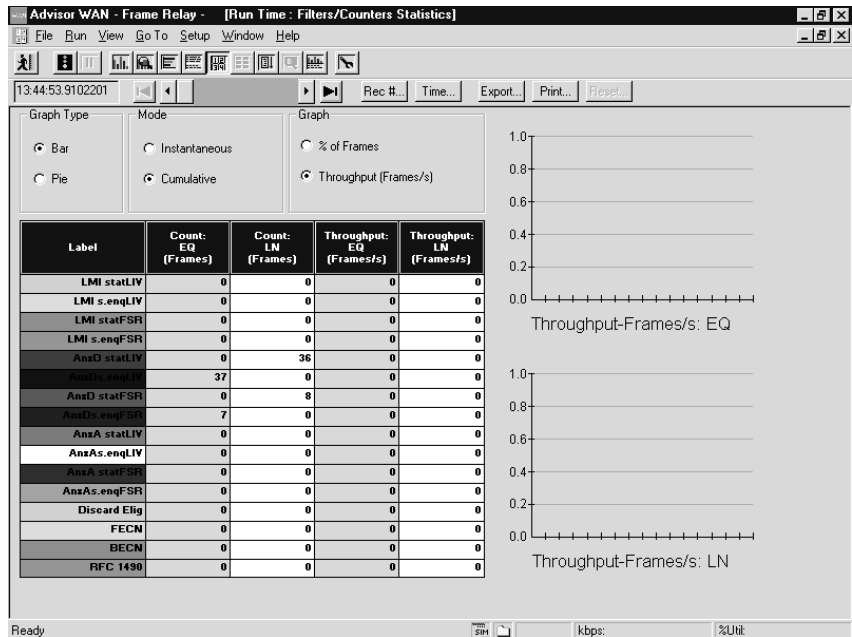


Figure 20.

Verifying Link Integrity Verification (LIV) Procedures by Examining Decoded Frame Relay Traffic

To verify that there are no protocol errors between the Advisor and the switch, you can use the Decode view. Specifically, you can examine the details of LMI signaling to verify that Full Status Reports are sent when requested and that the Send Sequence Number (SSN) and Received Sequence Number (RSN) interchange is operating correctly.

Frame relay requires that some number of the Link Integrity Verification (LIV) messages be correctly exchanged before the CPE (the Advisor in this case) requests and receives a Full Status Report (FSR). According to the recommendations and the Frame Relay Forum UNI Implementation Agreement, the default value for these interchanges is five (although other values are sometimes used). This means that the sixth message sent by the user after the network responds correctly five times will contain a FSR request, and if the in-channel signaling procedures are operating correctly, the network will return a Status Message containing an FSR.

From where we left off in the last sub-section, stop the Auto User LMI test by clicking the Stop tool bar button in the Advisor's tool bar. You will now examine the traffic in 'post-process' mode - that is, you will use the Decode view to look at the frame relay traffic held in the Advisor's capture buffer.

To verify whether the network responds correctly to the Advisor's request for a FSR, you can use both the Simulate Results view and the Decode view. Figure 19 shows the Simulate Results view in which both LIV and FSR messages are shown to have been received by the Advisor. You can scroll through these results to see the sequence of LIV and FSR messages that occurred. This lets you easily verify whether the correct number of LIV messages were sent and received before FSRs were sent and received. If you see LIV messages but no FSRs, the switch may be improperly configured or there is no PVC provisioned. To see decoded fields within these messages, go to the Decode view.

As shown in Figure 21, the Summary portion of the Decode view shows the Status Enquiry messages sent by the Advisor and the Status Messages sent by the frame relay switch. The LMI version (Original LMI, Annex D, or Annex A) is shown along with the DLCI value and CR, DE, FECN, and BECN conditions. (**Note:** on a fully functioning network, these frame relay signaling messages would be surrounded by other frame relay frames carrying data.) In the Detailed portion of the view, you can see the individual fields of the LIV messages decoded, and in the Hex portion of the view you can see the actual hexadecimal values associated with those fields. Scroll through the frame relay data noting the LIV messages. Scroll until you see an FSR request from the Advisor and the FSR sent in response by the network. Again, if you do not see FSRs, then either the Link Integrity Verification Procedure is not working or the switch does not have any PVCs configured to the link. You can also use the Search feature in the Decode view to find specific frames.

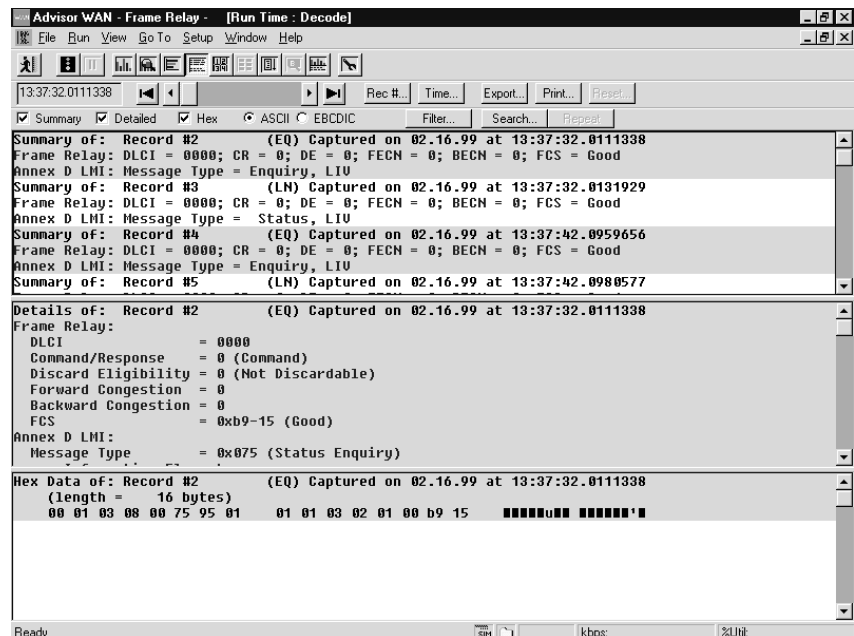


Figure 21.

Now you can verify that SSN and RSN procedures are working properly. With an LIV message positioned at the top of the screen, scroll through the Detailed portion of the view displaying the Send Sequence Number and Receive Sequence Number (shown in Figure 22). As you look at subsequent LIV messages, you should see that each LIV message sets its RSN equal to the SSN of the previous message sent by the other side and increment its SSN by one. If this is not the case, then the network's LIV procedure is not operating. If each RSN is set equal to the SSN of the previous message, and you cannot see a Full Status Report in any of the received Status messages, then the network may not have any PVCs configured to the link.

```
Details of: Record #3 (LN) Captured on
02.16.99 at 13:37:32.0131929
Frame Relay:
  DLCI = 0000
  Command/Response = 0 (Command)
  Discard Eligibility = 0 (Not Discardable)
  Forward Congestion = 0
  Backward Congestion = 0
  FCS = 0xfa-7b (Good)
Annex D LMI:
  Message Type = 0x07d (Status)
  --- Information Elements ---
  Locking Shift
  Report type = 0x001 (Link Integrity
Verification)
  Link Integrity Verification
    Send sequence num = 001
    Recv sequence num = 001
```

Figure 22.

Verifying PVC Assignments by Examining Decoded Frame Relay Traffic

This sub-section shows you how to verify which PVCs are available (active/inactive) and lets you see if the results correspond to what you expect (as determined by the agreement between the user and the service provider). You will also learn how to verify that data can be sent and received on the network.

In the Summary portion of the Decode view, scroll until you find a Full Status Report message sent by the network (you can also use the Search feature). Position the FSR at the top of the view. In the Detailed portion of the view, you should be able to see the entire decoded FSR frame (see Figure 23). This frame shows a list of the detected PVCs (listed by DLCI) and whether each is active or inactive. Using this list, you can verify that the PVCs you expect have been configured to the link, and that their status is as expected.

```
Details of: Record #29 (EQ) Captured on
01.27.97 at 10:35:28.1750216
Frame Relay:
  DLCI = 1023
  Command/Response = 0 (Command)
  Discard Eligibility = 0 (Not Discardable)
  Forward Congestion = 0
  Backward Congestion = 0
  FCS = 0x78-7c (Good)
Original LMI:
  Message Type = 0x07d (Status)
---- Information Elements ----
  Report type = 0x000 (Full Status
Report)
  Keep Alive Sequence
    Send sequence num = 177
    Recv sequence num = 178
  PVC Status
    DLCI = 0100 old active
    Reserved/Bandwidth = 0x01-f4-00/128000 bps
  PVC Status
    DLCI = 0120 old active
    Reserved/Bandwidth = 0x01-f4-00/128000 bps
```

Figure 23.

