Configuring and Using Solstice™ Frame Relay 2.0

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Preface

Configuring and Using Solstice™ Frame Relay 2.0 contains the information required to configure and maintain a Solstice Frame Relay system. For installation instructions, refer to *Installing Solstice Frame Relay 2.0*.

Who Should Use This Book

This book is intended for system administrators who want to create and maintain a WAN using Solstice Frame Relay 2.0. It assumes no previous knowledge of Frame Relay. However, it does assume that you are familiar with the Solaris™ operating environment.

How This Book Is Organized

Chapter 1, “Solstice Frame Relay Overview,” provides an overview of the Solstice Frame Relay product and of Frame Relay technology.

Chapter 2, “Configuring Solstice Frame Relay,” explains how to create an intial configuration using the `frinit` initialization script, and how to modify a configuration by editing the `fr.cf` configuration file.

Chapter 3, “Monitoring and Maintenance,” describes the monitoring and maintenance utilities supplied with Solstice Frame Relay.

Chapter 4, “Troubleshooting,” provides information on resolving problems with Solstice Frame Relay.

Appendix A, “Technical Background,” provides information on frame structures, addressing and the different LMI versions. Understanding the material in this appendix is useful for reference purposes, but is not required to use the product.

Appendix B, “Modem and Null Modem Cables,” provides cabling diagrams for a number of common configurations.

Appendix C, “Installing the SunNet Manager Agent,” describes the installation of the SunNet Manager agent.

Glossary is a list of words and phrases found in this book and their definitions.

What Typographic Changes Mean

The following table describes the typographic changes used in this book.

Table P-1 Typographic Conventions

Typeface or Symbol	Meaning	Example
`AaBbCc123`	The names of commands, files, and directories; on-screen computer output	Edit your `.login` file. Use `ls -a` to list all files. `machine_name% You have mail.`
`AaBbCc123`	What you type, contrasted with on-screen computer output	`machine_name% su` `Password:`
AaBbCc123	Command-line placeholder: replace with a real name or value	To delete a file, type `rm` *filename*.
AaBbCc123	Book titles, new words or terms, or words to be emphasized	Read Chapter 6 in *User's Guide*. These are called *class* options. You *must* be root to do this.

Shell Prompts in Command Examples

The following table shows the default system prompt and superuser prompt for the C shell, Bourne shell, and Korn shell.

Table P-2 Shell Prompts

Shell	Prompt
C shell prompt	`machine_name%`
C shell superuser prompt	`machine_name#`
Bourne shell and Korn shell prompt	`$`
Bourne shell and Korn shell superuser prompt	#

Solstice Frame Relay Overview 1

This chapter provides a basic introduction to Solstice Frame Relay 2.0 and to Frame Relay technology.

1

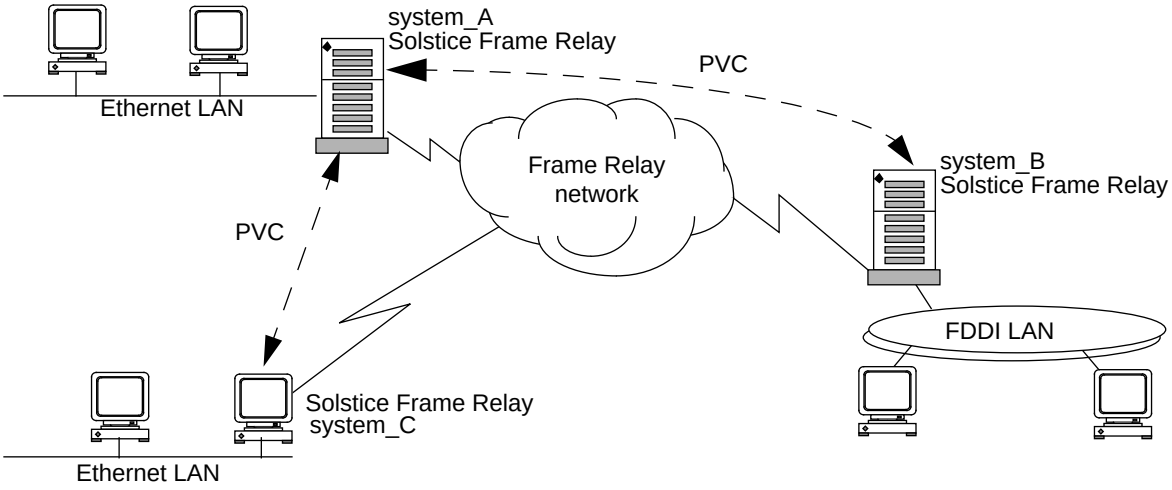


Figure 1-1 Frame Relay Overview

The Frame Relay protocol provides a way of connecting an individual machine to a wide area network (WAN). This WAN may be a public Frame Relay network, for example a network provided by a telephone company, or a private Frame Relay network, owned by a particular organization.

Frame Relay is typically used for interconnecting remote LANs across a WAN. In Figure 1-1 the Frame Relay systems act as routers, routing IP traffic between the three LANs. Only one system on each LAN needs to run Frame Relay and be connected to the Frame Relay network—the other systems on the network all route the traffic for the remote site through it.

Frame Relay works by creating a Permanent Virtual Circuit (PVC) between two systems on a Frame Relay network. A PVC is a dedicated, logical communication path between the two systems. For example in Figure 1-1, there are PVCs between system_A and system_B, and system_A and system_C. A number of PVCs can be multiplexed across the same physical connection, so in Figure 1-1, both PVCs from system_A use the same physical link to the Frame Relay network. As part of configuring Solstice Frame Relay 2.0, you create a mapping between destinations and PVCs, so that the software knows which PVC to use for traffic to a particular destination.

It is conventional to show a Frame Relay network as a cloud, as in Figure 1-1 on page 2.

As Figure 1-2 shows, Frame Relay defines the way the interface between a system running Frame Relay and a system providing a network connection (usually a switch) works. Frame Relay does not define the means of transmission that should be used between the switches. It may be Frame Relay, it may be some other set of networking protocols.

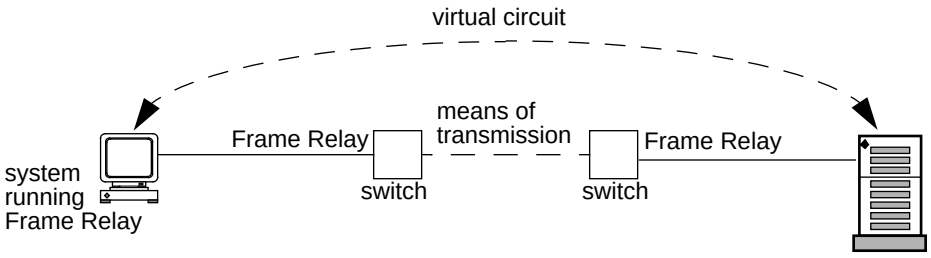


Figure 1-2 Frame Relay Detail

The Frame Relay protocol is an implementation of the datalink layer of ISO's 7 Layer Model. The idea behind the 7 Layer model is to break data communications technology down into manageable chunks. It does this by defining a series of software layers. Each layer is designed to carry out particular tasks independently of the layers above and below it. The datalink layer makes sure that network traffic gets from one end of a communications link to another.

Solstice Frame Relay 2.0 works with the TCP/IP protocol suite. Figure 1-3 shows how Frame Relay fits into the TCP/IP protocol stack:

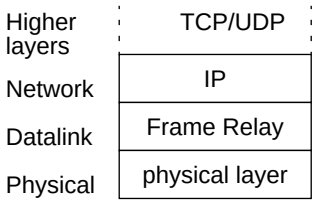


Figure 1-3 Frame Relay and the TCP/IP Protocol Stack

Advantages of Using Frame Relay

Frame Relay is designed to interconnect high performance end systems over high quality communications equipment. It therefore makes the following assumptions:

- The underlying network will generate very few errors and lose very little traffic.
- Higher layer protocols and end user systems will deal with any remaining errors.

For these reasons, Frame Relay is more streamlined than other protocols used for the same purpose, such as X.25. This means that Frame Relay offers the following advantages to users:

- Increased network throughput.
- Improved network response time.
- Improved bandwidth management.
- Reduced overall networking costs.

On the other hand, Frame Relay is not the best choice for use over noisy, error-prone lines. For these lines, X.25 remains the more appropriate solution.

Table 1-1 compares the operations carried out by Frame Relay and X.25.

Table 1-1 Frame Relay Compared with X.25

Operation	**Frame Relay**	**X.25**
Delineating the frame from noise and other spurious signals	YES	YES
Performing a Frame Check Sequence to validate frame integrity	YES	YES
Accounting for all traffic on the link	NO	YES
Sequencing traffic on the link	NO	YES
Flow control	NO	YES

1

Addressing

Frame Relay uses DLCI (Data Link Connection Identifier) addresses. DLCIs are mapped to the destinations they reach—the same DLCI always identifies the same destination.

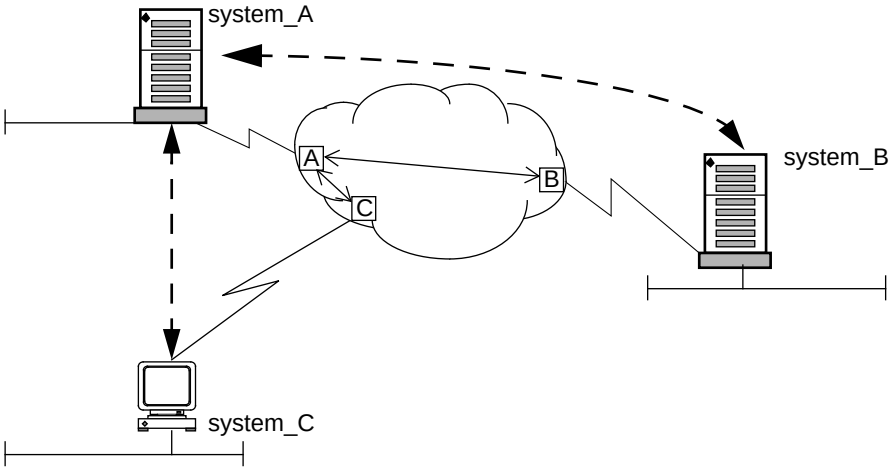


Figure 1-4 DLCI Operation

DLCIs do not have end to end significance, a DLCI just tells the receiving node which interface to forward data on. Each node on a Frame Relay network maintains a table, that maps DLCIs to destinations.

For example, suppose that system_A in Figure 1-4 uses DLCI 46 to identify traffic for system_B. This tells the switch to forward the traffic on towards system_B. System_A assigns a different DLCI to traffic for system_C. This tells the switch to send it on towards system_C.

The part of Switch A's mapping table that relates to system_A would look something like this:

Table 1-2 Example DLCI Mapping Table

Line In	DLCI	Line Out
System_A	46	Switch B
	74	Switch C

When you subscribe to a public network, the network provider allocates a DLCI for each remote destination. If you are creating a private Frame Relay network, you need to allocate a DLCI to each destination. Allowed values for user traffic are between 16 and 1007, so you can have up to 992 PVCs per physical connection.

1

Handling Congestion

Solstice Frame Relay 2.0 uses a system of forward and backward explicit congestion notifications (called FECNs and BECNs) to notify other Frame Relay systems on a network of congestion.

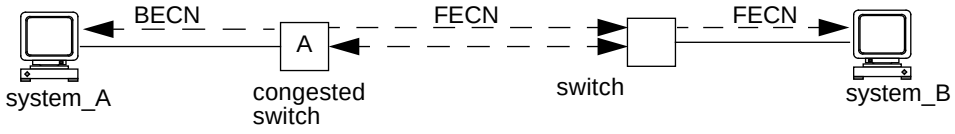


Figure 1-5 BECN and FECN Operation

For example, in Figure 1-5, switch A is congested. The next time it sends some traffic to Frame Relay system_A, it includes a BECN flag, to indicate that there is congestion further *back* up the line. The next time it has some traffic for Frame Relay system_B, it includes a FECN flag, to indicate the system_B that there is congestion *forwards* from itself.

A system receiving a BECN knows that a system that it is sending traffic to is congested and that there is a risk that traffic it sends out on that interface may not get through. A system receiving a FECN knows that a system that is sending it traffic is congested and that it may not be receiving all the traffic sent to it.

On receiving a BECN or a FECN on a particular virtual circuit, Solstice Frame Relay 2.0 places a Discard Eligibility (DE) flag in all outgoing traffic on that circuit, indicating that, if necessary, this data can be discarded. If the congestion leads the switches to begin discarding traffic, they discard traffic containing a DE flag before discarding other traffic.

Solstice Frame Relay 2.0 also supports Consolidated Link Layer Management (CLLM). This writes a message to both the console and the Frame Relay log file if there is congestion on the network.

Handling Errors

If the standard Cyclic Redundancy Check (CRC), performed by the serial port hardware on the Frame Check Sequence (FCS), shows that a frame is distorted, the frame is discarded. Unlike many other datalink layer protocols, Frame Relay does *not* send any kind of notification of the discard to the sender, it assumes that higher layer protocols will deal with it.

Choosing Information and Burst Rates

Frame Relay service providers offer an option called the Committed Information Rate (CIR). This is the traffic level that they will commit to deliver to its destination, and is usually a percentage of the traffic levels that their lines are physically capable of dealing with. Service providers generally offer a choice of CIRs. To decide which is the most appropriate for you, work out your average throughput requirement and subscribe to a CIR that will deal comfortably with this level of traffic. In a typical installation, the CIR is approximately 25% of the line speed.

To go along with the CIR, providers offer a Committed Burst Size (B_c). This is the maximum amount of data that the network agrees to transfer under normal conditions during a particular time interval. Choose a B_c that will cope with your peak throughput requirements. In a typical installation, the B_c is the same as the line speed.

Finally, Frame Relay providers offer an Excess Burst Size (B_e). This is the maximum amount of data that the network will attempt to deliver during a particular time interval. This data contains the DE marker—indicating that, if necessary, it can be discarded. If the congestion leads the switches to begin discarding traffic, they discard traffic containing DE markers before discarding other traffic.

Local Management Interface

Frame Relay uses a procedure called the Local Management Interface (LMI) to monitor link integrity and PVC status. Solstice Frame Relay 2.0 supports three versions of LMI, the original version defined by the original LMI committee, the version defined by ANSI T1.617 (Annex D), and the version defined in Annex A of the CCITT's Q.933 Recommendation. This guide refers to them as

Original, ANSI Annex D, and CCITT LMI, respectively. These differ in the fine details of their operation, but not in the overall principles, or in the information provided.

LMI is controlled by two configurable parameters, the *polling interval*, and the *enquiry interval*. LMI sends two different kinds of enquiries to the switch, a *link integrity request*, and a *full status request*. The polling interval defines, in seconds, the interval between link integrity requests. The enquiry interval defines how many link integrity requests should be sent between each full status request. Figure 1-6 summarizes what happens when you have a polling interval of 4 and an enquiry interval of 3. A link integrity request is sent every 4 seconds, and every fourth request sent is a full status request:

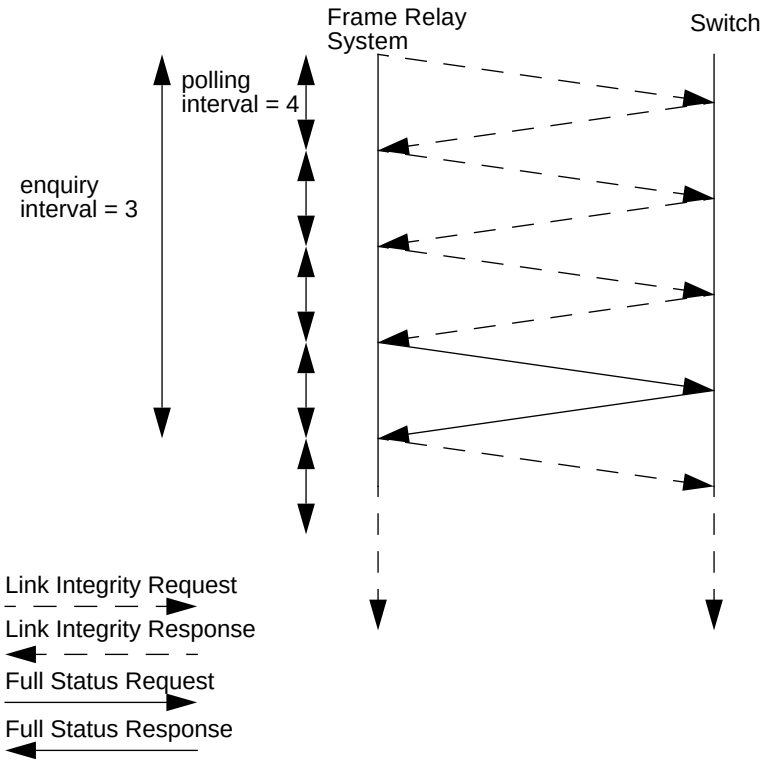


Figure 1-6 LMI Summary

Link integrity responses let the Frame Relay system work out whether the link is up or down. If the link is down, IP is notified to stop sending traffic for this link. Full status responses provide status information on each PVC in addition to the link information. A PVC can be *active*, *down*, or *new*. A new PVC is one that has just been added by the service provider and is now ready to receive traffic.

Product Features

Solstice Frame Relay 2.0 provides the following features:

- IP connectivity over public and private Frame Relay networks.
  Solstice Frame Relay provides an upper interface to IP. This means it can be used as the basis for a Wide Area Network using TCP/IP giving users access to standard Unix networking protocols, such as `ftp` and `rlogin`.
- Up to 992 permanent virtual circuits (PVCs) per Frame Relay link.
  This means that traffic from multiple users and multiple applications can be multiplexed across a single, physical line. Multiplexing is transparent, as each user appears to have a separate connection.
- Support for both the onboard synchronous port of Sun machines and for the SunLink HSI high speed interface card.
  This provides a choice of line speeds, depending on users' requirements.
- SunNet Manager agent.
  Statistics and configuration information can be collected using SunNet Manager.
- Support for Local Management Interface
  This is a set of procedures for collecting information on PVC status at the subscriber's user interface.
- Monitoring and tracing programs
  These are useful both for troubleshooting and for day to day maintenance purposes.
- Ability to interwork with non-Sun synchronous ports
  The product has been tested with a number of non-Sun boards. Refer to the *Solstice Frame Relay IPI* for an up to date list.

1

Standards Compliance

Solstice Frame Relay 2.0 complies with the following standards:

- ANSI T1.606 Addendum: Frame Relay Bearer Service Architectural Framework and Service Description.
- ANSI T1.617 Annex D: Additional Procedures for PVCs Using Unnumbered Information Frames.
- CCITT Q.922 Annex A: Core aspects of Q.922 for use with Frame Relaying Bearer Service.
- CCITT Q.933 Annex A: Additional Procedures for PVCs Using Unnumbered Information Frames.
- RFC1490: Multiprotocol Interconnect over Frame Relay.
- RFC1315: Management Information Base for Frame Relay DTEs.

Installation Requirements

Hardware

Solstice Frame Relay 2.0 is designed to run on SPARC™ systems running Solaris™ 2.4 or later versions. It can use any of the following serial ports:

- ZSH
  A Sun workstation's onboard serial port.
- SunLink HSI
  This is a high speed interface available as a separate product from Sun Microsystems. It provides 4 WAN interfaces and allows for higher speeds and better performance than the onboard serial port. Contact your supplier for information on availability and pricing.

The product has been tested with a number of non-Sun boards. Refer to the *Solstice Frame Relay IPI* for an up to date list.

Software

Solstice Frame Relay 2.0 provides an upper interface to the Internet Protocol (IP), allowing the creation of a Wide Area Network (WAN) using TCP/IP. This allows the use of `rlogin`, `ftp`, and other facilities. The TCP/IP protocol suite is delivered as part of the Solaris system software.

1

Configuring Solstice Frame Relay 2

To create a brand new Frame Relay configuration, use the Frame Relay initialization script `frinit`. To modify an existing configuration, edit the Frame Relay configuration file `fr.cf`.

Warning – When you run `frinit`, it automatically renames your existing configuration file as `fr.cf.old`. If you want to make changes to an existing configuration, edit the `fr.cf` file by hand instead of running `frinit`.

2

Initial Configuration

Systems A, B and C in Figure 2-1 are all connected to the same public Frame Relay network. The example in this section looks at how to use the `frinit` initialization script to carry out an initial configuration of system_A.

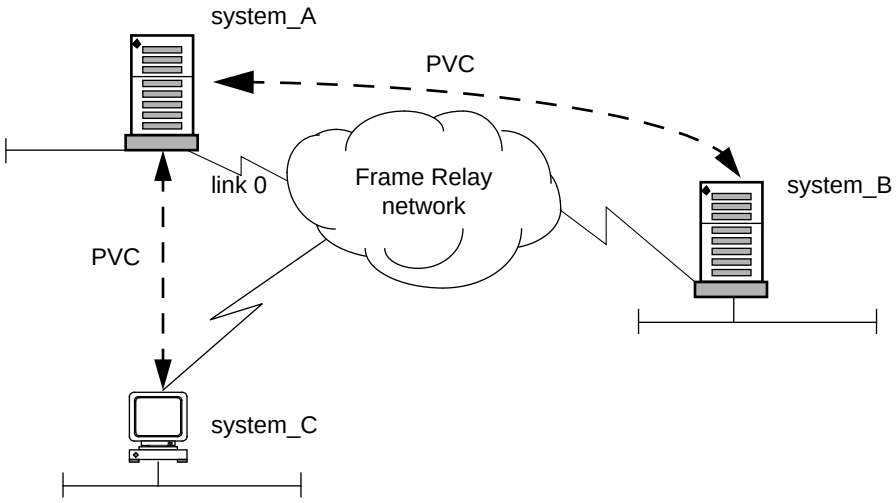


Figure 2-1 Example Frame Relay Configuration

Before you Start

Before you begin configuring a system, you need to know the following information:

- How many physical links you require. The example configuration uses a single physical link to connect to a single Frame Relay network.
- Which physical device to use to connect to the Frame Relay network: one of the onboard serial ports, or a SunLink HSI High Speed Interface. The example configuration uses the high speed interface `hih0`.
- How many PVCs you are going to use. You need to establish one PVC to each destination machine. In the example, system_A requires two PVCs, one to system_B and one to system_C.

- The DLCI for each PVC. If you are connecting to a public Frame Relay network PVCs are allocated by the network supplier. If you are configuring a private Frame Relay network, refer to Table A-1 on page 84 for the list of PVCs available for user traffic. In the example, the DLCIs are 200 and 300.
- The IP addresses or hostnames of the remote machines you want to connect to. In the example, these are system_B and system_C.

Initializing Solstice Frame Relay 2.0 using `frinit`

The `frinit` script provided with Solstice Frame Relay 2.0 creates a file called `fr.cf`, which configures the product. Once you have created `fr.cf` using `frinit`, you can edit it to add or modify information.

To start `frinit`, log in as root or become superuser and enter:

```
# /opt/SUNWconn/bin/frinit
```

The script prompts for a series of parameters. The default values appear in brackets following the prompt. Press Return to accept them.

The first group of parameters defines the link to the Frame Relay network. Configure the link like this:

1. **Assign an identifier to the link**:

```
Frame Relay link ID [0]:
```

   By default, the first Frame Relay link is numbered as 0.

2. **Enter the UNIX device name of the serial port for this link**:

```
Unix device associated with Frame Relay link ID 0 : hih0
```

   If you are using one of the onboard serial ports, this is `zsh0` or `zsh1`. For a SunLink HSI serial port, this is `hih`*n*

3. Enter your choice of clocking for this link:

```
Type of clocking for this port
    [1] - External (loopback=no txc=txc  rxc=rxc)
    [2] - Internal (loopback=no txc=baud rxc=rxc)
    [3] - Specify your own clocking parameters

   Your choice [1]:
```

External clocking, the default, is the most common way of handling clocking when connected a Frame Relay switch. If you are connecting two machines back-to-back for testing, choose Internal clocking. See “Configuring Systems Back-to-Back” on page 77 for instructions on back-to-back configuration.

If your Frame Relay switch uses non-standard clocking, specify the Line Speed, Transmit Clock, and Receive Clock supplied by your service provider using option 3:

```
   Type of clocking for this port
    [1] - Internal (loopback=no txc=baud rxc=rxc)
    [2] - External (loopback=no txc=txc  rxc=rxc)
    [3] - Specify your own clocking parameters

   Your choice [1]: 3

   Line speed [19200]:
   Transmit clock: txc
   Receive  clock: baud
```

Once you have finished defining the link, `frinit` displays your choices and asks you to confirm them:

```
   You have selected the following configuration:
   fr_link_id     0
   unix_device    hih0
   txc_clock      txc
   rxc_clock      rxc

   Ok to add this entry? [y]:
```

Press Return or enter y to accept the entry, or enter n to refuse it. If you enter n, the script prompts you to add another Frame Relay link. Repeat Steps 1 to 3 for the new link, or respond n to exit the script.

If you accept the entry, the next step is to add information about each PVC running over the link. In the example, there are two PVCs running over link 0, one to system_B and one to system_C. You need to add information about each PVC and associate each PVC with the IP address of the remote machine.

Configure a PVC like this:

The Solstice Frame Relay software automatically allocates an IP interface identifier to each PVC.

1. Enter the local IP address

```
Configuration of IP interfaces over Frame Relay
-----------------------------------------------


IP Information for fr0


    Local IP address information
    Enter an IP host that is listed in your hosts map
    or an IP address with internet dot notation

    Local IP address [system_A]:
```

The local IP address is the IP address of the machine you are configuring now. In the example, the name system_A appears in the hosts map, so the script uses it as the default.

2. Enter the address of the remote machine you want to reach over this PVC:

```
    Remote IP address information
    Enter an IP host that is listed in your hosts map
    or an IP address with internet dot notation

    Remote IP address: system_B
```

Enter either an IP address in internet dot notation or a hostname from your hosts map.

3. Enter the Maximum Transmission Unit size:

```
Maximum Transmission Unit (MTU) [1500]:
```

Accept the default of 1500 unless your Frame Relay service provider has given you a different value.

4. Specify the DLCI of this PVC:

```
DLCI Number Associated with fr0 : 200
```

This is the DLCI allocated to the PVC by your service provider. In the example it is 200. The allowed range for user traffic is 16 to 1007.

When you have finished adding information about the PVC, the entry is displayed for you to accept or cancel:

```
ifconfig fr0 plumb
ifconfig fr0 system_A system_B mtu 1500 netmask 255.255.255.0 up

    ip_interface   fr0
    dlci_number    200

    Ok to add this configuration [y]?
```

Repeat steps 1 to 4 for each PVC that runs over the link you are configuring. In the example there is a second PVC to system_C. The script prompts, responses and summary look like this:

```
    Do you want to add another IP interface [y]: y

IP Information for fr1


    Local IP address information
    Enter an IP host that is listed in your hosts map
    or an IP address with internet dot notation

    Local IP address [system_A]:

    Remote IP address information
    Enter an IP host that is listed in your hosts map
    or an IP address with internet dot notation

    Remote IP address: system_C

    Maximum Transmission Unit (MTU) [1500]:

    DLCI Number Associated With fr1 : 300

    You have selected the following configuration:

    ifconfig fr1 plumb
   ifconfig fr1 system_A system_C mtu 1500 netmask 255.255.255.0 up

    ip_interfacefr1
    dlci_number300

    Ok to add this configuration [y]?
```

When you have finished adding PVCs, answer `n` to this prompt:

```
Do you want to add another IP interface [y]:
```

The `frinit` script prompts you to add another link. Either repeat the steps for adding a link, or enter `n` to exit from `frinit`.

When you exit from `frinit`, it generates a file called `fr.cf` in the `/etc/opt/SUNWconn/fr` directory. See “Modifying an Existing Configuration”, for a description of the structure of this file and for instructions on making changes and updates.

Note – When you run `frinit`, it automatically renames your existing configuration file as `fr.cf.old`. If you want to make changes to an existing configuration, edit the `fr.cf` file by hand instead of running `frinit`.

Starting the Solstice Frame Relay Software

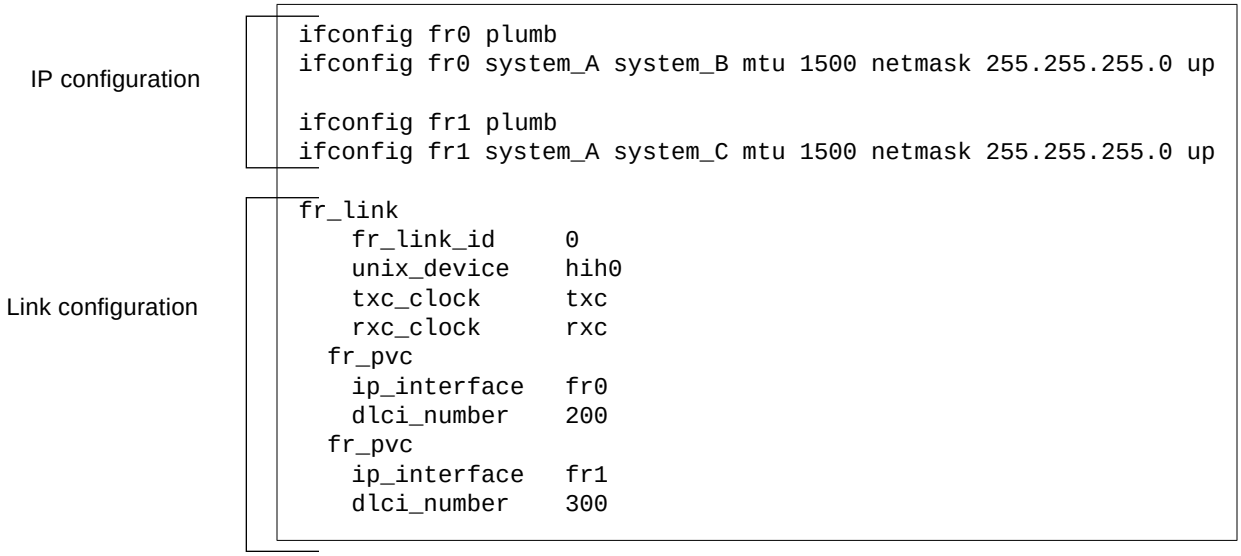
Once you have carried out your initial configuration using `frinit`, you need to start the Solstice Frame Relay software. To do this, enter the command:

```
# /etc/init.d/fr.control start
```

Note – When you reboot a system running Solstice Frame Relay, the Frame Relay software restarts automatically.

Modifying an Existing Configuration

The `/etc/opt/SUNWconn/fr/fr.cf` file for the example configuration of two PVCs running over a single link looks like this:




```
ifconfig fr0 plumb
ifconfig fr0 system_A system_B mtu 1500 netmask 255.255.255.0 up

ifconfig fr1 plumb
ifconfig fr1 system_A system_C mtu 1500 netmask 255.255.255.0 up

fr_link
    fr_link_id     0
    unix_device    hih0
    txc_clock      txc
    rxc_clock      rxc
  fr_pvc
    ip_interface   fr0
    dlci_number    200
  fr_pvc
    ip_interface   fr1
    dlci_number    300
```

The file is in two sections. The top section contains IP information. The bottom section defines the Frame Relay link and the PVCs that run over it. Look at the IP interface name given as part of the `ifconfig` statement to see which IP configuration goes with which PVC.

You can edit the configuration file to add new links, new PVCs, or more detail to the existing links and PVCs.