Verifying Network Connectivity Using Frame Relay PING

In this sub-section, you will learn how to use the Advisor to verify (to a first level) that data can be transmitted through the network successfully on selected PVCs. Using the Advisor, there are two main ways to do this:

- You can generate traffic onto a test PVC that is configured to echo back traffic. This is a technique often used by service providers using the Advisor's Traffic Generation feature.
- You can use the Advisor to PING remote network nodes on the PVCs you want to test. This is a technique often used by end users and subscribers, and is the technique we discuss here.

To send frames on one or more of the specified PVCs while maintaining the in-channel signaling procedures, you will use the frame relay PING test. When this test runs, it detects the signaling type and verifies that it is operating correctly. Then the Advisor sends a PING Echo Request message on the DLCI and to the IP address you specified. When the Advisor receives an Echo Reply, you know that network connectivity exists on the selected PVC.

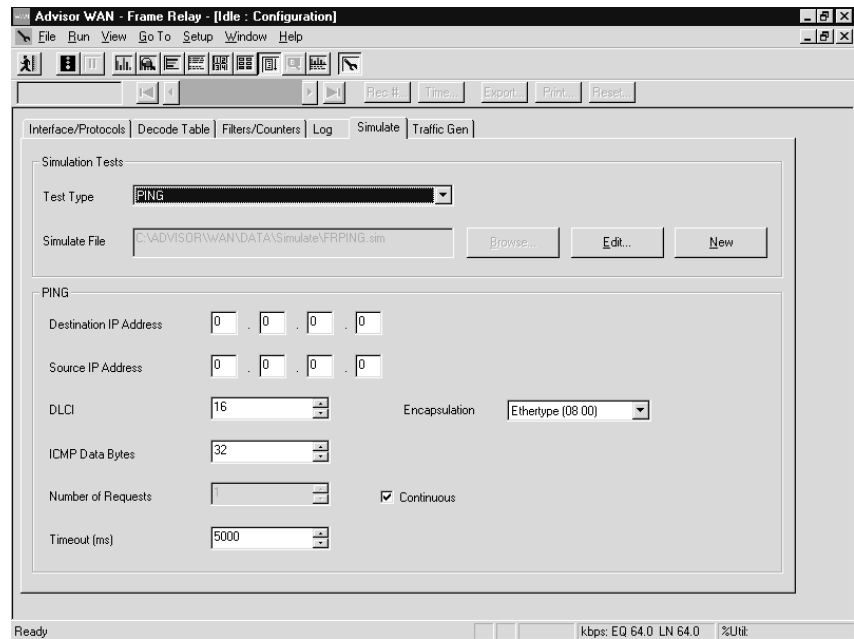


Figure 24

If you are continuing from the last sub-section, go to the Simulate folder in the Configuration view. In the Test Type list box, change Auto User LMI to PING. If you are starting here in this section, make sure you have exited the Advisor application, and select the frame relay PING supplied test from the Advisor menus in the Windows desktop. In either case, in the Simulate folder in the Configuration view, set the Source and Destination Addresses and the DLCI value appropriate for the test (see Figure 24). The DLCI value should correspond to the PVC you are testing. If the Advisor is emulating an IP node that is part of an existing subnet, you will need to use a known and appropriate Source IP address.

Start the test by clicking the Start tool bar button. The Advisor will determine the signaling type and begin LIV messaging. Once a number of LIV and FSR messages have been successfully exchanged, the Advisor will send ICMP Echo Request messages according to how the test is configured. If the PVC and the end node are both operating correctly, you should see Echo Reply messages in both the Simulation Results view and the Decode view. Figure 25 shows the Echo Request and Echo Reply in the Decode view.

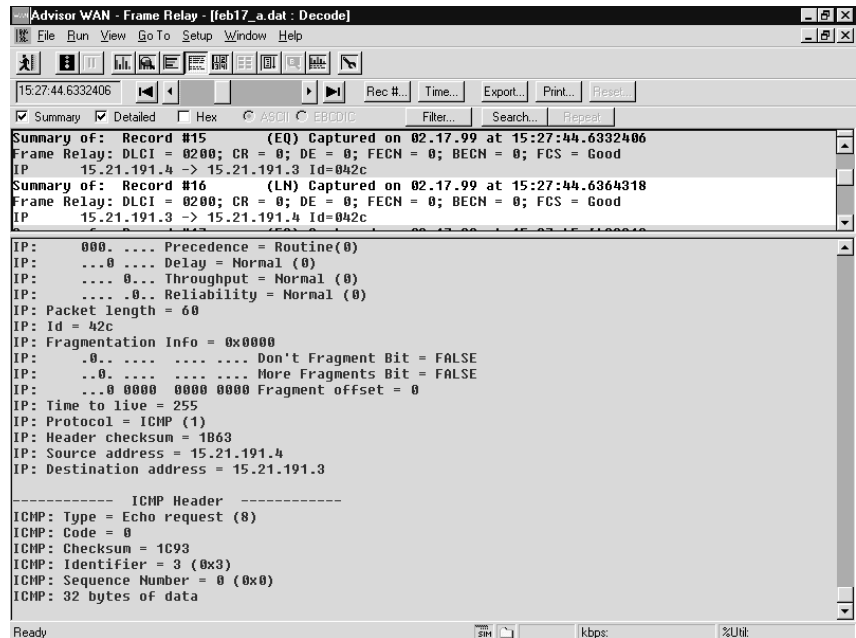


Figure 25.

Verifying PVC Configurations

In earlier sections, we discussed connecting to and testing the physical interface, and installing and verifying new frame relay service. This section describes how to verify the actual PVC (permanent virtual circuit) configuration of the network for both newly installed or well established segments.

Frame relay networks connect certain stations and route traffic between them over specific PVCs. Some of the problems that can exist are:

- Stations can be incorrectly numbered or labeled.
- The network topology may not be what is intended.
- Unexpected DLCIs might exist.
- Far-end devices may not respond.
- Other symptoms suggesting administrative or configuration problems.

In general, to verify a network's configuration, you need to demonstrate that Station A can transfer data to Station B over one designated PVC, that Station A can transfer data to Station C over another PVC, and so on.

Connect the Advisor, Select the Test, and Verify the Physical Interface

To begin, connect the Advisor to the network so that you can monitor the traffic between customer premises equipment (CPE) and the network. What you will be doing is examining a series of decoded frames to verify that the expected PVCs exist and that you can successfully communicate between stations on those PVCs. You can find connection diagrams earlier in this Note and in the Advisor's online Help.

Once you are connected, select a monitor supplied test to start the Advisor application. The test you select should correspond to the in-channel signaling version used on the network - for example, Annex A, Annex D, or Original LMI. See Appendix A for more information about frame relay's in-channel signaling and see Appendix B for more information about the Advisor's supplied tests.

Before you start the test, you may need to fine-tune the configuration provided by the supplied test to match the conditions at the connection point. You do this in the physical interface configuration dialog box accessed from the Interface/Protocols folder. Press F1 while in this dialog box for Help on the parameters you might need to set. In addition, you may want to alter the part of the configuration that controls the kinds of analysis the Advisor performs. You do this in the other folders in the Configuration view - again, press F1 while in these folders to learn more.

Finally, start monitoring the network by clicking the Start tool bar button in the Advisor's tool bar. Using the techniques discussed in previous sections of this Application Note, verify that there are no problems with the physical interface and layer. If the front panel LEDs and the Line Status view show normal operation, go on to the next sub-section.

Verifying PVC Configuration by Examining Statistical and Decoded Frame Relay Traffic

You can do a number of things to verify and evaluate the PVC configurations on an existing frame relay network:

- Use the DLCI Statistics view to see which PVCs are detected and to characterize the traffic levels associated with each.
- Use the Decode view to examine Full Status Reports to see the PVCs for which the network is configured..
- Monitor PINGS on select DLCIs to verify PVC connectivity.

These techniques are covered next.

Examine Detected DLCIs

To get a quick overview of the PVCs configured for the link, go to the DLCI Statistics view (shown in Figure 26). The Advisor displays the first 30 DLCIs it detects at the top of the view. This list should match what you expect in terms of existing PVCs. By clicking on any of the DLCI labels at the top of the view you display traffic statistics for individual PVCs such as throughput, utilization, and basic error and alarm counts. You can also change the graphical display to suit your needs.