Adding New PVCs

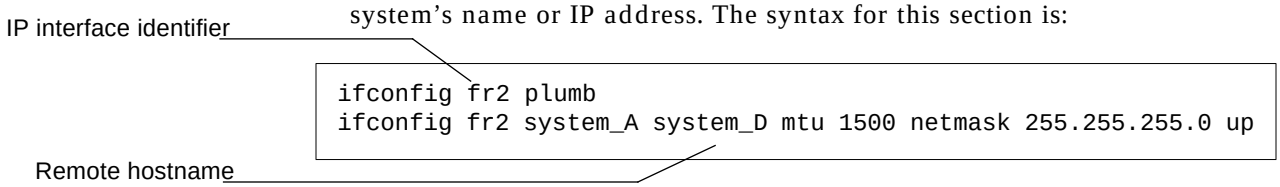
Suppose you wanted to add a new PVC to the example configuration. The link is to a system called system_D. The DLCI of the PVC between system_A and system_D is `400`.

Note – If you are connected to a public Frame Relay network, and need to add a PVC to a new destination, contact your service provider to arrange this. Your service provider will tell you the DLCI to use, and any other necessary configuration information.

To add the new PVC:

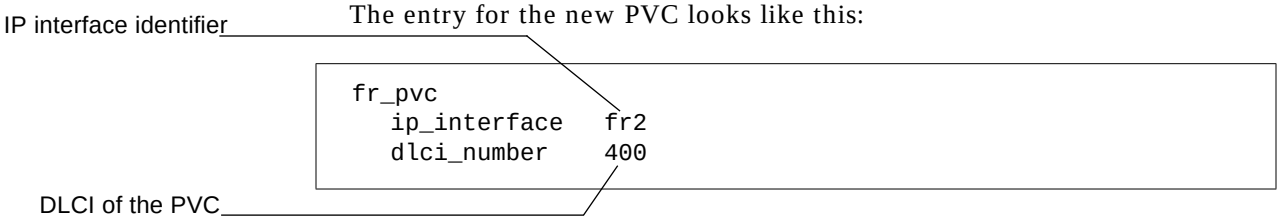
1. **Open the file `/etc/opt/SUNWconn/fr/fr.cf` for editing.**

2. **Add the necessary IP information for the remote destination at the top of the file.**
   Each entry must have a unique IP interface identifier, and specify the remote system's name or IP address. The syntax for this section is:




```
ifconfig fr2 plumb
ifconfig fr2 system_A system_D mtu 1500 netmask 255.255.255.0 up
```

3. **Add the necessary PVC information to the link configuration section.**
   The entry for the new PVC looks like this:




```
fr_pvc
   ip_interface   fr2
   dlci_number    400
```

Once you have finished adding PVC information, the complete file looks like this:

IP configuration for new PVCs

New PVC

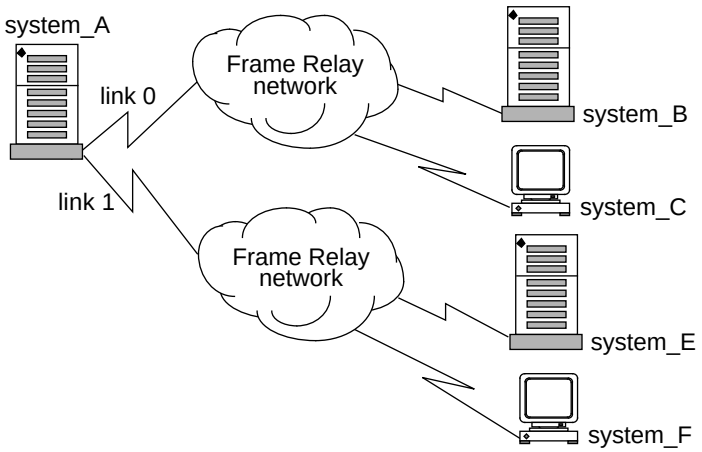
```
ifconfig fr0 plumb
ifconfig fr0 system_A system_B mtu 1500 netmask 255.255.255.0 up

ifconfig fr1 plumb
ifconfig fr1 system_A system_C mtu 1500 netmask 255.255.255.0 up

ifconfig fr2 plumb
ifconfig fr2 system_A system_D mtu 1500 netmask 255.255.255.0 up

fr_link
    fr_link_id     0
    unix_device    hih0
    txc_clock      txc
    rxc_clock      rxc
  fr_pvc
    ip_interface   fr0
    dlci_number    200
  fr_pvc
    ip_interface   fr1
    dlci_number    300
  fr_pvc
    ip_interface   fr2
    dlci_number    400
```

Adding New Links



To add a second link to a second Frame Relay network to the example configuration

1. **Open the file** `/etc/opt/SUNWconn/fr/fr.cf` **for editing.**

2. **Add IP information for each remote destination to the top section of the file**
   Each entry must have a unique IP interface identifier, and specify the remote system's name or IP address. The syntax for this section is

IP interface identifier

Remote hostname

```
ifconfig fr2 plumb
ifconfig fr2 system_A system_E mtu 1500 netmask 255.255.255.0 up

ifconfig fr3 plumb
ifconfig fr3 system_A system_F mtu 1500 netmask 255.255.255.0 up
```

   Allocate the IP interface number and specify the hostname or IP address of the remote system.

3. Add an `fr_link` section for the new link:

```
fr_link
    fr_link_id     1
    unix_device    hih1
    txc_clock      txc
    rxc_clock      rxc
```

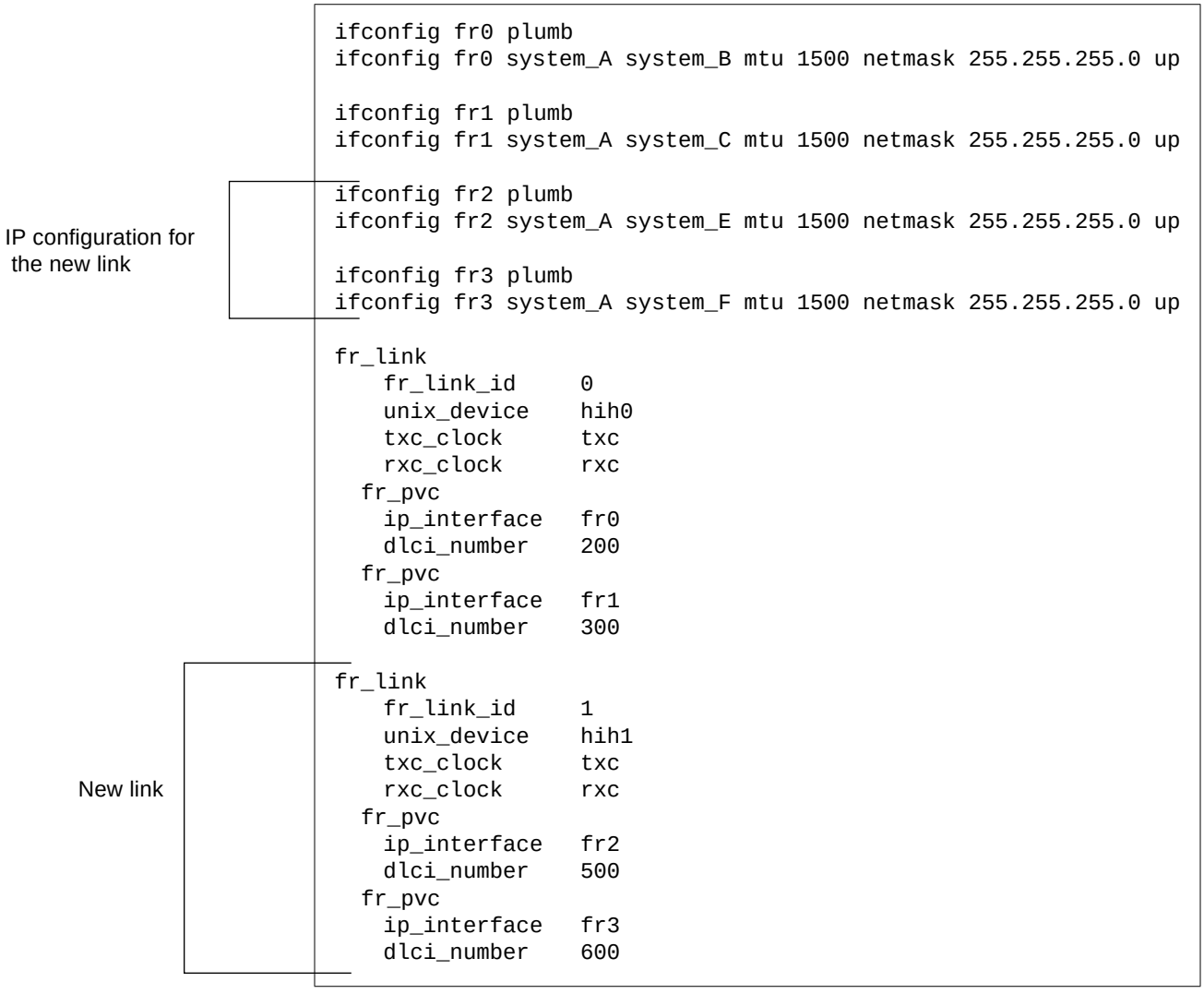
Add the new `fr_link` section at the bottom of the file, *below* the PVC information for link 0. The example above shows a new link, link 1, that uses the `hih1` Unix device. The `txc_clock` and `rxc_clock` values shown in the example are appropriate for external clocking—the default for connecting to a public Frame Relay network.

4. *Below* the new `fr_link` section, add an `fr_pvc` section for each PVC reachable across the new link:

```
fr_pvc
   ip_interface   fr2
   dlci_number    500
 fr_pvc
   ip_interface   fr3
   dlci_number    600
```

Make sure you use the same `ip_interface` number here as you used in the IP configuration section.

With the new link and PVCs added, the complete configuration file looks like this:




```
ifconfig fr0 plumb
ifconfig fr0 system_A system_B mtu 1500 netmask 255.255.255.0 up

ifconfig fr1 plumb
ifconfig fr1 system_A system_C mtu 1500 netmask 255.255.255.0 up

ifconfig fr2 plumb
ifconfig fr2 system_A system_E mtu 1500 netmask 255.255.255.0 up

ifconfig fr3 plumb
ifconfig fr3 system_A system_F mtu 1500 netmask 255.255.255.0 up

fr_link
    fr_link_id     0
    unix_device    hih0
    txc_clock      txc
    rxc_clock      rxc
  fr_pvc
    ip_interface   fr0
    dlci_number    200
  fr_pvc
    ip_interface   fr1
    dlci_number    300

fr_link
    fr_link_id     1
    unix_device    hih1
    txc_clock      txc
    rxc_clock      rxc
  fr_pvc
    ip_interface   fr2
    dlci_number    500
  fr_pvc
    ip_interface   fr3
    dlci_number    600
```

Adding More Detail

Solstice Frame Relay provides a number of optional keywords for adding more detail to a configuration. You can specify how you want congestion to be handled, the kind of management to use, and how management should operate. Finally, you can provide the CIR you have subscribed to. The Solstice Frame Relay software uses this information to calculate the percentage of CIR you are using. This is displayed by the `frmon` utility, see “Monitoring Link and PVC Statistics using frmon” on page 38.

Changing Congestion Handling

By default, when a Solstice Frame Relay system receives traffic containing BECN or FECN flags, it sets the DE flag in all outgoing traffic on the same PVC. If it is necessary to start discarding traffic, the Frame Relay network discards traffic containing a DE flag before it starts discarding other traffic.

To specify that the DE flag must never be set in outgoing traffic on a link, add the following line to the `fr_link` entry for that link:

```
turn_off_de yes
```

To revert to the default behavior, either delete the line, or change the argument to `no`.

Note – If necessary, the Frame Relay network will still discard traffic that does not contain the DE flag.

Adding Local Management Interface Support

By default, the LMI procedures that verify link integrity and PVC status are disabled. Solstice Frame Relay 2.0 supports three versions of LMI—Original, ANSI, and CCITT.

To enable LMI on a link, add the `use_lmi` keyword to the `fr_link` entry. Valid arguments are:

Table 2-1 `use_lmi` Argument

Argument	Meaning
`original`	Use the original version of LMI. This is the default option.
`ansi`	Use the ANSI Annex D version of LMI.
`ccitt`	Use the CCITT version of LMI.
`off`	Disable LMI.

LMI uses two configurable parameters:

- The *polling interval* specifies the number of seconds which elapse between two messages to check for link integrity. To set a polling interval, use the `polling_interval` keyword, followed by the number of seconds you want to set as the interval. If you omit this keyword, the default of 6 seconds is used.
- The *enquiry interval* controls the interval between PVC status checks. It does this by specifying how often the polling interval expires between PVC status checks. For example, if the polling interval is 6 and you want to check PVC status every 60 seconds, use the default enquiry interval of 10. To set the enquiry interval, enter the `enquiry_interval` keyword, followed by a numeric value. If you omit this keyword, the default is used.

To disable LMI, either delete this line from the `fr.cf` file, or set `use_lmi` to `off`.

The following example shows the entry for a link that supports the ANSI Annex D version of LMI, using a polling interval of 12 and an enquiry interval of 5. This means that the link integrity is checked every 12 seconds and the PVC status every 60:

```
ifconfig fr0 plumb
ifconfig fr0 system_A system_B mtu 1500 netmask 255.255.255.0 up

fr_link
    fr_link_id        0
    unix_device       hih0
    txc_clock         txc
    rxc_clock         rxc
    use_lmi           annex_D
    polling_interval  12
    enquiry_interval  5
  fr_pvc
    ip_interface      fr0
    dlci_number       200
```

Specifying the Committed Information Rate

Specifying the CIR lets the `frmon` utility calculate and display the percentage of CIR that you are using. See “Monitoring Link and PVC Statistics using frmon” on page 38. To specify the CIR, add the keyword `cir` to the `fr_link` section, and specify the CIR you have subscribed to in bits per second:

```
ifconfig fr0 plumb
ifconfig fr0 system_A system_B mtu 1500 netmask 255.255.255.0 up

fr_link
    fr_link_id        0
    unix_device       hih0
    txc_clock         txc
    rxc_clock         rxc
    cir               128000
  fr_pvc
    ip_interface      fr0
    dlci_number       200
```

If you don't want to specify the CIR, delete this line. If you do this, the `frmon` display shows the percentage of CIR as `unknown`.

Updating the Solstice Frame Relay Software

Once you have modified your configuration, you need to update the Solstice Frame Relay software. To do so without stopping and restarting the Solstice Frame Relay software, enter the command:

```
#/etc/init.d/fr.control update
```

Stopping, Starting and Updating Solstice Frame Relay

The `fr.control` utility lets you stop and start Solstice Frame Relay, and update the configuration.

To start the Solstice Frame Relay software, enter the command:

```
# /etc/init.d/fr.control start
```

If all is well, a message tells you that Solstice Frame Relay is starting. If the software detects an error in your configuration, Solstice Frame Relay does not start. Instead, a message tells you to look in the `fr.log` file for more specific error messages. Refer to “Interpreting the Solstice Frame Relay Log File” on page 57 for help in finding and fixing the problem.

If you modify the `fr.cf` file, you need to update your configuration to take account of the changes. To do so without stopping and restarting the Solstice Frame Relay software, enter the command:

```
# /etc/init.d/fr.control update
```

If there are errors in the configuration, a message tells you to refer to the `fr.log` file.

To stop running Solstice Frame Relay, enter this command:

```
# /etc/init.d/fr.control stop
```

Note – When you reboot a system running Solstice Frame Relay, the Frame Relay software restarts automatically. It is called by the `/etc/rc2.d/S46fr` script. Delete this script to prevent automatic restarts on boot.

2

Configuration File Summary

The `fr.cf` file uses the following structure

Table 2-2 gives the valid keywords and arguments used by the link and PVC sections of the `fr.cf` file:

Table 2-2 Link and PVC Keywords

Keyword	Meaning	Arguments	Status
`fr_link`	All following keywords relate to the same link.	none.	mandatory
`fr_link_id`	Identifies the link.	Any positive number.	mandatory
`unix_device`	Identifies the synchronous port to use.	`zsh`*n*, `hih`*n*.	mandatory
`line_speed`	Specifies line speed for physical connection.	speed in bits per second.	mandatory if clocking is internal
`txc_clock`	Source of transmit clock signal.	`baud`, `txc`, `rxc.`	mandatory
`rxc_clock`	Source of receive clock signal.	`baud`, `txc`, `rxc.`	mandatory
`turn_off_de`	Do not set DE flag on this link if congestion occurs.	`yes`, `no`. Default is `no`.	optional
`use_lmi`	Enable LMI.	`original`, `ansi`, `ccitt`, `off`. Default is `off`.	optional
`polling_interval`	Specify LMI timer value.	Any positive number. Default is `6`.	optional
`enquiry_interval`	Specify PVC enquiry interval.	Any positive number. Default is `10`.	optional

Table 2-2 Link and PVC Keywords

Keyword	Meaning	Arguments	Status
`fr_pvc`	All following keywords relate to the same PVC, until the occurrence of another `fr_pvc` keyword or an `fr_link` keyword.	none.	mandatory
`ip_interface`	Associates the PVC with an IP interface.	`fr`*n*.	mandatory
`dlci_number`	Specifies DLCI for this PVC.	DLCI.	mandatory
`cir`	Set Committed Information Rate.	Committed Information Rate in bits per second.	optional

Table 2-3 summarizes the valid parameters of the `ifconfig` keyword, used to define an IP interface over Frame Relay. They are the standard parameters used by the `ifconfig(1M)` command.

Table 2-3 `ifconfig` Parameters

Parameter	Meaning
`fr`*n*	Identifies the IP interface.
local IP address	IP address or hostname of local IP interface.
remote IP address	IP address or hostname of remote IP interface.
`mtu`	Next parameter is the MTU value.
mtu value	Value of MTU to use.
`netmask`	Next parameter is the IP netmask.
netmask value	The IP netmask.
`up`	The link is active.

2

Monitoring and Maintenance 3

Solstice Frame Relay 2.0 provides a number of tools and utilities that let you monitor your Frame Relay network. These are useful for monitoring your Frame Relay installation and for troubleshooting.

3

Monitoring Link and PVC Statistics using `frmon`

The `frmon` utility monitors link and PVC statistics on either a cumulative or periodic basis.

Using `frmon`

The `frmon` utility takes the following options:

Table 3-1 `frmon` Options

Option	Meaning
`–L`	Display link-related statistics instead of PVC related statistics.
`–n`	Display cumulative statistics instead of periodically updated statistics.
`–d`	Replace line utilization statistics with information on invalid frames received.
`–l` *linkid*	Display statistics only for the specified link.
`–v` *range*	Display statistics for the specified PVC or range of PVCs.
`–i` *interval*	Use this sampling interval in place of the default 30 seconds.
`–p` *period*	The length of time, in minutes, for which `frmon` will display current statistics. The default is 1440 minutes, that is 24 hours. To display the statistics continuously, set to 0.

Entered without any options, `frmon` displays statistics for all currently active PVCs, updated every 30 seconds. The display remains current for 24 hours and includes line utilization statistics:

```
hostname% frmon

     Wed Oct 25 10:34:04 1995
Lnk I/F   DLCI State  TxOctet  TxFr   RxOctet  RxFr   FECN BECN outil iutil
1   fr5   104    UP   292732   345      7293    17    123    3   65%   12%
3   fr1    27    UP      502    87    194382   319      7   21  154%   85%
```

The default display fields for per-PVC statistics are:

Table 3-2 Default Per-PVC Statistics

Field	Meaning
Lnk	The link used by the PVC.
If	The IP interface identifier for the PVC.
DLCI	The DLCI for the PVC.
State	The PVC's current state. Possible values are active, inactive and invalid.
TxOctet	The number of octets transmitted since last update.
TxFr	The number of frames transmitted since last update.
RxOctet	The number of octets received since last update.
RxFr	The number of frames received since last update.
FECN	The number of FECNs received since last update.
BECN	The number of BECNs received since last update.
outil	Outbound line utilization as a percentage of the Committed Information Rate (CIR). If you have not specified the CIR, see "Specifying the Committed Information Rate" on page 31, this is shown as unknown.
iutil	Inbound line utilization as a percentage of the Committed Information Rate (CIR). If you have not specified the CIR, see "Specifying the Committed Information Rate" on page 31, this is shown as unknown.

Entered with the –d option, frmon includes statistics on invalid frames sent and received in the place of the line utilization statistics:

```
hostname% frmon –d –i10

Lnk I/F  DLCI State  TxOctet  TxFr   RxOctet  RxFr  FECN  BECN IvFrm IvNli
1   fr5   104    UP   292732   345      7293    17   123     3    23     4
3   fr1    27    UP      502    87    194382   319     7    21     0     0
```

The extra fields are:

Table 3-3 Additional Per-PVC Statistics

Field	Meaning
IvFrm	The number of invalid frames received.
IvNli	The number of frames with invalid NLPI received.

Entered with the –L option, frmon displays statistics for all currently active links, updated every 30 seconds. The display remains current for 24 hours:

```
hostname% frmon –L

     Wed Oct 25 10:34:04 1995
Lnk LMI TxOctet  TxPkt   RxOctet  RxPkt   FECN BECN Poll FEnq Shrt UkVC Err  ?IE
0   none  87654    123      3212     23     10    3   22   12    1    4   0    0
2   AnxD  12345    876    873428    726      0    0   14    6    0    0   5    0
```

The fields are:

Table 3-4 frmon –L Fields

Field	Meaning
Lnk	Link number.
LMI	Version of LMI in use. Possible values are LMI, AnxD or none.
TxOctet	Number of octets transmitted.
TxPkt	Number of frames transmitted.
RxOctet	Number of octets received.
RxPkt	Number of frames received.
FECN	Number of frames received with the FECN bit set.
BECN	Number of frames received with the BECN bit set.
Poll	LMI polling interval in seconds.
FEnq	LMI full enquiry interval in seconds.
Shrt	Number of frames received that were too short.

Table 3-4 `frmon –L` Fields

Field	Meaning
`UkVC`	Number of frames received with an unconfigured DLCI.
`Err`	Number of LMI frames received with an invalid protocol.
`?IE`	Number of LMI frames received with an unknown information element.

Interpreting `frmon` *output*

Table 3-5 lists some trends to look out for and action you could take:

Table 3-5 Interpreting `frmon` Output

Output	Meaning	Action
High proportion of frames received contain BECN or FECN.	Network may be congested.	Contact your service provider.
Low percentage of CIR.	Either you have configured the wrong value in the `fr.cf` file or you are consistently using less bandwidth than you have available.	Check the value in the `fr.cf` file matches the CIR you subscribed to. If it does, consider lowering your CIR, if this is more cost effective.
High percentage of CIR.	Either you have configured the wrong value in the `fr.cf` file or you are consistently using up almost all the bandwidth available to you.	Check the value in the `fr.cf` file matches the CIR you subscribed to. If it does, consider raising your CIR for better performance.

Table 3-5 Interpreting `frmon` Output

Output	Meaning	Action
Large number of frames containing invalid NLPID.	You are receiving a lot of non-IP traffic.	Investigate where this is coming from.
Large number of LMI errors.	Your system cannot read the LMI frames it is receiving. You may have configured it to use the wrong version.	Check that you have configured your system to use the same version of LMI as is supported by the Frame Relay network.
Large number of invalid frames.	You are being sent corrupt traffic, or the network is corrupting traffic.	Contact system administrator of the remote device to find out if there is a problem. Contact your network provider.

Displaying Link and PVC Statistics using `frstat`

The `frstat` utility displays detailed link and PVC statistics, corresponding to those defined by the Frame Relay MIB.

Using `frstat`

Enter the command `frstat`, followed by one of the following options:

Table 3-6 `frstat` Options

Option	Meaning
–`l` *linkid*	Display statistics only for the specified link.
`fr`*n*	Display statistics for the PVC associated with this IP device.

The link-specific display looks like this:

```
hostname% frstat -l 2

Frame Relay statistics for link 2
=================================
output Frames           = 214
output Octets           = 34215
input Frames            = 7654
input Octets            = 234831
frDlcmiState            = ANSI T1.617 Annex D
frDlcmiPollingInterval  = 6
frDlcmiFullEnquiryInter = 20
frCircuitReceivedFECNs  = 65
frCircuitReceivedBECNs  = 3
receivedShortCnt        = 12
unknownDLCICnt          = 2
dlcmiProtoErrCnt        = 3
dlcmiUnknownIECnt       = 8
```

The fields are:

Table 3-7 `frstat` Link Specific Fields

Field	Meaning
`output Frames`	Number of frames transmitted on this link for all DLCIs.
`output Octets`	Number of octets transmitted on this link for all DLCIs.
`input Frames`	Number of frames received on this link for all DLCIs.
`input Octets`	Number of octets received on this link for all DLCIs.
`frDlcmiState`	Type of LMI in use: LMI (original version), Annex D or none.
`frdlcimPollingInterval`	LMI polling interval in seconds.
`frDlcmiFullEnquiryInter`	LMI full enquiry interval in seconds.
`frCircuitReceivedFECNs`	Number of frames received with FECN bit set.
`frCircuitReceivedBECN`	Number of frames received with BECN bit set.
`receivedShortCnt`	Number of undersized frames received.
`unknownDLCIcnt`	Number of frames received with an unknown DLCI.
`dlcmiProtoErrCnt`	Number of frames received with invalid LMI version configured.
`dlcmiUnknownIECnt`	Number of LMI frames received with unknown Information Element.

The PVC specific display looks like this:

```
hostname% frstat fr2

Frame Relay statistics for fr2
==============================
frCircuitState           = active
frCircuitSentFrames      = 427
frCircuitSentOctets      = 34921
frCircuitReceivedFrames  = 312
frCircuitReceivedOctets  = 21387
invalidFrameCnt          = 12
invalidNlpidCnt          = 1
```

The fields are:

Table 3-8 `frstat` PVC Specific Fields

Field	Meaning
`State`	Whether a PVC is `active`, `inactive` or `invalid`.
`frCircuitFramesSent`	The number of frames transmitted.
`frCircuitOctetsSent`	The number of octets transmitted.
`frCircuitFramesReceived`	The number of frames received.
`frCircuitOctetsReceived`	The number of octets received.
`invalidFrameCnt`	The number of invalid frames received.
`invalidNlpidCnt`	The number of frames received using an invalid NLPI.

Interpreting `frstat` *Output*

Table 3-9 lists some trends to look out for and action you could take:

Table 3-9 Interpreting `frstat` output

Output	Meaning	Action
High proportion of frames received contain BECN or FECN.	Network may be congested.	Contact your service provider.
Large number of incoming frames with an unknown DLCI.	You are receiving traffic for a destination that does not exist on your system.	Check the `fr.cf` file to make sure that all your DLCIs are configured correctly. If they are, contact your network provider, as there may be a routing problem at the switch.
Large number of frames containing invalid NLPID.	You are receiving a lot of non-IP traffic.	Investigate where this is coming from.
Large number of LMI errors.	Your system cannot read the LMI frames it is receiving. You may have configured it to use the wrong version.	Check that you have configured your system to use the same version of LMI as is supported by the Frame Relay network.
Large number of invalid frames.	You are being sent corrupt traffic, or the network is corrupting traffic.	Check whether you have configured to use Internal clocking when the switch you are connecting to provides the clock. Contact the system administrator of the remote device to find out if there is a problem. Contact your network provider.

Decoding and Displaying Frames using `frtrace`

The `frtrace` utility captures information about each frame sent and received by Solstice Frame Relay.

Using `frtrace`

Enter `frtrace` on a command-line and redirect the output to a file:

```
hostname% frtrace > filename
```

The trace continues until you stop it using `Ctrl-c`.

By default, `frtrace` output has the following components and format:

```
timestamp: direction : length, dlci, linkid, NLPID protocol
```

The fields are:

Table 3-10 `frtrace` Components

Field	Meaning
timestamp	The time at which this trace was recorded.
direction	A frame can be outgoing (`Send`) or incoming (`Recv`).
length	Length in octets of this frame.
dlci	The frames's DLCI.
linkid	The link on which the frame was sent or received.
NLPID	A 1 octet code, identifying the protocol in use.
protocol	The protocol in use.

To display frame contents as well as headers, use the –`x` option:

```
hostname% frtrace -x > filename
```

The components and format of this type of trace are:

```
timestamp: direction : length, dlci, linkid, NLPID protocol

hex dump of packet
```

Using the Color Options

If you have a color terminal, for example the CDE `dtterm`, you can use different colors to distinguish frames sent from frames received. In this case, do not redirect output to a file, as this will have unpredictable results.

Enter the following:

```
#frtrace -c
```

To specify the colors to use, use the `–r` (for frames received) and `–s` (for frames sent) options. The colors must be one of the following: `Black`, `Red`, `Green`, `Yellow`, `Blue`, `Magenta`, `Cyan`, `White`. The default colors are Blue for frames sent, Red for frames received. If the terminal does not support color, the program attempts to flag transmitted frames in reverse video.

Interpreting `frtrace` *Output*

If you are having trouble interpreting traces, refer to Appendix A, “Technical Background” for information on Frame Relay frame formats and other information that may be useful. If you are still having trouble interpreting traces, send a copy to your authorized support provider.

Successful Frame Relay Call

This sample trace is of a system that is successfully sending and receiving IP traffic:

```
# /opt/SUNWconn/fr/bin/frtrace

15:42:12: Recv 136 octets, dlci=100, linkid=1, NLPID=cc (IP Packet)
15:42:12: Send 44 octets, dlci=100, linkid=1, NLPID=cc (IP Packet)
15:42:12: Send 44 octets, dlci=100, linkid=1, NLPID=cc (IP Packet)
15:42:12: Recv 136 octets, dlci=100, linkid=1, NLPID=cc (IP Packet)
15:42:12: Send 44 octets, dlci=100, linkid=1, NLPID=cc (IP Packet)
15:42:12: Recv 136 octets, dlci=100, linkid=1, NLPID=cc (IP Packet)
15:42:12: Recv 136 octets, dlci=100, linkid=1, NLPID=cc (IP Packet)
15:42:12: Recv 136 octets, dlci=100, linkid=1, NLPID=cc (IP Packet)
15:42:12: Send 76 octets, dlci=100, linkid=2, NLPID=cc (IP Packet)
```

The NLPID of cc indicates that this is IP traffic.

This sample trace shows the contents of some frames containing IP traffic:

```
# /opt/SUNWconn/fr/bin/frtrace -x

15:43:05: Send 76 octets, dlci=100, linkid=3, NLPID=cc (IP Packet)

        18 41 03 cc 45 00 00 48 b0 0d 40 00 ff 11 af 43      ".A..E..H..@....C"
        81 9d 17 02 81 9d 02 17 80 46 80 1d 00 34 67 68      ".........F...4gh"
        33 5f c1 55 00 00 00 00 00 00 00 02 00 01 86 ac      "3_.U............"
        00 00 00 01 00 00 00 01 00 00 00 00 00 00 00 00      "................"
         00 00 00 00 00 00 00 00 00 00 00 00                  ".........."

15:43:05: Recv 76 octets, dlci=200, linkid=6, NLPID=cc (IP Packet)

        30 81 03 cc 45 00 00 48 89 8f 40 00 ff 11 eb d7      "0...E..H..@....."
        81 9d 01 02 81 9d 02 01 80 76 80 17 00 34 ca ac      ".........v...4.."
        32 64 74 f8 00 00 00 00 00 00 00 02 00 01 86 ac      "2dt............."
        00 00 00 01 00 00 00 01 00 00 00 00 00 00 00 00      "................"
          00 00 00 00 00 00 00 00 00 00 00 00                  ".........."
```

LMI Trace

This example shows an exchange of LMI frames, using the original version of LMI:

```
# /opt/SUNWconn/fr/bin/frtrace -x

15:41:37: Send 13 octets, dlci=1023, linkid=0, NLPID=9 (Original LMI Frame)

         fc f1 03 09 00 75 01 01 01 03 02 37 0d              ".....u.....7.   "

15:41:39: Send 13 octets, dlci=1023, linkid=0, NLPID=9 (Original LMI Frame)

         fc f1 03 09 00 75 01 01 00 03 02 38 0d              ".....u.....8.   "

15:41:39: Recv 21 octets, dlci=1023, linkid=0, NLPID=9 (Original LMI Frame)

         fc f1 03 09 00 7d 01 01 00 03 02 0e 38 07 06 00      ".....}......8..."
          c8 02 00 40 00                                       "...@.           "

15:41:41: Send 13 octets, dlci=1023, linkid=0, NLPID=9 (Original LMI Frame)

         fc f1 03 09 00 75 01 01 01 03 02 39 0e              ".....u.....9.   "

15:41:41: Recv 13 octets, dlci=1023, linkid=0, NLPID=9 (Original LMI Frame)

          fc f1 03 09 00 7d 01 01 01 03 02 0f 39                "".....}......9
```

A DLCI of 1023 always indicates an original LMI frame, as does an NLPID of 9.