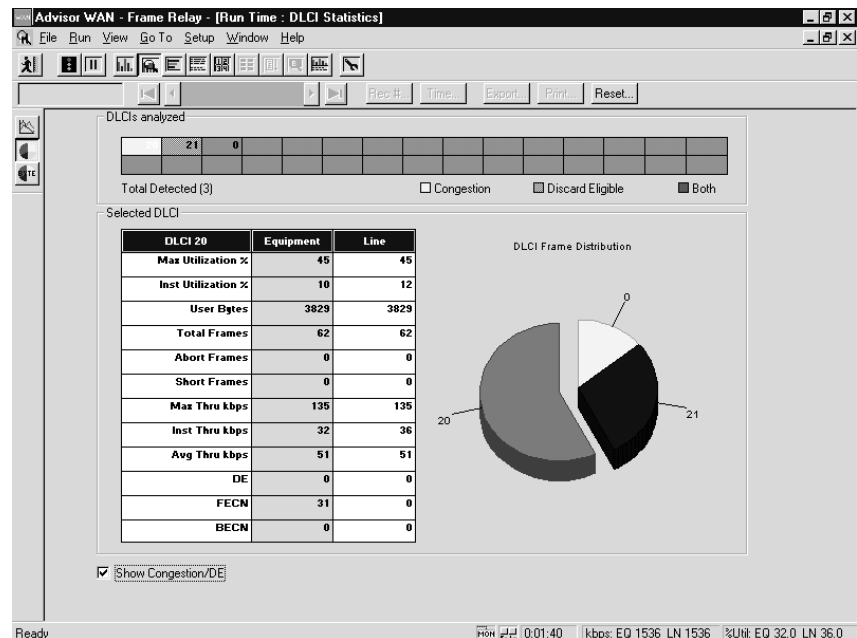


Figure 26.

Confirm That Detected DLCIs Match Network Configuration

The next step is to make sure the DLCIs detected by the Advisor match those for which the network is configured. Pause the monitor run by clicking the Freeze tool bar button. Go to the Decode view and scroll through the buffered frames until you find an FSR message (you can also use the Search feature). Look at the decoded FSR message in the Detailed portion of the view to see the status of existing DLCIs/PVCs (shown in Figure 27).

Compare the list of DLCIs shown in the DLCI Statistics view (those detected by the Advisor directly) to those shown in the FSR message:

- If DLCI Statistics indicate more DLCIs than that shown in the FSR message, then: (1) customer premise equipment (CPE) is attempting to use DLCIs not configured by the network, or (2) the network has deactivated DLCIs that have not been used by the CPE (rare).
- If DLCI Statistics indicate less DLCIs than that shown in the FSR message: the CPE is not using all the DLCIs configured by the network (normal behavior).

```
Details of: Record #29      (EQ) Captured on 01.27.97 at 10:35:28.1750216
Frame Relay:
  DLCI                = 1023
  Command/Response    = 0 (Command)
  Discard Eligibility = 0 (Not Discardable)
  Forward Congestion  = 0
  Backward Congestion = 0
  FCS                  = 0x78-7c (Good)
Original LMI:
  Message Type        = 0x07d (Status)
  - Information Elements -
  Report type         = 0x000 (Full Status Report)
  Keep Alive Sequence
    Send sequence num = 177
    Recv sequence num = 178
  PVC Status
    DLCI                = 0100 old active
    Reserved/Bandwidth  = 0x01-f4-00/128000 bps
  PVC Status
    DLCI                = 0120 old active
    Reserved/Bandwidth  = 0x01-f4-00/128000 bps
```

Figure 27.

Verify PVC Network Connectivity

To verify network connectivity, you'll want to transfer data from one station to another and monitor this with the Advisor. Continuing from the last subsection, resume the monitor run by clicking the Resume tool bar button. Initiate a series of PINGs from the stations that you want to check. Again pause the monitor run and find the PING messages in the Decode view. Figure 28 shows the decoded IP packet and the ICMP Echo Reply from the requested station. You can compare the source and destination addresses shown in the messages to the network topology to confirm that the workstations, servers, and routers are networked as expected.

```
Details of: Record #39          (LN) Captured on 02.16.99 at 13:27:38.5831134
Frame Relay:
  DLCI                = 0200
  Command/Response    = 0 (Command)
  Discard Eligibility = 0 (Not Discardable)
  Forward Congestion  = 0
  Backward Congestion = 0
  FCS                  = 0xa7-06 (Good)

----- IP Header -----
IP: Version = 4
IP: Header length = 20
IP: Type of service = 0
IP:   000. .... Precedence = Routine(0)
IP:   ...0 .... Delay = Normal (0)
IP:   .... 0... Throughput = Normal (0)
IP:   .... .0.. Reliability = Normal (0)
IP: Packet length = 100
IP: Id = 8c
IP: Fragmentation Info = 0x0000
IP:   .0.. .... .... Don't Fragment Bit = FALSE
IP:   ..0. .... .... More Fragments Bit = FALSE
IP:   ...0 0000 0000 0000 Fragment offset = 0
IP: Time to live = 255
IP: Protocol = ICMP (1)
IP: Header checksum = 1EDB
IP: Source address = 15.21.191.3
IP: Destination address = 15.21.191.4

----- ICMP Header -----
ICMP: Type = Echo reply (0)
ICMP: Code = 0
ICMP: Checksum = E654
ICMP: Identifier = 4382 (0x111e)
ICMP: Sequence Number = 527 (0x20f)
ICMP: 72 bytes of data
```

Figure 28.

Characterizing Service Performance

Characterizing network and service performance, also known as 'baselining', is a necessary part of routine network maintenance. This type of proactive network testing allows you to assess and measure service performance according to administratively determined factors such as access rate, PVC configuration, and Committed Information Rate (CIR). In addition, it yields important information regarding the value received by the end user, the distribution of usage across PVCs, and the demand for bandwidth by service type and network application.

The primary application of frame relay is to inter-network LANs. Because frame relay multiplexes many PVCs using different DLCIs, frame relay interfaces are convenient points from which to get an overview of network activity. With the Advisor's ability to decode LAN traffic encapsulated in frame relay frames, you can check to see if the LAN traffic is passing across the WAN as expected. If you are a service provider, frame relay interfaces may be the only places you can access the User-to-Network Interface (UNI) to help resolve internetwork trouble.

Service and network performance characterization generally depends on making measurements over a period of time in order to establish baselines for comparison and to expose trends and patterns. To baseline a frame relay network, typically, you will:

- Measure link usage and reliability.
- Measure error indication characteristics.
- Assess PVC activity, usage, and performance relative to expectations (e.g. CIR).
- Characterize internetwork usage by LAN type to tune the service.

Connect the Advisor, Select the Test, and Verify the Physical Interface

To begin, connect the Advisor so that you can monitor the traffic on the link you want to characterize (connecting the Advisor was covered in earlier sections of this note). Then select one of the frame relay supplied tests that corresponds to the physical interface to which you will connect and that provides counts of the type of LAN traffic you expect on the link. Regardless of the frame relay test you select, comprehensive LAN decoding will be performed.

As with the other testing procedures mentioned in this document, you may need to fine-tune the Advisor's physical interface configuration and analysis options (covered in detail earlier in this Note). Because of the nature of network characterization measurements, you will likely want to configure analysis options that support long term monitoring, that preserve limited Advisor disk space, and that expose trends and intermittent network behavior. To do this, you can use the following features:

- Monitor Options in the Interface/Protocols folder - this controls the time period the Advisor will monitor, allowing limited long term analysis.
- Hardware Filters/Counters - can also be used for long term monitoring, this feature preserves finite disk space by limiting the amount of captured data to only that which you need.
- Statistics Logs - creates 'snapshots' of statistical conditions at regular intervals during extended monitor sessions. This topic is covered in more detail later in this section.

See the Advisor's online Help for more information about any of these configuration options.

Once you are connected and configured, start the test by clicking the Start tool bar button. Use the procedures discussed earlier in this Note to verify that the physical interface and physical layer is operational. Specifically, you will use the front panel LEDs and the Line Status view (if available) to see if any problems are indicated.

Assessing the Access Port Usage and Reliability

Beginning with the Line Vital Statistics view (shown in a previous section), you can get a good overview of the performance of the link. This view presents throughput, utilization, frame and octet counts, and basic error counts all independent of the PVCs/DLCIs used or the LAN protocols that might be present. This measurement view provides the means by which you can evaluate the general health of the link. If you are monitoring for long periods of time and have configured the Advisor to log Line Vital Statistics, you will have an idea of how the link performs over time.

Assessing Usage by DLCI

The DLCI Statistics view (shown earlier in this document) provides information about the general health of frame relay traffic associated with a specific DLCI. The upper portion of the view shows the DLCIs (up to 30) that have been detected. By clicking on any of the DLCI values, you can see the throughput, utilization, counts of frames and bytes, and counts of basic errors for the selected DLCI. In addition, congestion notification errors are counted, and various measurement values can be graphed. It is in this view that you can see whether a specific PVC (as defined by a DLCI) is exceeding the CIR that has been negotiated. Again, logged DLCI Statistics can provide trend information over many hours or days.