This example shows an exchange of LMI frames, using the ANSI Annex D version of LMI:

```
# /opt/SUNWconn/fr/bin/frtrace -x

16:02:43: Send 14 octets, dlci=0, linkid=0, NLPID=8 (ANSI LMI Frame)

          00 01 03 08 00 75 95 01 01 00 03 02 44 43            ".....u......DC  "

16:02:43: Recv 19 octets, dlci=0, linkid=0, NLPID=8 (ANSI LMI Frame)

          00 01 03 08 00 7d 95 01 01 00 03 02 44 44 07 03      ".....}......DD.."
          0c c0 82                                              "...              "

16:02:45: Send 14 octets, dlci=0, linkid=0, NLPID=8 (ANSI LMI Frame)

          00 01 03 08 00 75 95 01 01 01 03 02 45 44            ".....u......ED  "

16:02:45: Recv 14 octets, dlci=0, linkid=0, NLPID=8 (ANSI LMI Frame)

          00 01 03 08 00 7d 95 01 01 01 03 02 45 45            ".....}......EE  "

16:02:47: Send 14 octets, dlci=0, linkid=0, NLPID=8 (ANSI LMI Frame)

          00 01 03 08 00 75 95 01 01 01 03 02 46 45            ".....u......FE  "

16:02:47: Recv 14 octets, dlci=0, linkid=0, NLPID=8 (ANSI LMI Frame)

          00 01 03 08 00 7d 95 01 01 01 03 02 46 46              ".....}......FF
```

A DLCI of 0 indicates either an ANSI Annex D or a CCITT LMI frame, as does an NLPID of 8.

This example shows an exchange of LMI frames, using the CCITT version of LMI:

```
# /opt/SUNWconn/fr/bin/frtrace -x

12:03:46: Send 13 octets, dlci=0, linkid=1, NLPID=8 (CCITT LMI Frame)

      00 01 03 08 00 75 51 01 01 53 02 02 25          ".....uQ..S..%   "

12:03:46: Recv 13 octets, dlci=0, linkid=1, NLPID=8 (CCITT LMI Frame)

      02 01 03 08 00 7d 51 01 01 53 02 26 00          ".....}Q..S.&.   "

12:03:52: Send 13 octets, dlci=0, linkid=1, NLPID=8 (CCITT LMI Frame)

      00 01 03 08 00 75 51 01 01 53 02 03 26          ".....uQ..S..&   "

12:03:52: Recv 13 octets, dlci=0, linkid=1, NLPID=8 (CCITT LMI Frame)

      02 01 03 08 00 7d 51 01 01 53 02 27 00          ".....}Q..S.'.   "

12:03:58: Send 13 octets, dlci=0, linkid=1, NLPID=8 (CCITT LMI Frame)

      00 01 03 08 00 75 51 01 00 53 02 04 27          ".....uQ..S..'   "

12:03:58: Recv 18 octets, dlci=0, linkid=1, NLPID=8 (CCITT LMI Frame)

      02 01 03 08 00 7d 51 01 00 53 02 28 27 57 03 0d ".....}Q..S.('W.."
      f8 83                                           "..              "
```

A DLCI of 0 indicates either an ANSI Annex D or a CCITT LMI frame, as does an NLPID of 8.

Using the SunNet Manager Agent na.fr

If you need instructions on installing the SunNet Manger agent, refer to Appendix C, “Installing the SunNet Manager Agent”.

If you have a SunNet Manager console, the SunNet Manager agent can provide statistics on the following:

- A physical link
- All PVCs on a particular link
- An IP interface

The link information provided is as follows:

Table 3-11 SunNet Manager per Link Statistics

Field	Meaning
link	Link number, can be used as the key to specify a single link.
output Frames	Number of frames transmitted.
output Octets	Number of octets transmitted.
input Frames	Number of frames received.
input Octets	Number of octets received.
frDlcmiState	Type of LMI (management) protocol in use. One of LMI (the original LMI), AnxD, ITU-T or none.
frDlcmiPollingInterval	LMI polling interval in seconds.
frDlcmiFullEnquiryInterval	LMI enquiry interval in seconds.
invalidLowerIfCnt	not used in this release.
receiveShortCnt	Number of packets that were too short received.
unknownDLCICnt	Number of packets with an unconfigured DLCI received.
dlcmiProtoErrCnt	Number of LMI frames with invalid protocol received.
dlcmiUnknownIECnt	Number of LMI frames with unknown Information Element received.

The PVC information provided is as follows:

Table 3-12 SunNet Manager per PVC Statistics

Field	Meaning
`link`	Link number, can be used as the key to specify a single link.
`ifname`	Interface name for IP.
`dlci`	DLCI number.
`frCircuitState`	State of the VC, one of active, inactive or invalid.
`frCircuitReceivedFECNs`	Number of frames received with FECN bit set.
`frCircuitReceivedBECNs`	Number of frames received with BECN bit set.
`frCircuitSentFrames`	Number of frames transmitted.
`frCircuitSentOctets`	Number of octets transmitted.
`frCircuitReceivedFrames`	Number of frames received.
`frCircuitReceivedOctets`	Number of octets received.
`noBuffersCnt`	Number of memory allocation failures.
`invalidFrameCnt`	Number of invalid frames received.
`invalidNlpidCnt`	Number of frames with invalid NLPID received.
`ipQFullCnt`	not used in this release.
`unknownDLCICnt`	Number of frames on an unknown DLCI received.

The following events can be reported to the SunNet Manager console in a trap report:

Table 3-13 Solstice Frame Relay Events

Event Type	Events
High priority VC events.	Frame Relay DLCI down.
Medium priority VC events.	Frame Relay DLCI up. DLCI started sending DE frames. DLCI stopped sending DE frames.
Low priority VC events.	Frame Relay DLCI status change. DLCI statistics set to zero. DLCI added to link. DLCI deleted from link.
High priority link events.	Frame Relay link down. Link started at user request. Link stopped at user request.
Medium priority link events.	Frame Relay link up. Frame Relay link statistics set to zero. Frame Relay configuration change.

SunNet Manager Error Messages

If it is unable to gather statistics, the agent sends one of the following error messages to the SunNet Manager console.

`Cannot open Frame Relay device`

The software may not have been started.

`FR_STAT ioctl failed`

An attempt to retrieve link statistics failed.

`DCLI_STAT ioctl failed`

An attempt to retrieve VC statistics failed.

`unable to allocate memory`

There is a resource allocation problem.

`putmsg call failed during DL_ATTACH to unit`

You are trying to open a non-existent Frame Relay device. Make sure that Solstice Frame Relay is running and that you have configured the device in question. If the problem persists, contact your support organization.

`getmsg call failed during DL_ATTACH to unit`

You are trying to open a non-existent Frame Relay device. Make sure that Solstice Frame Relay is running and that you have configured the device in question. If the problem persists, contact your support organization.

`Invalid ACK during DL_ATTACH to unit`

You are trying to open a non-existent Frame Relay device. Make sure that Solstice Frame Relay is running and that you have configured the device in question. If the problem persists, contact your support organization.

`Error, unexpected ACK during DL_ATTACH to unit`

You are trying to open a non-existent Frame Relay device. Make sure that Solstice Frame Relay is running and that you have configured the device in question. If the problem persists, contact your support organization.

`Unknown interface name`

The specified `/dev/fr`*n* device was not found. Make sure that Solstice Frame Relay is running and that you have configured the device in question. If the problem persists, contact your support organization.

`Missing interface name, use key`

Interface statistics were requested, but no device name was given as the request key.

Interpreting the Solstice Frame Relay Log File

The file `/var/opt/SUNWconn/fr.log` is created the first time you run the `/etc/init.d/fr.control start` script.

Note – As `/var/opt/SUNWconn/fr.log` is continually updated, it can grow very large. To start again with a fresh log file, copy `/dev/null` onto the current file.

It contains three types of message:

- *Informational messages*
  These inform you of changes to your configuration. They appear when Solstice Frame Relay is in normal operation and do not require any remedial action.
- *Syntax error messages*
  These inform you of syntax errors in the file `fr.cf`. You need to find and fix the error before you can start and use Solstice Frame Relay.
- *System error messages*
  These inform you of problems with the system on which you are running Solstice Frame Relay. Some of the problems reported are serious enough to prevent the product from running, others are transitory in nature, or have little or no effect on the product's operation.

Note – The information given below does not contain an exhaustive list of all the messages that can appear in the Solstice Frame Relay log, since many of the messages are self-explanatory. If you receive a message which is not listed here and is not self-explanatory, contact your authorized service provider. See "Getting Help" on page 79 for a list of the information you need to provide.

Messages that can appear in the Solstice Frame Relay log file are:

`Attach request failed:` *message*

System error. Possibly due to a resource allocation problem. Reboot your system. If this does not solve the problem, contact your support center for help.

`Cannot send DL_ATTACH_REQ for device` *dev* `on ppa` *ppa*

System error. Possibly due to a resource allocation problem. Reboot your system. If this does not solve the problem, contact your support center for help.

`Cannot add FR DLCI` *dlci* `on link` *link id*

System error. Possibly due to a resource allocation problem. Reboot your system. If this does not solve the problem, contact your support center for help.

`Cannot allocate memory`

System error. A process, or processes, is using up all your memory. Identify the problem process and clean up. If this does not help, reboot your system.

`Cannot attach fr`*unit*

System error. Possibly due to a resource allocation problem. Reboot your system. If this does not solve the problem, contact your support center for help.

`Cannot delete FR DLCI` *dlci* `on link` *link id*

System error. Possibly due to a resource allocation problem. Reboot your system. If this does not solve the problem, contact your support center for help.

`Cannot open Frame Relay driver`

System error. The file `/usr/kernel/drv/fr` does not exist or is corrupted. Either your install has failed, or the file has been corrupted. Remove and reinstall the `SUNWfra` package.

`Cannot open sync port` *portname*

System error. This synchronous port does not exist or is busy. Check the configuration file to make sure you have entered the correct portname. If the number is correct, wait a while and try again. If the port is still busy, check whether it is being used by another product. If it is, choose another synchronous port to use with Solstice Frame Relay.

`Cannot push Frame Relay module on` *devicename*

System error. The file `/usr/kernel/drv/fr` does not exist or is corrupted. Either your install has failed, or the file has been corrupted. Remove and reinstall the `SUNWfra` package.

`Cannot read DL_OK_ACK attach reply`

System error. Possibly due to a resource allocation problem. Reboot your system. If this does not solve the problem, contact your support center for help.

`Cannot set Frame Relay link id on` *devicename*

System error. Possibly due to a resource allocation problem. Reboot your system. If this does not solve the problem, contact your support center for help.

`Cannot set LMI attributes on` *devicename*

System error. Possibly due to a resource allocation problem. Reboot your system. If this does not solve the problem, contact your support center for help.

`Cannot turn off DE bit on link` *linkid*

System error. Possibly due to a resource allocation problem. Reboot your system. If this does not solve the problem, contact your support center for help.

`Create FR DLCI` *dlci* `on link` *linkid*

Informational message. DLCI created successfully.

`Delete FR DLCI` *dlci* `on link` *linkid*

Informational message. DLCI deleted successfully.

`Failed to add DLCI` *dlci* `to Frame Relay link` *linkid*

System error. Possibly due to a resource allocation problem. Reboot your system. If this does not solve the problem, contact your support center for help.

`Failed to attach ppa` *ppa* `for device` *dev*

System error. This synchronous port does not exist or is busy. Check the configuration file to make sure you have entered the correct portname. If the portname is correct, wait a while and try again. If the port is still busy, check whether it is being used by another product. If it is, choose another synchronous port to use with Solstice Frame Relay.

`Failed to delete DLCI dlci from Frame Relay link` *linkid*

System error. Possibly due to a resource allocation problem. Reboot your system. If this does not solve the problem, contact your support center for help.

`Frame Relay daemon exiting`

Informational message.

`Got sighup signal -`

Informational message. The configuration has been updated using `/etc/init.d/fr.control update`.

`Got software termination signal -`

Informational message. The software has been halted using `/etc/init.d/fr.control stop`.

`LMI enabled on Frame Relay link` *linkid*

Informational message.

`Link` *linkid* `deleted by the user`

Informational message.

`New link created by the user: link id =` *linkid*

Informational message.

`No Frame Relay PVCs defined in` *configfile*

Syntax error. Edit `fr.cf` to add the PVCs you require.

`No Frame Relay links defined in` *configfile*

Syntax error. Edit `fr.cf` to add the links you require.

`PVC on fr`*unit*`, link` *linkid*`, dlci` *dlci* `created by the user`

Informational message. A new PVC has been created.

`PVC on fr`*unit*`, link` *linkid*`, dlci` *dlci* `deleted by the user`

Informational message. A PVC has been deleted.

`S_IOCGETMODE ioctl failed for device` *dev* `on ppa` *ppa*

System error. There is a problem with the synchronous driver. Run `frinit` and try starting the software again.

`S_IOCSETMODE ioctl failed for device` *dev* `on ppa` *ppa*

System error. There is a problem with the synchronous driver. Run `frinit` and try starting the software again.

`Serial port` *dev* `on ppa` *ppa* `is busy`

System error. Check that no other process is using this port. If it is, reconfigure Solstice Frame Relay to use a different synchronous port. If not, wait a few minutes then try again.

`Set Frame Relay link id` *linkid* `on` *dev*

Informational message.

`Short reply to attach request`

System error. Possibly due to a resource allocation problem. Reboot your system. If this does not solve the problem, contact your support center for help.

`Successful configuration`

Informational message.

`Sync_device` *dev* `missing minor device number`

Syntax error. You must specify the number of the device you want to use, `zsh`*n* or `hih`*n*.

`Turn off DE bit on Frame Relay link` *linkid*

Informational message.

`Unable to set Frame Relay trace stream`

System error. Possibly due to a resource allocation problem. Reboot your system. If this does not solve the problem, contact your support center for help.

`attach failed:` *message*

System error. Possibly due to a resource allocation problem. Reboot your system. If this does not solve the problem, contact your support center for help.

`chdir failed -`

System error. Possibly due to a resource allocation problem. Reboot your system. If this does not solve the problem, contact your support center for help.

dlci number`: dlci should be in [16.1007]`

Syntax error. DLCI for user traffic must be a numerical value between 16 and 1007.

dlci number`: value not recognized`

Syntax error. DLCI for user traffic must be a numerical value between 16 and 1007.

enquiry interval`: value not recognized`

Syntax error. Enquiry interval must be a numerical value greater than 0.

enquiry interval`: value should be > 0`

Syntax error. Enquiry interval must be a numerical value greater than 0.

`fork failed -`

System error. The `proc` table may be full. Clean up and try again or reboot.

fr_link`: calloc failed`

System error. A process or processes is using up all your memory. Identify the problem process and clean up. If this does not help, reboot your system.

fr_pvc: `calloc failed`

System error. A process or processes is using up all your memory. Identify the problem process and clean up. If this does not help, reboot your system.

`get_pvc_status_msg: getmsg failed -`

System error. Possibly due to a resource allocation problem. Reboot your system. If this does not solve the problem, contact your support center for help.

`get_token: calloc failed`

System error. A process or processes is using up all your memory. Identify the problem process and clean up. If this does not help, reboot your system.

`get_token: can't open Frame Relay config file`

The file `fr.cf` does not exits. Run `frinit` to create it, or create it manually.

ip interface `interface is up`

Informational message.

ip interface: `fr keyword expected`

Syntax error. You have omitted, or mistyped, the `fr`*n* keyword from the `ifconfig` line of `fr.cf`.

ip interface: `interface number not recognized`

Syntax error. The IP interface must be identified by a number greater than or equal to 0.

ip interface: `interface number should be >= 0`

Syntax error. The IP interface must be identified by a number greater than or equal to 0.

ip interface `interface is down`

Informational message.

line speed: `Frame Relay link speed should be >= 0`

Syntax error. The link speed must be a number greater than or equal to 0.

link id: `Frame Relay link id should be >= 0`

Syntax error. The link must be identified by a number greater than or equal to 0.

link id: `value not recognized`

Syntax error. The link must be identified by a number greater than or equal to 0.

lmi value: `unknown lmi value`

Syntax error. LMI value must be one of `original`, `ansi`, `ccitt` or `none`.

`parse_config_file: Errors in configuration`

Syntax error. The `fr.cf` file contains errors.

polling interval: `value not recognized`

Syntax error. The polling interval must be a number greater than 0.

polling interval: `value should be > 0`

Syntax error. The polling interval must be a number greater than 0.

rxc clock: `value not recognized`

Syntax error. Enter a valid receive clock value.

turn off de: `value not recognized`

Syntax error. Set `turn_off_de` to `yes` or `no`.

txc clock: `value not recognized`

Syntax error. Enter a valid transmit clock value.

`unplumb_if: open /dev/ip has failed -`

System error. IP is not present or is not operating.

`unrecognized symbol` *symbol*

Syntax error in the `fr.cf` file. *symbol* has no meaning.

Troubleshooting 4

This chapter contains information for troubleshooting possible problems with Solstice Frame Relay. Problems are generally related to either cabling or configuration.

“Resolving Common Problems” on page 67 suggestions for dealing with these problems. Check this section first to see if the procedures solve the problem.

Otherwise, follow the complete troubleshooting procedure. In general, it is best to take a “bottom up” approach to troubleshooting. The tests in this chapter are described in that order. In summary, check:

- **The Physical layer:**
  Hardware
  Line status

- **The Datalink layer**
  Link and PVC status
  Configuration errors
  Trace information
- **The Network Layer:**
  Protocol status
  Connectivity
  Network addresses
  Local routing tables
  Permissions
  Remote operations
  NIS operations (if applicable)

Resolving Common Problems

This section provides information for resolving common problems. These problems are most likely to appear when you bring up Solstice Frame Relay for the first time. If you cannot resolve the problem using the procedures given here, carry out the full set of tests described in the remainder of this chapter.

Cabling Problems

The following may be symptoms of cabling problems:

- Frame Relay does not come up, or does not stay up
- The message `xmit hung` appears in the console
- No data is being sent and/or received

Check the following:

1. Make sure you are using the correct type of cable. Refer to Appendix B, “Modem and Null Modem Cables” for cabling diagrams.
2. Make sure all cables are properly seated.
3. Make sure that you are using a cable designed for synchronous connections.
4. If you have a spare cable, replace your existing cable and retry the connection.

Configuration Problems

The following symptoms may indicate that you have made a mistake in your configuration:

- Frame Relay does not come up, or does not stay up.
- Link is up but not responding correctly.

Check the following:

1. Check the `fr.log` file for messages relating to invalid parameters.
2. Make sure you specified the correct serial port when you ran `frinit` or edited the configuration file.

3. Use `frmon` to see whether the problem is with your links or PVCs.
4. If you can find out about the remote host, check that it is still up.
5. Run the `ifconfig` command to check the status of IP.
6. Perform a back-to-back test, to test your configuration against that of another machine. If your configuration operates correctly in back-to-back mode, the problem is likely to be with the Solstice Frame Relay network. Contact your service provider for help.

Checking the Physical Layer

First of all make sure that your power cables are in good working order, and that they are all plugged-in, switched on, and tightly seated. Then carry out loopback tests. Finally, check the line status.

Checking Port Status

If you are using the onboard serial port of a SPARC station the most thorough hardware test you can do is to use `syncloop(1M)`. If you are using a high speed interface, the most thorough hardware test you can do is to use `hsi_loop(1M)`.

Both `syncloop` and `hsi_loop` check the following components of your communications link:

- Software configuration
- CPU-to-card communication
- Correct operation of the serial port
- EIA-449 or EIA-232 ports and cables
- Local and remote modems
- Transmission line

Both `syncloop` and `hsi_loop` provide the same test options and require the same equipment:

Table 4-1 `syncloop` and `hsi_loop` Options and Equipment

Option	Level of test	Equipment
Option 1	Internal test	None
Option 2	Loopback test	Loopback plug
Option 3	Local or remote modem loopback test	Modem
Option 4	Test using previous configuration	Previous setup

Checking Line Status

To check the line status, use the `syncstat(1M)` or `hsi_stat(1M)` command to observe the line over periods of ten seconds. Look for the following symptoms:

Table 4-2 Checking Line Status

Symptom	Possible Causes	Recommended Action
Output packets but no input packets.	Remote system not initialized or line not properly connected to remote system.	Contact the administrator of the remote system to resolve these problems.
Input packets with CRC errors.	Transmission medium causing errors.	Contact your network provider.
No input or output packets.	Solstice Frame Relay may not have initialized.	Restart Solstice Frame Relay.

Checking the Datalink Layer

If the problem is not at the physical layer, check the Solstice Frame Relay software and configuration:

- Check the link and PVCs are up—use `frmon`.
- Check the `fr.log` file to make sure that your configuration is valid.
- Observe connection attempts and obtain clearing causes and diagnostic codes—use `frtrace`.

Checking Link and PVC Status

The default version of the `frmon` utility lets you check the status of all your links and PVCs. It also provides information on traffic levels and line utilization.

Use `frmon` to narrow down the origin of your problem. Then double check the configuration of the problem link or PVC to see if there are errors you need to fix.

Checking for Configuration Errors

When you start or update the Solstice Frame Relay software, messages about any configuration errors you have made are written to the Solstice Frame Relay log file `/var/opt/SUNWconn/fr.log`. Check this file to see if there are errors in your configuration you need to fix.

If you try to start Solstice Frame Relay using an invalid configuration, you see this error message:

```
#  /etc/init.d/fr.control start
Starting Frame Relay
Frame Relay Daemon Not Started, See /var/opt/SUNWconn/fr.log
```

Look at the end of the `/var/opt/SUNWconn/fr.log` file for the most recent information. Refer to “Interpreting the Solstice Frame Relay Log File” on page 57 for a complete list of log messages with their meanings and suggested remedial action.

4

Observing Connection Attempts

If your Solstice Frame Relay system is attempting to connect with the Frame Relay network, use `frtrace` to trace outgoing and incoming traffic and look for diagnostic messages coming from the network.

Checking the Network Layer

Once you are sure that the physical and datalink layers are both working correctly, check to see whether the problem is at the network layer. Check the following:

- The state of the line, using `ifconfig`.
- Connectivity, using `ping`.
- The network address, using `netstat –i`.
- The routing tables, using `netstat –r`.
- Remote operation, using `rlogin`.
- Name server operation.

Checking the Protocol Status

When Solstice Frame Relay is running, you can use `ifconfig` to monitor the current state of the line. Give the Frame Relay interface name as an argument. For example,

```
hostname# ifconfig fr0
fr0: flags=8d1<UP,POINTOPOINT,RUNNING,NOARP,MULTICAST> mtu 1500
        inet address --> address netmask ffffff00
        ether 0:0:0:0:0:0
```

If `ifconfig` does not display `UP` and `RUNNING`, then either you did not configure Frame Relay correctly or the remote system cannot be contacted.

Note – Wait 30 seconds after bringing the Frame Relay link up to check these statistics, as these flags can be up to 30 seconds out of date.

Checking Connectivity

Use `ping` to check that the connection is up:

```
hostname# ping –r gateway_a
gateway_a is alive
```

The `–r` option tells `ping` that the remote host is on a directly-connected interface. If the remote host does not respond, a routing problem exists at some point between the local and remote hosts.

Checking the Network Addresses

Use the `netstat –i` command to check that the correct local and remote addresses are assigned to the Solstice Frame Relay interface:

```
hostname# netstat -i
```

Make sure that the IP addresses for the local and remote Frame Relay interfaces are the same in the `/etc/hosts` files or NIS host maps for the machines on both ends of the Frame Relay link.

Checking the Local Routing Tables

Use the `netstat –r` command to display the local routing tables:

```
hostname# netstat -r
```

The routing table looks like this:

Entry for Frame Relay interface

```
Routing tables
Destination    Gateway    Flags    Refcnt    Use     Interface
host_a          sun-bb      UGH       0          0        ie1
host_b          sun-bb      UGH       0          0        ie1
gateway_b       gateway_a   UGH       1          12897    fr0
route7          route7      UGH       0          0        ie0
eastgate        route71     UGH       0          158      ie0
backbone        alpha-bb    U         1          16087    ie1
dresdenpc       route1      UG        0          0        ie1
loopback        localhost   U         2          113436   lo0
beta-bb         alpha       U         4063       146044   ie0
dallas2         route7      UG        0          0        ie0
trainingpc      route62     UG        0          0        ie1
```

Make sure there is a routing table entry for each possible destination network.

If it isn't, and you are using *static routing*, add the appropriate static routes. If you are using *dynamic routing* with `in.routed`, do the following:

1. Check that `in.routed` is running by typing:

```
hostname% ps –ef | grep route
  root  process_id 1 80 Feb 22  1:55 /usr/sbin/in.routed -q
```

If the routing tables still are not correct, become superuser, and continue with the next steps.

2. Kill `in.routed` and flush the routing tables:

```
# kill –9 process_id
# /usr/sbin route –f
```

where *process_ID* is the process ID displayed by the `ps –ef` command.

3. Restart `in.routed` as follows:

```
#/usr/sbin/in.routed
```

Checking Remote Operations

Check that remote operations are working correctly by using `rlogin` or `rsh` to reach the remote host over the Solstice Frame Relay link. If this fails, it probably indicates that the machines on each end of the link have different MTU sizes.

Checking Naming Service Operations

If your network or the network at the opposite side of the Solstice Frame Relay link runs a naming service, check that this naming service is working correctly. Refer to your naming service's documentation.

Disabling Routing

If your system has more than one IP interface, it may declare itself to be an IP router when it reboots. Your system will then route IP traffic between its Frame Relay interface and its other IP interfaces. If your system is running Solaris 2.5, you can disable the routing by creating an empty file `/etc/notrouter`.

Configuring Systems Back-to-Back

If you are having problems with a Solstice Frame Relay system, it can be useful to run it back-to-back with another system that you know is working correctly. If your problems persist, they are almost certainly due to your configuration or to a problem with the Solstice Frame Relay installation. If the problems do not appear when running back-to-back, they are likely to be due to the Frame Relay network. In this case, contact your service provider for help.

To run two systems back-to-back you require a null modem cable. Use an asymmetrical cable that is appropriate for the serial port you want to test. Refer to Figure B-4 on page 95 for the pin-out for a synchronous EIA-232-A null modem cable, suitable for use with a `zsh` onboard serial port, and to Figure B-6 on page 98 for a synchronous EIA-449 null modem cable suitable for use with an `hih` high speed interface.

Edit the `fr.cf` file on each system to create a link and PVC between the two systems. Configure the system that works correctly to provide the clock. This lets you leave the problem system's clocking as External. If either system is configured to use LMI, set the `use_lmi` keyword to `off`, or delete the line, as LMI only works when the Frame Relay system is connected to a switch.

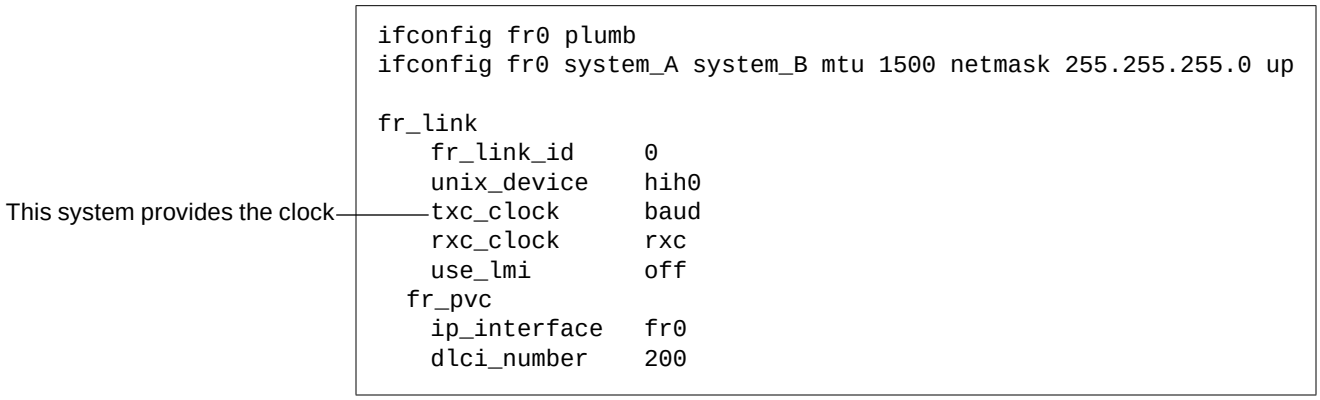
For example, if you had a single PVC running over a single link, the problem system's `fr.cf` file might look like this:

```
ifconfig fr0 plumb
ifconfig fr0 system_A system_B mtu 1500 netmask 255.255.255.0 up

fr_link
    fr_link_id     0
    unix_device    hih0
    txc_clock      txc
    rxc_clock      rxc
    use_lmi        off
  fr_pvc
    ip_interface   fr0
    dlci_number    200
```

The name of the UNIX device the null modem cable is plugged into

Configure the other system to provide the clock:



Getting Help

If none of the measures described in this chapter resolve your problem, you need to contact either your technical support organization, or your network service provider for further help.

If the problem appears to be with your configuration, or with the Solstice Frame Relay software, contact your technical support organization. Be prepared to provide the following:

- The name and version number of the problem product—in this case Solstice Frame Relay 2.0.
- The version of the Solaris operating system that you are using.
- An exact description of your configuration.
- An exact description of the problem.
- A description of any remedial measures you have tried and the results you obtained.
- Copies of traces, statistics and the Solstice Frame Relay log file.

If the problem appears to be with the Frame Relay network itself, contact your service provider.

4

Technical Background A

Frame Structure

Frame Relay uses a simplified version of the HDLC frame structure, as it does not provide accounting, sequencing and flow control functions. A Frame Relay frame has this format:

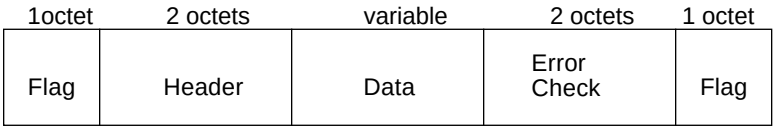


Figure A-1 Frame Relay Frame Format

The frame fields are:

- *Flag*
  A flag is placed between each frame, to mark where the frame begins and ends.

- *Header*
  The header field fulfills the same functions in a Frame Relay frame as the Address and Control fields in other datalink layer frames. The header has this structure:

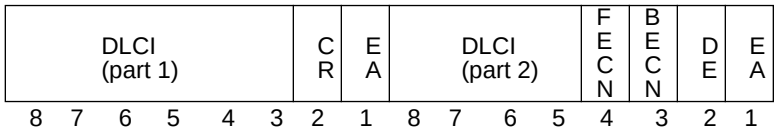


Figure A-2 Header Structure

The fields are:

- *DLCI*
  The Data Link Connection Identifier. This is the address that identifies the Frame Relay virtual connection.
- *C/R*
  The Command Response bit. Identifies whether the frame is a command or a response to a command.
- *EA*
  The Address Extension bit. Indicates whether address extensions are in use or not.
- *FECN* and *BECN*
  The Forward and Backward Explicit Congestion Notification bits. Notify other Frame Relay systems that there is problem with congestion.
- *DE*
  Discard Eligibility flag. Frames containing the DE flag will be discarded before other frames if congestion occurs.