Assessing Usage by LAN Stack

One way to characterize how frame relay service is being used is to see a list of the LAN protocols encapsulated in frame relay frames. During a monitor run, the LAN Protocols folder (found in the Display Filter Properties dialog box) is dynamically updated to show the LAN protocols detected in the monitored traffic. Once you know the type of LAN traffic occurring on the network, you can focus your analysis using hardware filters/counters and display filters to gather statistics on specific encapsulated LAN traffic.

Assessing Network Layer and IP Application Layer LAN Traffic

Two important supplied tests that can help you evaluate frame relay traffic based on the LAN traffic it carries are called 'Analysis of Network Layer LAN Protocols' and 'Analysis of IP Application Layer LAN Protocols'. These tests configure a number of hardware filters/counters to gather statistics on common LAN protocols. The Advisor's online Help and this Note's Appendix B both provide more information on these supplied tests.

Assessing Usage for Multiprotocol Encapsulation under RFC 1490

It is often useful to assess LAN traffic carried on frame relay by the encapsulation method that is used. One common method is RFC 1490. The Advisor provides several supplied tests that allow you to characterize frame relay usage based on this type of encapsulation. Two such tests are 'Analysis of Network Layer LAN Protocols (RFC 1490)' and 'Frame Relay Analysis per RFC 1490', both of which provide hardware filters and counters that target specific types of LAN packets encapsulated in this manner as well as frame relay LMI frames. In addition, a number of other supplied tests provide a single filter/counter that gives total counts of all LAN frames that are encapsulated per this RFC. The Advisor's online Help and this Note's Appendix B both provide more information on supplied tests in general.

Other Methods of Encapsulation

Besides the encapsulation method described by RFC-1490, others may also be in use. Encapsulation methods such as Ethertype (and others) are commonly used, and the Advisor provides supplied tests for this purpose. In addition, routers or bridges may have their own unique (proprietary) sub-layer(s) between the frame relay header and the LAN protocols. In this case, you would use the User Defined Bytes dialog box accessed from the Decode Table folder in the Configuration view. Using this dialog box, you can configure the Advisor to expect extra bytes between the frame relay header and the encapsulated LAN traffic as it displays decoded frames.

Assessing IP and IPX Traffic

If the frame relay network you are monitoring carries a substantial amount of IP or IPX traffic, you can use the Advisor's Top Talkers Statistics measurement (see Figure 29) to gather statistics specific to these protocols. Top Talkers shows which IP or IPX users are consuming the most bandwidth on a given link, and you can display this information as line utilization, throughput, frame rate, or percentage of total frames. To see the IP or IPX 'top talkers' on a specific PVC, you can set up hardware filters to limit captured traffic to the desired DLCI. In this way, you will see top talker statistics for the target DLCI only.

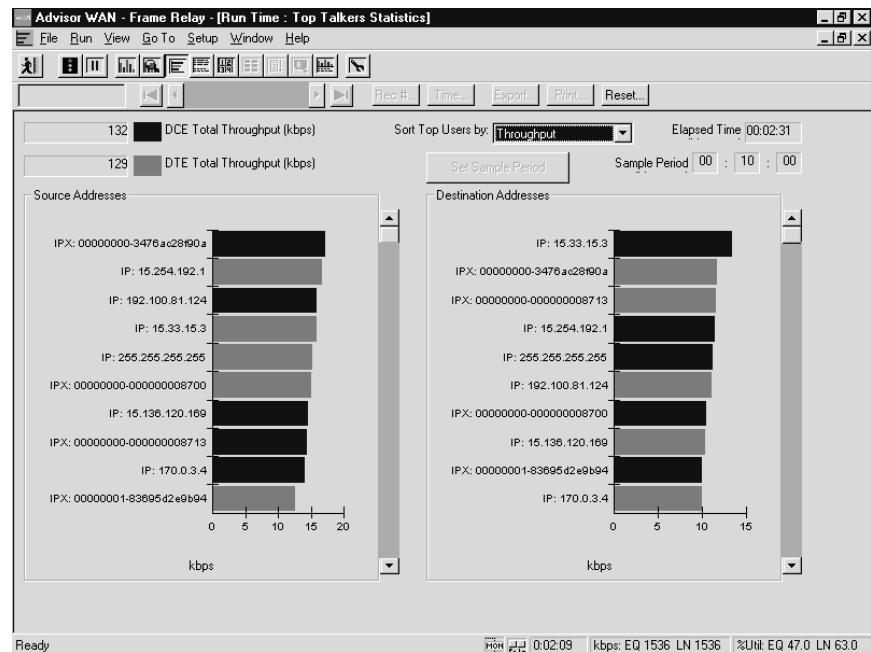


Figure 29.

Associate B-channel Call Activity with PVCs

To more quickly isolate frame relay traffic carried on one or more ISDN B-channels, you can use the B-channel Tracking view. This view provides you with a high level look at ISDN call activity so you can identify which channels are carrying frame relay traffic. Once you know this, you can perform normal frame relay monitor analysis on those channels as you would on other, non-ISDN interfaces. Please see the online Help for details on using this analysis feature.

Logging Statistics and Counters

Service characterization would be inadequate without the ability to monitor and accumulate statistical information over long time periods. You can use the Advisor's logging capability to record 'snapshots' of all of the statistics the Advisor can capture over hours, days, or even weeks.

You set up logging in the Log folder in the Configuration view. You can select the kind of statistics you want logged, the name of the log file, how often you want statistics logged to disk, and the time period over which the log will be created. You can then view this logged data the same way you would look at post-process statistics contained in the Advisor's capture buffer. Please see the online Help for more information.

Using the Agilent Internet Reporter

The Agilent Internet Reporter is a complete network baselining and reporting application that can help correlate, analyze, and report the statistics you gathered during service characterization. The Agilent Internet Reporter allows you to create graphical reports that show trends, patterns, and establish performance baselines for your frame-relay service. The Agilent Internet Reporter lets you enter CIR values sorted according to link and PVC for direct comparison with your usage studies. Service performance is much easier to interpret using the Agilent Internet Reporter. A complete application note, *Agilent Internet Reporter*, is available from Agilent Technologies - ask your Agilent representative for more information.

Internetwork Troubleshooting

Frame relay is a relatively simple protocol. It is a link-layer protocol service that depends on a physical connection, a physical layer access port, data-link layer conformance, in-channel signaling procedures, and proper PVC configuration.

For all intents and purposes, frame relay is about interconnecting LANs with logical private lines. Unlike leased lines, where each link is a physical point-to-point connection, frame relay multiplexes several circuits onto one physical connection, and this has the potential to make troubleshooting more complex as network complexity increases.

These internetwork troubleshooting guidelines are another way of summarizing the previous sections of this Application Note. That is, every installation comes down to troubleshooting the connections and the line, the clocking and channelization, the data link, the in-channel signaling, and the router and switch configuration. More specifically, when you perform internetwork troubleshooting, you will:

- Check the connections and cabling, the clocking, the line rate, and any channelization.
- Check the integrity of the link itself and verify that no unacceptable error indications exist. Conveniently, frame relay has link-integrity verification built-in, in the form of the in-channel signaling procedures.
- Check to see if the PVCs that are assigned are set up as agreed and that equipment is configured correctly to make use of the PVCs.
- Check network connectivity and basic data transfer on existing PVCs.

Throughout this process, you need to make note of reliability problems, protocol problems, or other error or congestion indications.

The troubleshooting guidelines that follow are also summarized in Figure 30:

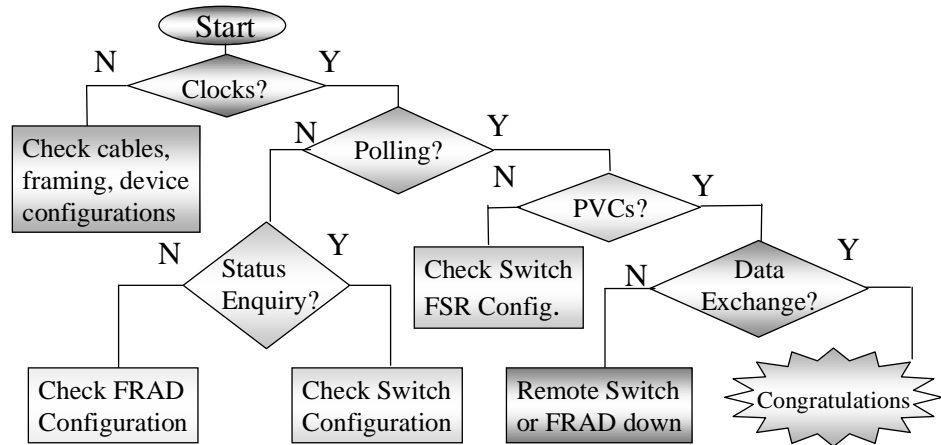


Figure 30.