- *Data*
  Also known as the Information Field or I-Field. This field contains user data that has been passed down from higher layers and encapsulated within the Frame Relay frame. For example, the Data field might contain an IP Datagram if IP is being routed over Frame Relay. The length of this field is variable.

- *Error Check*
  Also known as the Frame Check Sequence (FCS) field. This is used to check that the frame has not been damaged while on the communications link.

Address Structure

Frame Relay uses DLCI (Data Link Connection Identifier) addresses. A DLCI identifies the virtual connection in use—the same DLCI always identifies the same logical connection across a particular physical connection. DLCIs are 10 bits long and are split between the first and second octet of the header. The first six bits are placed in the first octet of the header, and the remaining four bits are placed in the second octet of the header.

The EA field is used to indicate whether any more octets follow in the header. This is because the Frame Relay standard allows the header to be two, three or four octets long. Solstice Frame Relay 2.0 always uses a two octet header, so the EA field at the end of the first octet is always 0, indicating that there is another octet to follow, and the EA field at the end of the second octet is always 1, indicating that the header is complete:

8	7	6	5	4	3	2	1
DLCI (part 1)						C/R	EA = 0
DLCI (part 2)				FECN	BECN	DE	EA = 1

Figure A-3 Two Octet Header

A

PVC Address Range

Solstice Frame Relay 2.0 supports up to 1024 PVCs per Frame Relay link. The PVC range is divided as follows:

Table A-1 Frame Relay PVC Range

DLCI range	use
0	ANSI Annex D
1 to 15	Reserved for future use
16 to 1007	User traffic
1008 to 1022	Reserved for future use
1023	Reserved for LMI and CLLM messages

In practice, this allows for up to 992 PVCs for user traffic per Frame Relay link.

Multiprotocol Encapsulation

Solstice Frame Relay 2.0 conforms to RFC1490, which specifies that an identifier should be included at the start of the I Field specifying which network layer protocol is being transmitted. This identifier is called a Network Layer Protocol Identifier (NLPID). It is the first octet of the I Field. Some possible NLPID values are:

Table A-2 Possible NLPID Values

NLPID Value	Meaning
`0x00`	Null network layer
`0x80`	SNAP
`0x81`	ISO CLNP
`0x82`	ISO ES-IS
`0x83`	ISO IS-IS
`0xcc`	IP

LMI Frame Format

The format of frame used by LMI differs slightly according to the version in use.

ANSI Annex D LMI Frame

The ANSI Annex D LMI frame has this format:

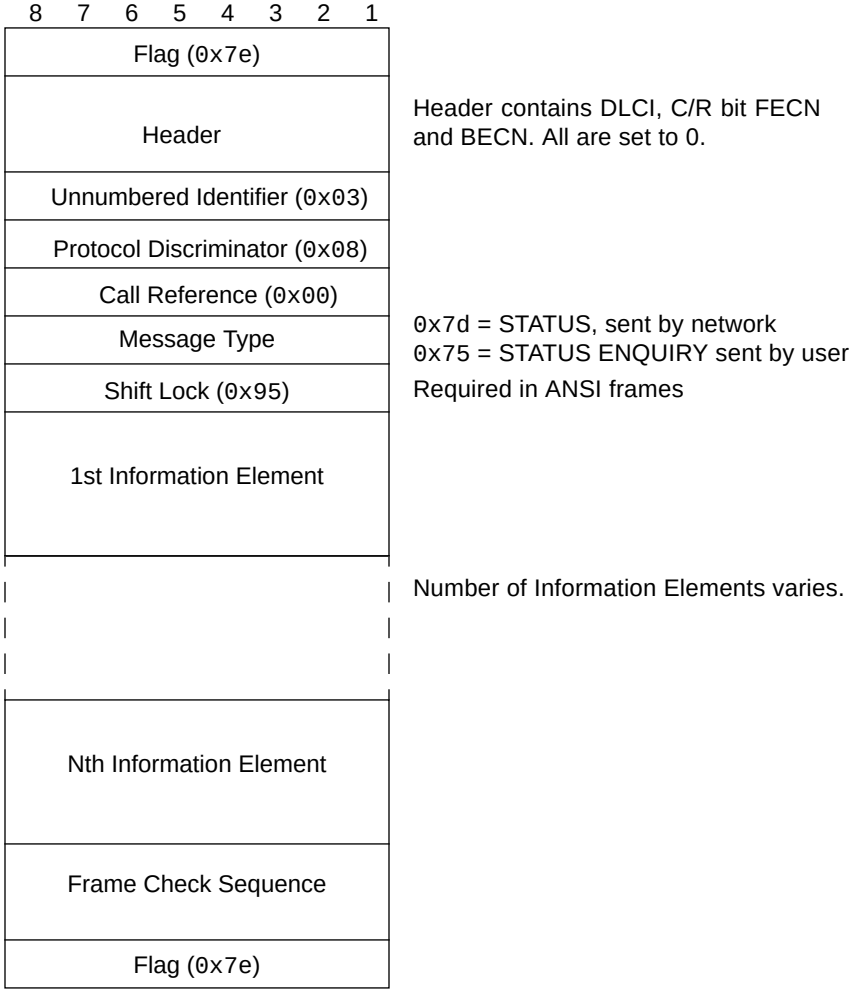


Figure A-4 ANSI Annex D LMI Frame Format

ANSI Annex D LMI uses three types of Information Element—*Report*, *Link Integrity* and *PVC Status*. They are shown below:

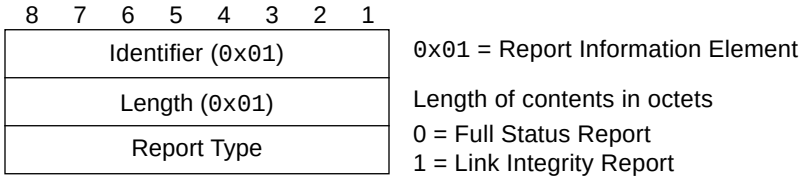


Figure A-5 Report Information Element

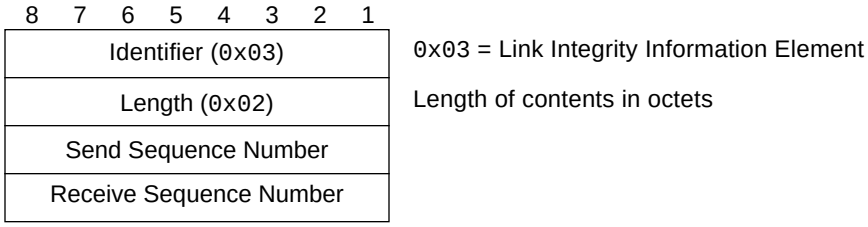


Figure A-6 Link Integrity Information Element

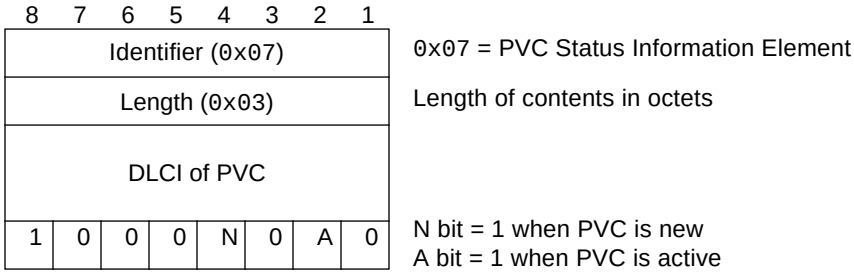


Figure A-7 PVC Status Information Element

The DLCI of the PVC is contained in two octets:

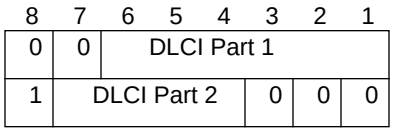


Figure A-8 ANSI Annex D LMI PVC Status DLCI Format

Original LMI

The frame format used by Original LMI differs from that used by ANSI Annex D in the following ways:

- There is no shift lock octet
- DLCI is 1023, not 0
- The PVC Status Information Element is structured like this:

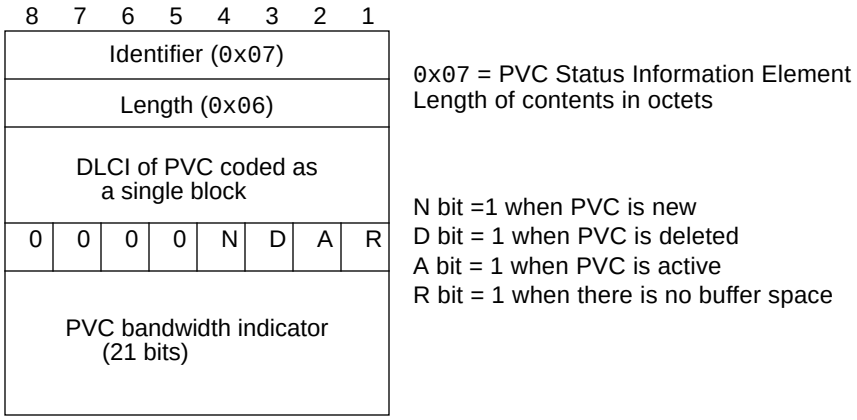


Figure A-9 Original LMI PVC Status Information Element

The DLCI of the PVC is contained in two octets:

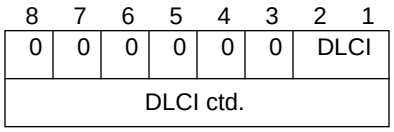


Figure A-10 Original LMI PVC Status DLCI Format

CCITT LMI

The frame format used by CCITT LMI differs from that used by ANSI Annex D LMI in the following ways:

- There is no shift lock octet
- Report Information Element Identifier is `0x51`
- Link Integrity Information Element Identifier is `0x53`
- PVC Status Information Element Identifier is `0x57`

IP over Frame Relay

This section summarizes configuration you need to carry out in order to run IP over Frame Relay, and the information you need to do so. *Internetworking with TCP/IP: Principles, Protocols, and Architecture*, by Douglas Comer is a useful source of information on IP routing.

- Obtain and allocate IP addresses.
  Every IP network must have a unique IP network number. To obtain new IP network numbers, contact:

  DDN Network Information Center
  14200 Park Meadow Drive
  Chantilly, VA 22021
  U.S.A.

  or email `registrar@nic.ddn.mil`, or phone 800-365-3642 (in the United States, only).
- If necessary, subnet your IP network.

- Decide whether to use dynamic or static IP routing.
  You need to weigh the cost of running a dynamic routing protocol such as RIP across a Frame Relay connection, against the cost of network downtime caused by out of date static routing tables.
  To use dynamic routing, initiate RIP, the Routing Information Protocol. This is provided in the file `in.routed`. The contents of the file are broadcast every 30 seconds. You can also use `gated`, if it is available on your system.

  To use static routing, configure the IP routing table. To do this, add entries to the routing table, using the `route add` command.

  A good compromise between using dynamic and static routing is to configure a static route to a routing gateway that is not attached to the Frame Relay network. The routing gateway can then handle the dynamic routing of traffic that does not need to cross the Frame Relay network.

  To look at the contents of the routing table, enter `netstat –r`.

A

Modem and Null Modem Cables B

This appendix provides the pinouts of cables that can be used for some common modem and null modem configurations. Refer to the manufacturer's documentation for a detailed description of special cables you may need to connect your particular modem.

B

Standard EIA-232-E Modem Cables

Figure B-1 shows the pinout for a 25-way, straight-through cable, which can be used to connect the EIA-232-E serial port on most SPARCstations and SPARCservers to a synchronous modem port modem port.

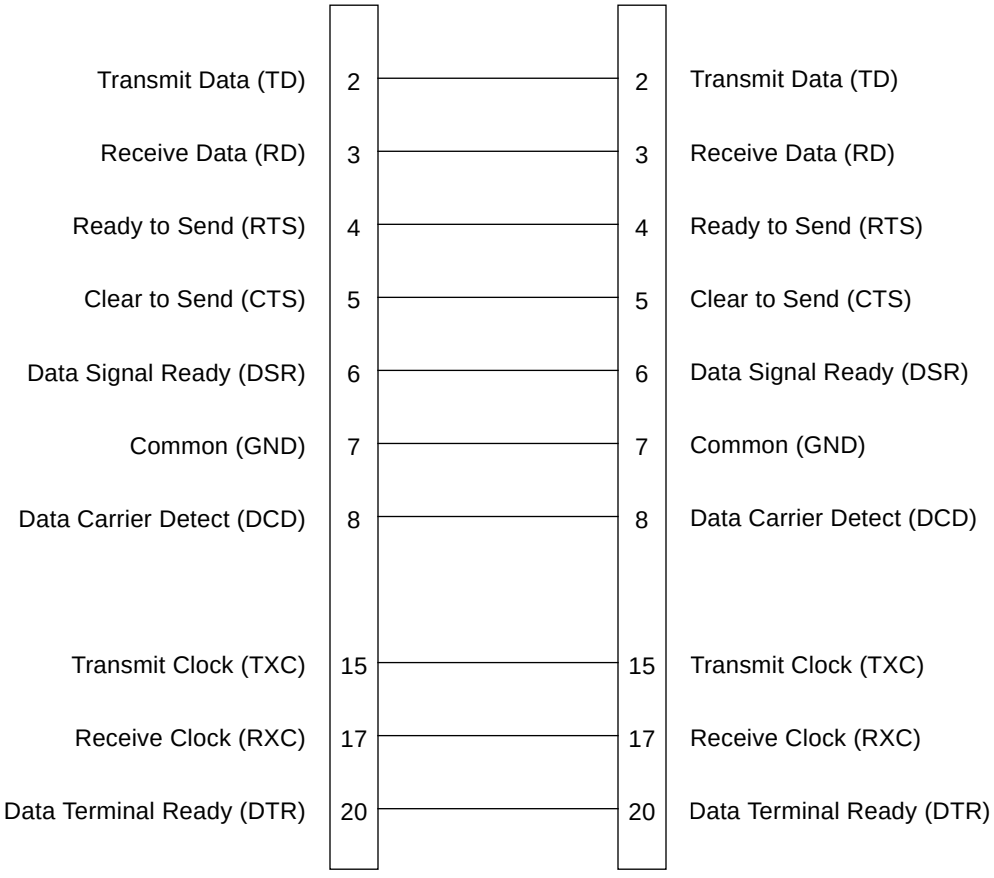


Figure B-1 Synchronous EIA-232-E Modem Cable

IPC/IPX Adapter Cables

Figure B-2 shows the pinouts for a cables used to convert the 8-pin serial port on a SPARCstation IPC or IPX to a 25-way modem port.

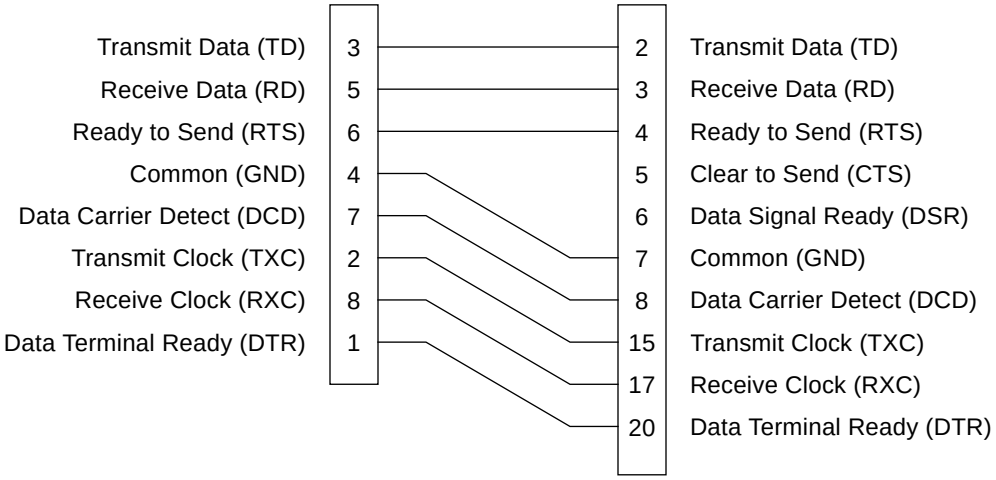


Figure B-2 Synchronous IPC/IPX Adapter Cable

An appropriate cable is available from Sun Microsystems. Contact your normal vendor.