- If there are no clocks or the data is not being framed correctly, the most likely cause is the connections or the cabling itself. Earlier in this Product Application Note, we described how to connect the Advisor and how to test the physical interface and protocol layer. You can use the front panel LEDs, the Status Bar at the bottom of the screen, and the Line Status view to get a quick indication of these problems. You can also more thoroughly test the physical layer by running BERT measurements.
- If there are clocks and the data is being framed correctly, but there are no in-channel signaling polling sequences, the most likely cause is that the equipment signaling type is not configured correctly or that the switch itself is not responding. You can use the Line Vital Statistics and Filters/Counters Statistics views to get the quickest indication of these problems. See the section *Installing and Verifying Frame Relay PVC Service* for more detail on how to verify this part of frame relay operation.
- If the polling sequence is correct, but no PVCs are designated, then the switch and the network are suspect. The Advisor's Decode view is an invaluable tool in this case. Again, see the section *Installing and verifying Frame Relay PVC Service* for more detail on how to solve these problems.
- If the expected PVCs are available but data cannot be exchanged, then the switch, PVC implementation, or the far end LAN may be down. See the section, *Verifying PVC Configurations* to learn more about interpreting decoded LAN traffic carried over the frame relay link.

Appendix A: Overview of Frame Relay

This Appendix provides a brief overview of frame relay. It can be used as a basis for further investigation for those new to frame relay, or to refresh the memory of those previously familiar with frame relay.

Frame relay specifications are controlled primarily by three groups:

- ANSI in North America
- ITU-T (International Telecommunications Union) in Europe
- Frame Relay Forum (FRF)

Both the ITU-T and the FRF continue to enhance existing standards and implementation agreements in areas that include multi-protocol encapsulation, switched virtual circuits (SVCs), Voice over frame relay (VoFR), frame relay OA&M, frame relay over SONET/SDH, and others.

While frame relay offers a high-performance alternative to leased-line bridging, Figure A1 shows that it differs from leased lines in that it is a connection-oriented protocol that uses a switching backbone to connect sites, a unique link layer protocol to transfer and route frames, and permanent or switched virtual circuits (PVCs or SVCs) rather than dedicated facilities to connect users (in this Application Note, we cover PVCs only).

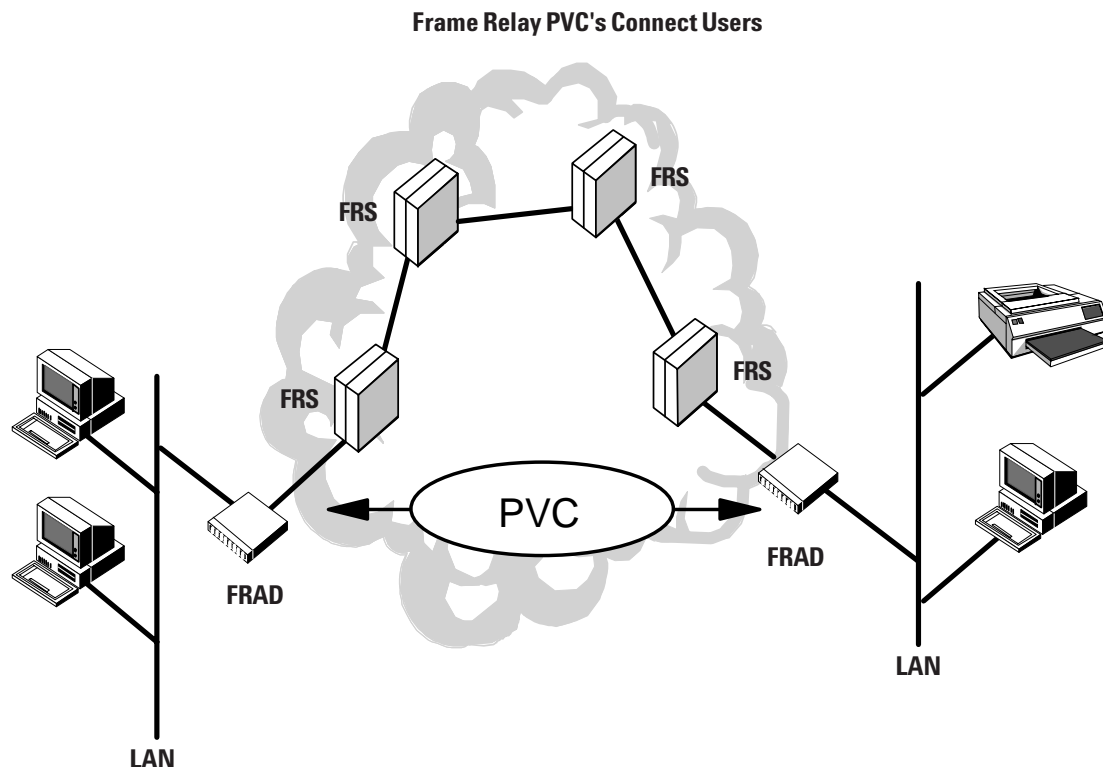


Figure A1.

Frame relay's interface to the user is referred to as the User-Network Interface (UNI). This interface is provided via a frame relay access device (FRAD) such as a router, which is connected to a frame relay switch (FRS). The PVC or SVC is defined as the connection between FRADs on which end user data is transferred. The interfaces between service providers or switches are called Network-Network Interfaces (NNI).

Frame Relay Physical Interfaces

FRADs and frame relay switches are often connected together using T1, E1, DS3, or HSSI (High Speed Serial Interfaces). V-series interfaces are also sometimes used to connect FRADs to CSUs/DSUs. The section *Connecting the Agilent Advisor to Frame Relay Circuits* earlier in this Application Note shows common frame relay topologies and connection points.

Frame Structure and Basic Operation

Figure A2 shows frame relay and upper layer functions in relation to the OSI Reference Model. At the Data Link layer frame relay utilizes LAP-F (a subset of ISDN's LAPD) which leaves error recovery, flow control, and frame acknowledgements to upper layer (e.g. TCP/IP) protocols. Some limited error checking is provided via CRC (Cyclic Redundancy Check) algorithms.

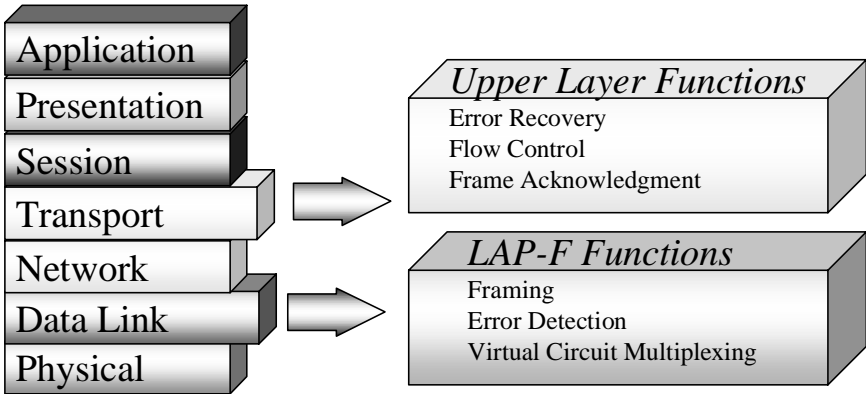


Figure A2

Figure A3 shows that frames are transferred between two points in the frame-relay network by encapsulating the data between a header and a frame check sequence (FCS). The header contains a Data Link Connection Identifier (DLCI) to identify the PVC being used.

Each PVC is defined by several different DLCIs. Figure A4 shows that as data is routed through the network it is assigned one DLCI after another. The DLCI number has LOCAL significance only, and the use of the DLCIs to associate a given frame with one PVC or another is how frame relay provides the advantage of multiplexing circuits. The DLCI should not be confused with network addressing such as a call reference or logical channel number.

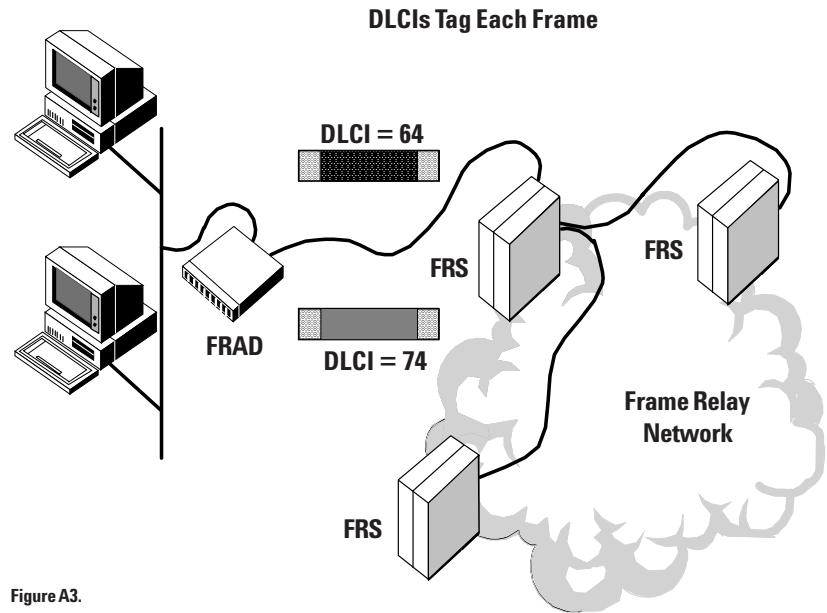


Figure A3.

Each PVC Uses Multiple DLCIs

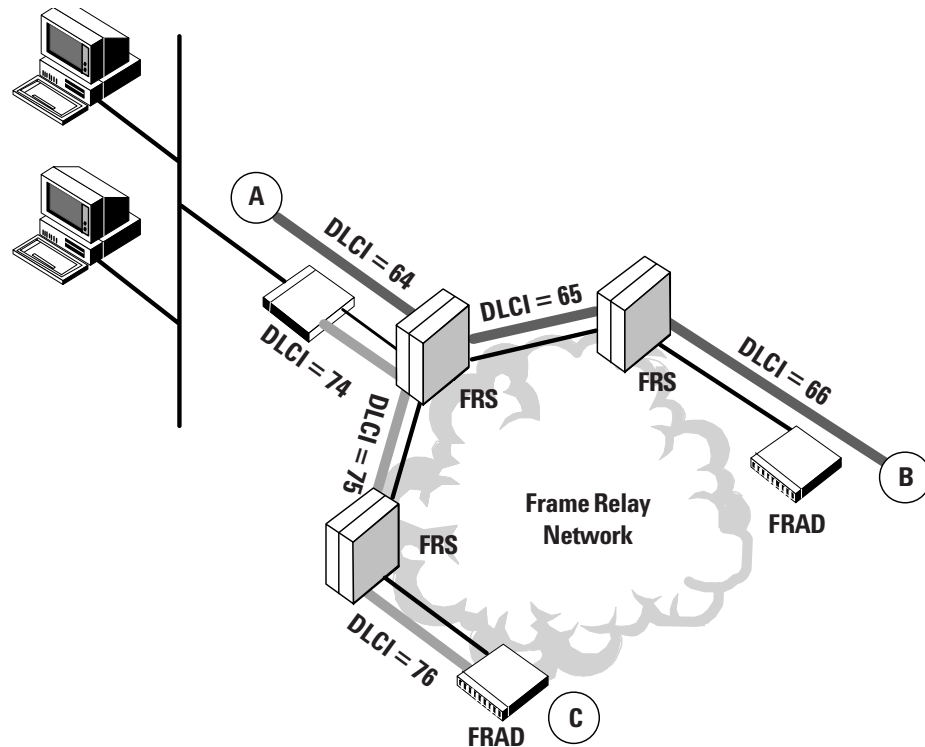


Figure A4.

Figure A5 shows frame relay's frame structure which consists of a flag, address field, control bits, information field, FCS (frame check sequence), and flag. The Frame Relay Forum recommends 1600 bytes as the maximum frame size. The address field is the most significant part of the frame, containing the address field extension bits, a command/ response indication, 3 bits reserved for forward and backward explicit congestion notification and discard eligibility (used with frame relaying services per ITU-T Q.922 (Annex A) or ANSI T1.617 (Annex D), and a data link connection identifier (DLCI) field. The address field extension bits indicate whether the link is using a 2, 3 or 4 octets address format. The fields are defined in more detail next:

- Flag — As in HDLC, frames start and end with at least one flag.
- DLCI — The DLCI is a number between 0 and 1023 and is used to identify a particular PVC.
- C/R — Command/Response Bit. This is not used by the network but is passed transparently to the user.
- EA — Extended Address Bit. The header contains two EA bits. The first is zero and the second is one. Frame relay allows the header to be extended so that the range of DLCI values may be increased. As long as the EA bit is zero, it indicates that there is another header byte to follow. There are no implementations known at this time which use anything other than two byte headers.
- FECN and BECN — Forward and Backward Explicit Congestion Notification Bits.
- DE — Discard Eligibility Bit. This bit may be set by the user to indicate that a frame has lower priority than others. If network resources become overloaded, these frames get dropped by the network.
- FCS — Frame Check Sequence which is used for error checking. Typically, for most frame relay interfaces, this is a 16 bit field.

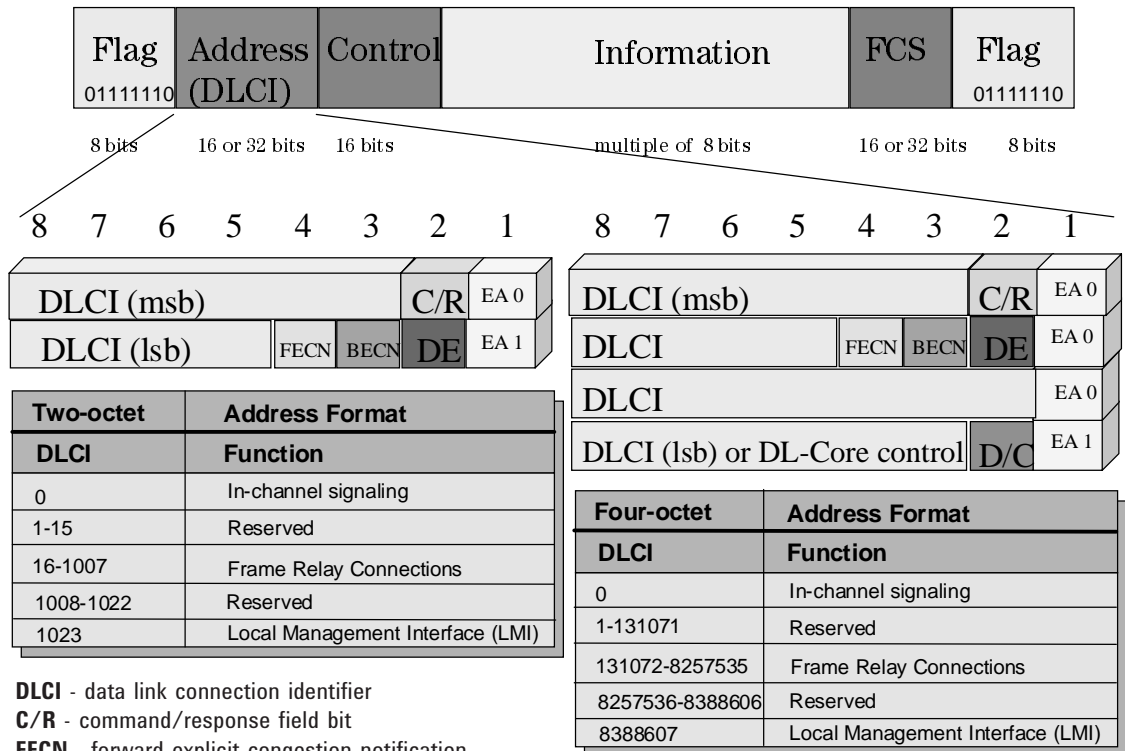


Figure A5.

Network Congestion

Congestion occurs when the network runs out of capacity to pass all data submitted. As shown in Figure [A6], the FECN bit is set to one by the network to notify the user that congestion in the direction of the received frame has occurred. The BECN bit is set to one by the network to notify the user that congestion in the direction opposite to the direction of the received frame has occurred.

In addition to FECN and BECN, frame relay can discard frames during times of congestion, relying on upper layers for recovery. Frames that have the DE (Discard Eligible) bit set are discarded before other frames in order to maintain agreed upon performance. Frames can also be discarded when they contain bad FCS values or when other frame errors have occurred.

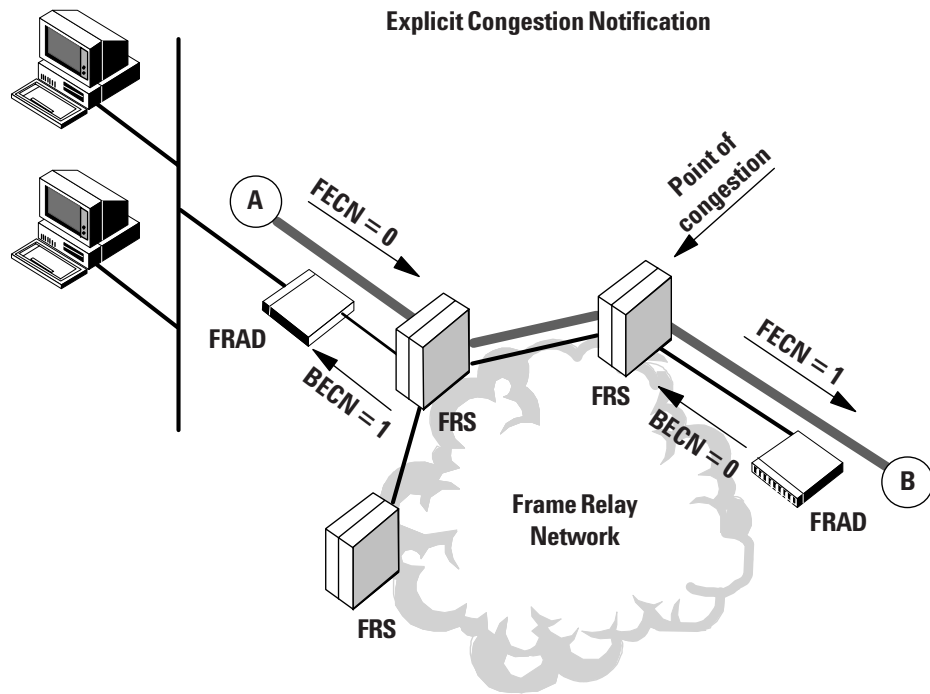


Figure A6.

In-Channel Signaling Procedures

In frame relay, local in-channel signaling messages provide information about the availability and status of the PVCs, the integrity of the link, and to detect and notify the user and network about errors. These signaling messages are layer 3 messages that are structured like Q.931 (ISDN) messages and are transferred using Q.922 (layer 2 frame relay) frames with a DLCI reserved for the signaling procedures (0 or 1023). The signaling procedures support the addition and deletion of Permanent Virtual Circuits (PVCs), report on the active or inactive state of DLCIs, and indicate link reliability and protocol errors. The principal feature of these procedures is the periodic issuing of Status Enquiry messages from the User and the required Status message response from the Network.

Signaling messages are traditionally referred to as LMI (Local Management Interface) even though the specifications now say "Local In-Channel Signaling".

One aspect of LMI is Link Integrity Verification (LIV). This is a procedure in which the user and the network periodically exchange polling sequence numbers to determine the integrity of the link. Examples of the polling sequence numbers are indicated in Figures A7 and A8 in the parentheses of the LIV and FSR messages. The user sends out a Status Enquiry message to the network which contains a send polling sequence number and the value of the last received polling sequence number. To indicate that the link has integrity, the network must return a Status message within a few seconds, containing the sequence number received from the user and a new send polling sequence number. For the link to maintain its integrity, the messages must be exchanged according to predetermined timers. The default value for sending Status Enquiry messages is once every 10 seconds. As a default setting, one out of every six message exchanges consists of a Full Status Report (FSR).

In this instance, the user requests a Full Status Report and the network must respond with a message that provides information about each available PVC. This report may indicate whether a PVC is new, active, or inactive. The user must detect that a PVC is deleted when it no longer appears in the Full Status Report. Status Enquiry and Status messages which include a Full Status Report also contain the Link Integrity Verification polling sequence number exchange.

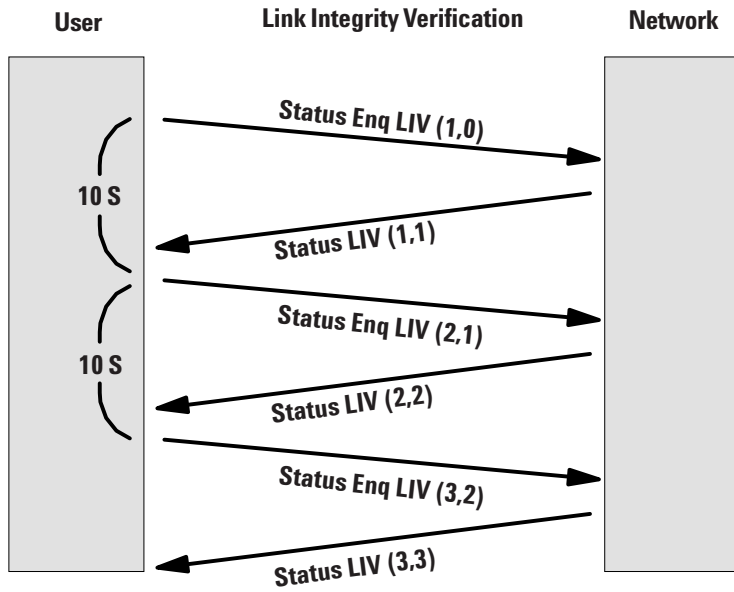


Figure A7.

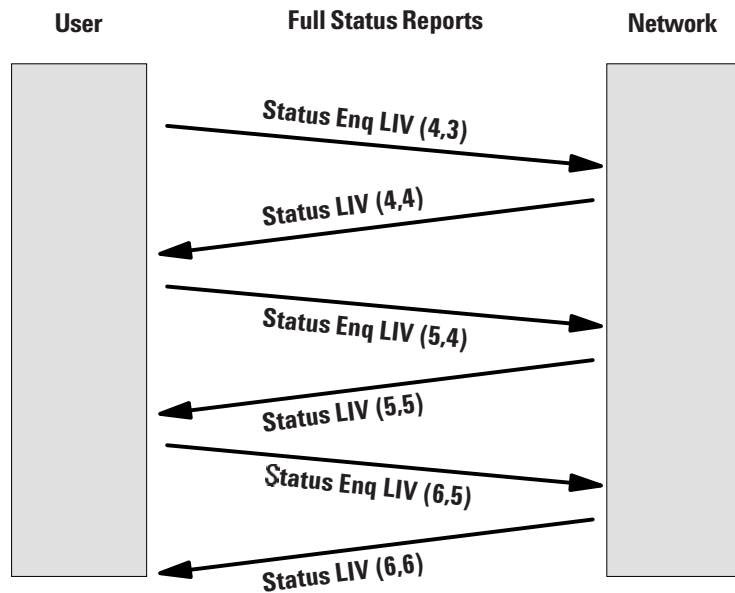


Figure A8.

Appendix B: Supplied Tests for Frame Relay

To start the Advisor WAN, you use a configuration short cut called a *supplied test*. A supplied test (often referred to as a "canned test") is a set of configuration settings which has been given a descriptive name and has been placed in the WAN Analysis menu structure of the Windows 98 Start menu. When you click on this name in the menu, you start the Advisor WAN application with most of its configurable parameters already set to match the network test situation for which the test was designed. So if you select a test that closely matches your measurement needs, you save time and effort in the configuration process. Supplied tests are provided for monitoring, simulation, traffic generation, and bit error rate testing. You can also create your own customized tests by editing supplied tests. The Advisor provides several frame relay supplied tests for each of the supported physical interfaces.

Frame Relay Monitor Supplied Tests

For each of the supported physical interfaces, the Advisor provides a number of frame relay supplied tests for numerous measurement situations. These supplied tests will auto-detect and decode most in-channel signaling types, and will decode and count important frame/packet types including encapsulated LAN traffic. In addition, there are supplied tests that can be used to monitor frame relay traffic carried on ISDN Basic Rate Interfaces. Monitor tests are used primarily to verify network operations, gather important statistics, and create benchmarks upon which later analysis and troubleshooting can be based. Please see the Advisor's online Help for more descriptions of the supplied tests.

Frame Relay Simulation / Traffic Generation Supplied Tests

For each of the supported physical interfaces, the Advisor provides a number of frame relay supplied tests that configure the Advisor for network emulation and traffic generation. Two important tests of this kind are the Auto User LMI and PING tests, both of which are referenced and used in this Product Application Note. These two tests cause the Advisor to emulate user/subscriber equipment by transmitting and responding to LMI in-channel signaling and, in the case of the PING test, sending data to remote nodes on the network. Please see the Advisor's online Help to learn more about the capabilities of simulation and traffic generation tests.

Creating Customized Tests

Because your test needs may not always be addressed by the Advisor's supplied tests, you can use existing supplied tests as templates for customized tests of your own. This can be as simple as altering the physical interface configuration and saving the altered test to a new name, or as complex as writing your own simulation or traffic generation scripts to emulate unique network behavior. There are a number of ways to edit and create your own tests, all of which are described in the Advisor's online Help.

**Appendix C:
V-Series Clock Selections
to Support Long Cables**

For most DTE to DCE connections that run at baud rates below 1 Mbps, both devices must be set to the same selection for DTE Clock Src (that is, both set to DCE or both set to DTE). Usually, jumpers or switches in each device are set the same.

For example, for many connections up to 2.048 Mbps, setting the DTE Clock Src to the typical 'DCE' in both devices (see Figure C1) will suffice unless the length of cable between devices exceeds approximately 20 ft. (7 m). This length can easily be reached if both devices are connected together through a patch panel that uses 6 ft. (2 m) cables to each device, or if the devices are rack-mounted or otherwise separated. With long cables, unreliable clocking of the DTE data by the DCE can occur if the total delay of the DCE (TC, ST, SCT) clock to the DTE equipment plus the delay of the DTE data to the DCE equipment is more than half of the baud rate. At 2.048 Mbps, this half bit delay time is only 244 ns for two drivers, two receivers, and two path cable delays.

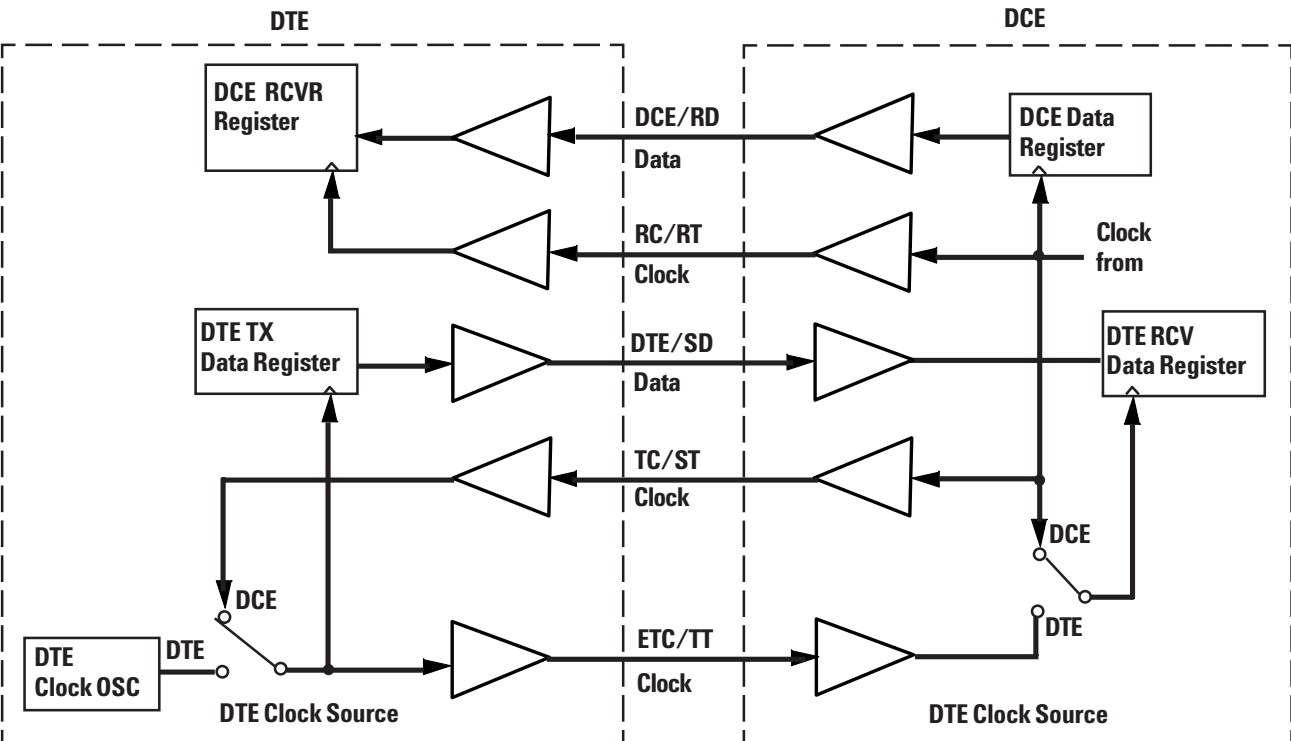


Figure C1

For these longer cable connections that exhibit excessive clock-to-data delays, the DTE device must support another type of clocking commonly called 'Loop Timing' as shown in Figure C2. This mode requires the DTE to connect the received DCE (TC, ST, SCT) clock to its internal DTE (ETC, TT, SCE) clock driver. The DTE is then transmitting its data and clock to the DCE with no delay difference, and it will not vary with cable length. The DCE's clocking selection should now be set to DTE (ETC, TT, SCE) so it will use this clock. The DCE device can now reliably receive the DTE data.

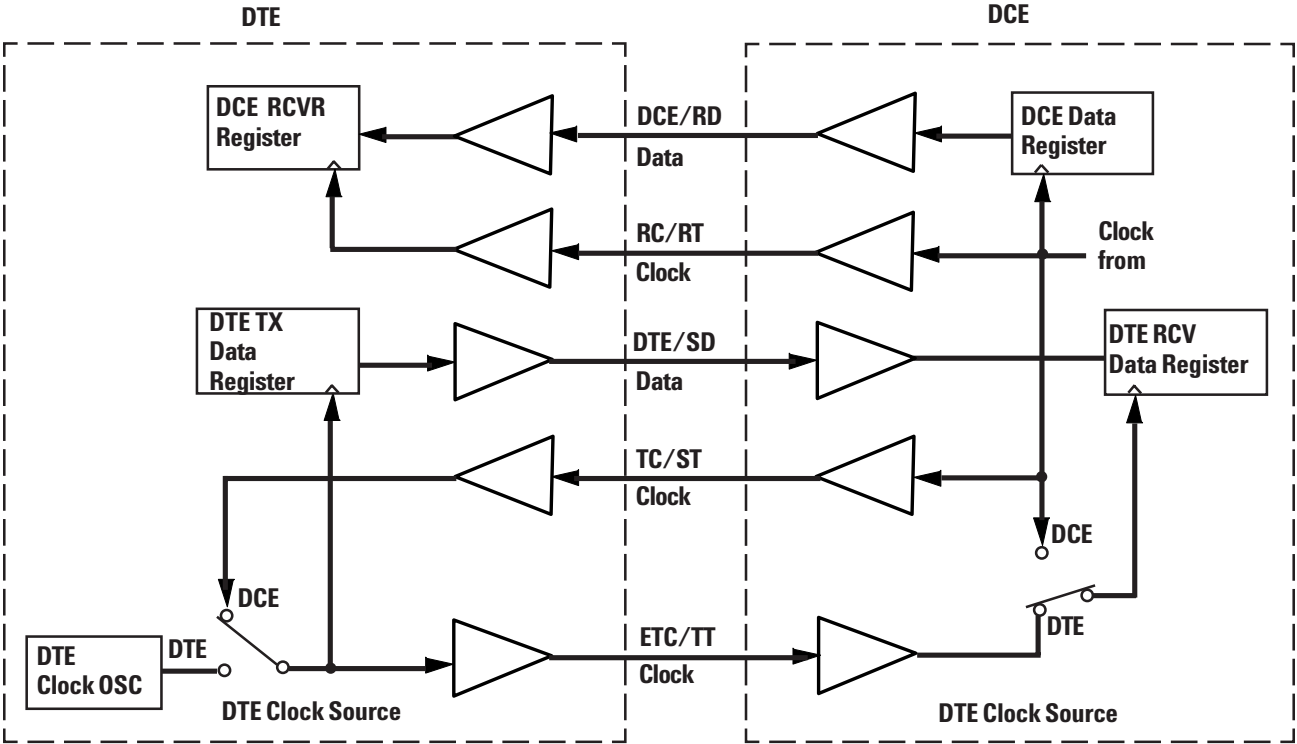


Figure C2.

To enable the Advisor to support 'Loop Timing' clocking, the DTE Clock Src parameter in the V-Series Configuration dialog box must be set correctly. For normal DTE bit error rate testing (BERT) or simulation, the Advisor will be set to DCE (TC, ST, SCT) and 'loop' this clock back to the DCE device as the DTE (ETC, TT, SCE) clock. If the Advisor is doing DCE simulation or BERT, it may have to be set to DTE clocking to receive data properly.

When monitoring data in this 'Loop Timing' mode, the Advisor would be set to DTE (ETC, TT, SCE) just like the DCE device must be to reliably receive the data. Also, be aware that inserting the 'Y cable' supplied with the instrument will add 6 ft (2 m) of cable between the DTE and DCE equipment and can cause them to work unreliable because they have not been set up for 'Loop Timing'. In this situation, try to monitor at a patch panel if available, at a T1 monitor point if available, or change the clocking to 'Loop Timing' if possible.

If however, the Advisor replaces a DTE device so that simulation can be done, the DTE Clock Src parameter should be changed to DCE (TC, ST, SCT) to properly transmit data and loop the clock back to the DCE device.

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Notes

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