B

Synchronous EIA-232-E Null Modems

Figure B-3 shows the pinout of a cable used to create a direct synchronous connection between two hosts when both sides provide a clock signal.

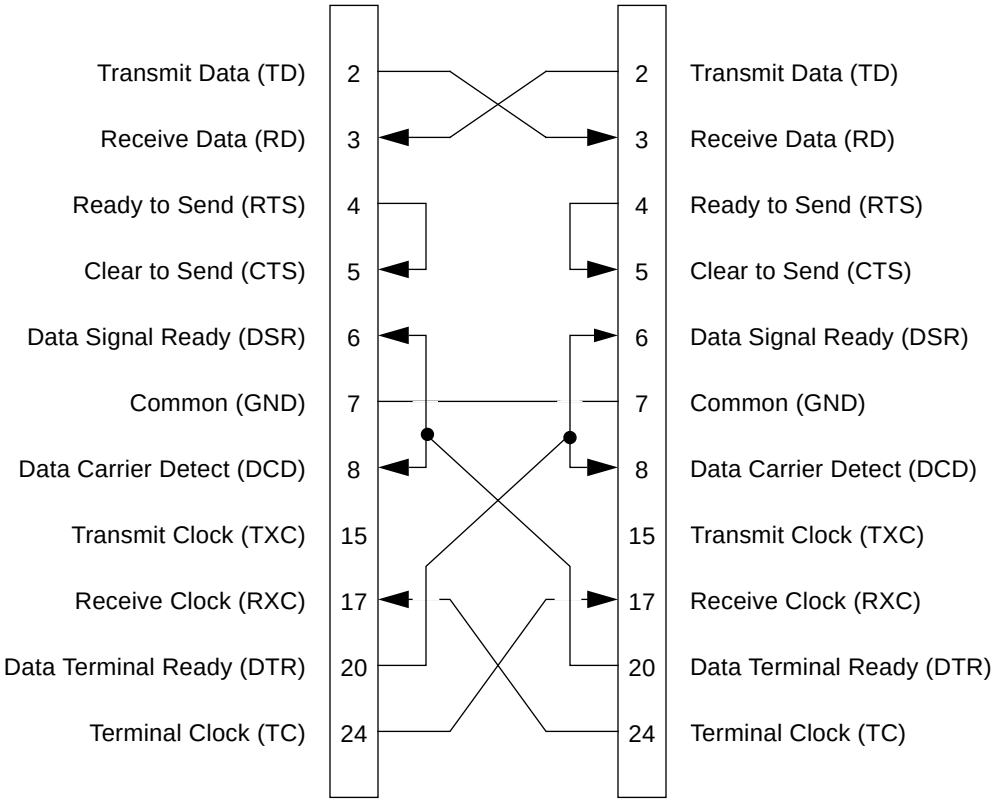


Figure B-3 Synchronous EIA-232 Null Modem (both sides provide clock)

Use `frinit`, or edit `fr.cf` to set the following clock values on both sides when using this type of cable:

```
txc_clock          baud
rxc_clock          rxc
```

Figure B-4 shows the pinout of a cable used to create a direct synchronous connection between two hosts when only one side provides a clock signal.

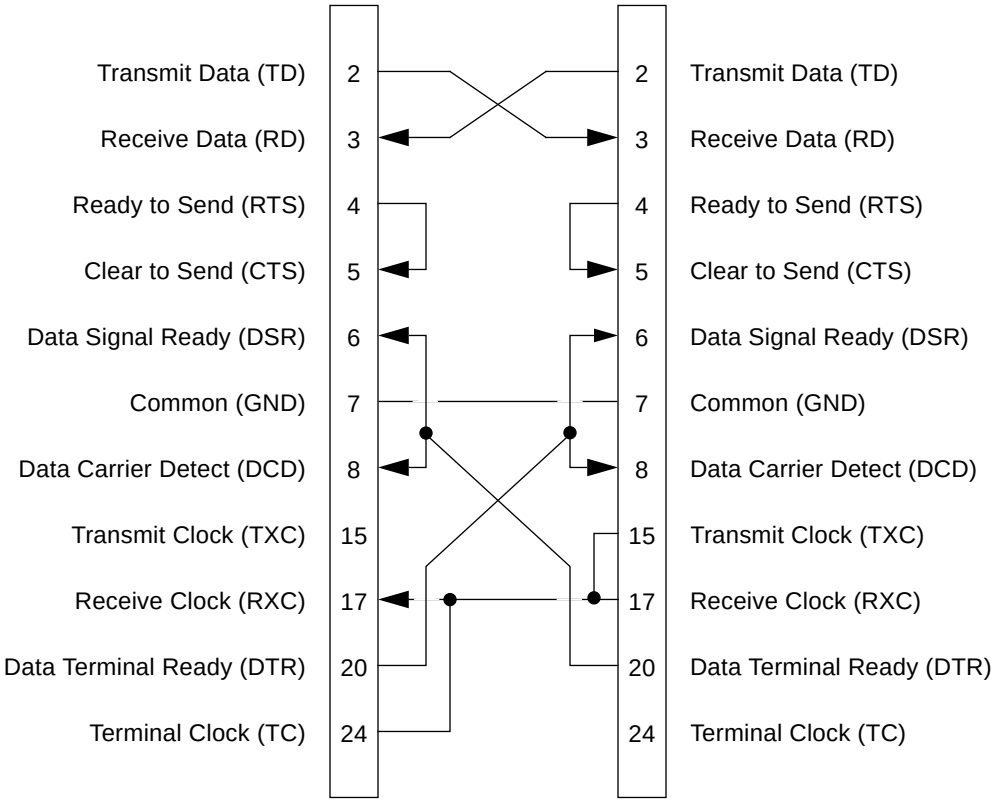


Figure B-4 Synchronous EIA-232 Null Modem (one side supplies clock)

Use `frinit`, or edit `fr.cf` to set the following clock values on the side that provides the clock:

```
txc_clock          baud
rxc_clock          rxc
```

Set the following values on the other side:

```
txc_clock          txc
rxc_clock          rxc
```

B

Synchronous EIA-449 Null Modems

The high-speed serial interface for Sbus (HSI/S) has a 37-way EIA-449 port. This type of port uses balanced transmission to provide improved speed and distance characteristics. Therefore, there are two pins for each signal.

Both Sides Provide Clock

When both sides of the connection provide a clock signal, pins 17 and 35 (Terminal Timing) and pins 8 and 26 (Receive Timing) are crossed-over, as shown in Figure B-5:

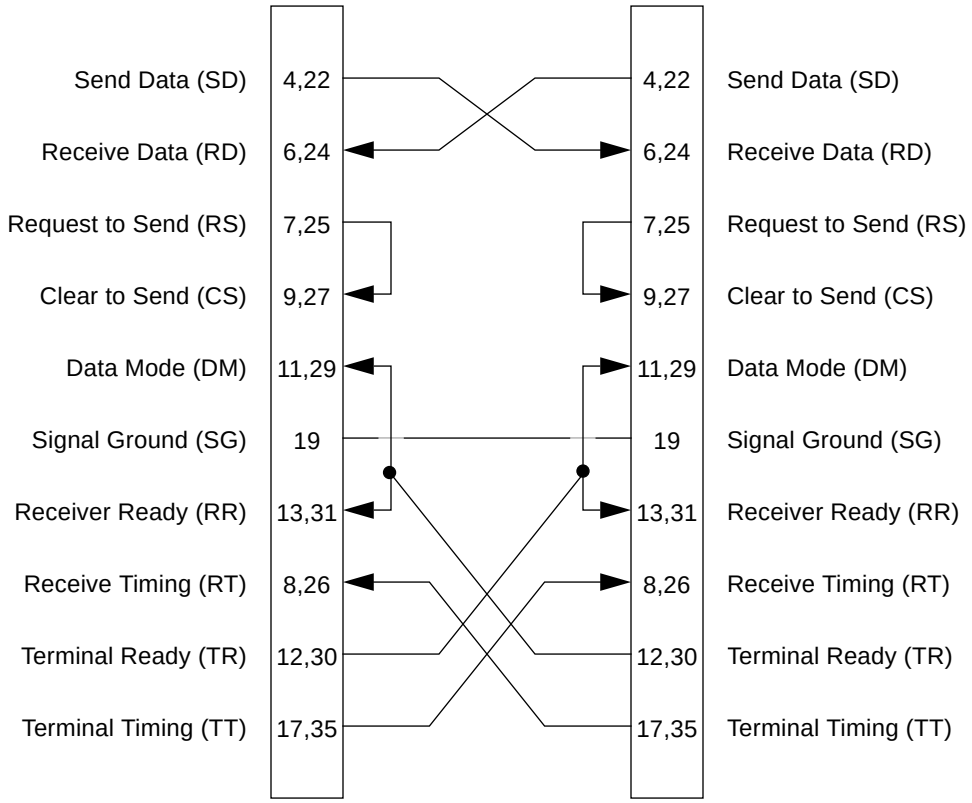


Figure B-5 Synchronous EIA-449 Null Modem (both sides supply clock)

Use `frinit`, or edit `fr.cf` to set the following clock values on both sides when using this type of cable:

```
txc_clock          baud
rxc_clock          rxc
```

One Side Provides Clock

When one side of the connection provides a clock signal, pins 17 and 35 (Terminal Timing) on one side are connected to pins 8 and 26 (Receive Timing) on both sides, as shown in Figure B-6.

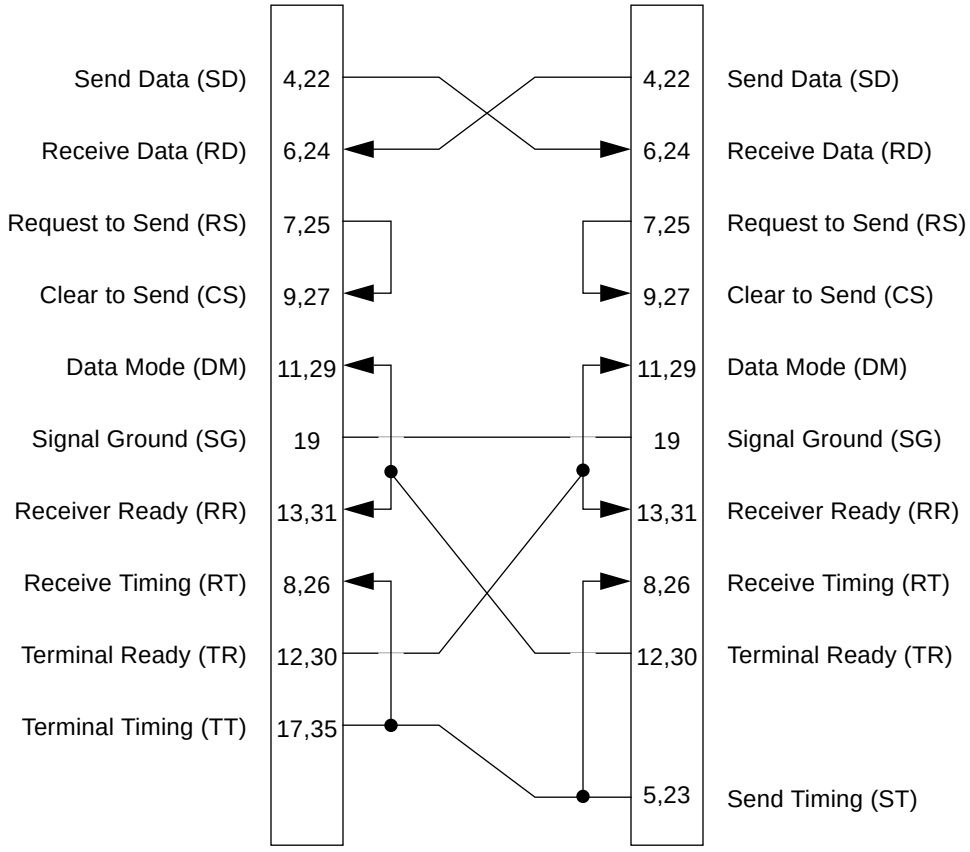


Figure B-6 Synchronous EIA-449 Null Modem (one side supplies clock)

Use `frinit`, or edit `fr.cf` to set the following clock values on the side that provides the clock:

```
txc_clock          baud
rxc_clock          rxc
```

Set the following values on the other side:

```
txc_clock          txc
rxc_clock          rxc
```

B

X.21 to EIA-449 Converter

Use the cable shown in Figure B-7 to convert between standard X.21 and EIA-449 interfaces:

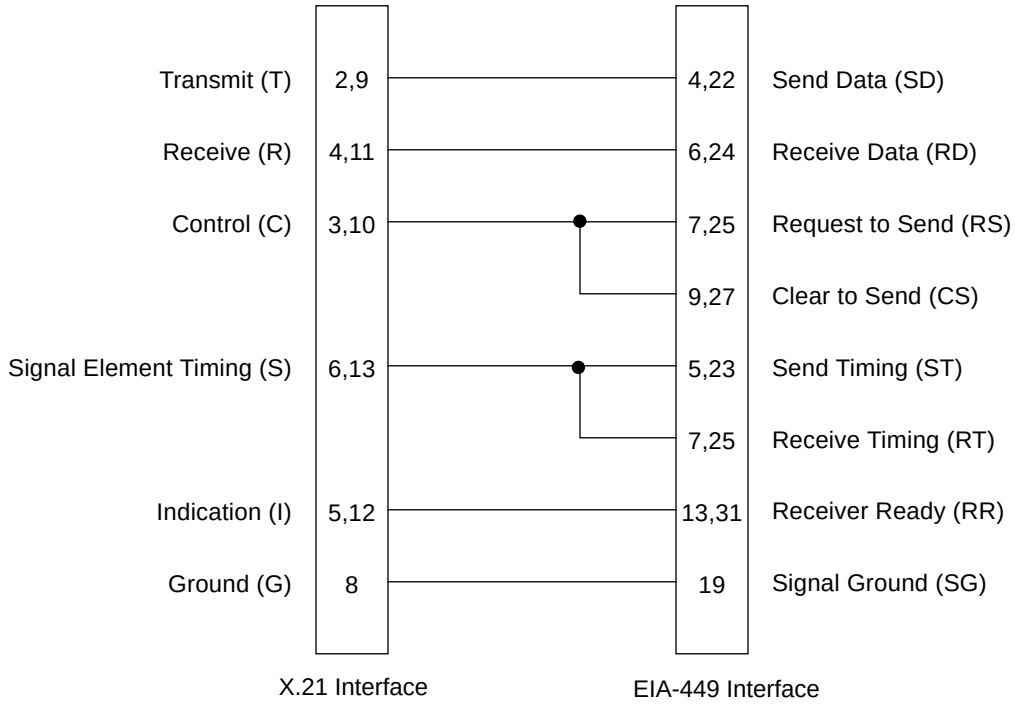


Figure B-7 X.21 to EIA-449 Converter

Installing the SunNet Manager Agent

C

By default, when you install Solstice Frame Relay, the SunNet Manager agent and its associated files are contained in the `SUNWfrb` package, and are installed in the `/opt/SUNWconn/fr/snm` directory.

The SunNet Manager agent is designed for use on a Solaris 2.*x* system.

To install the SunNet Manager agent on a system running Solstice Frame Relay, log in as root and do the following:

1. **Install the `SUNWsnmag` package.**
   This package is part of the SunNet Manager product, and contains all the standard SunNet Manager agents, together with the libraries they need to run.

2. **Copy the files `na.fr` and `fr.schema` from the `/opt/SUNWconn/fr/snm` directory to the SunNet Manager Agents directory.**
   This is usually `/opt/SUNWconn/snm/agents`.

3. **Add the following line to the `inetd.conf` file:**

```
na.fr/10  tli rpc/udp wait root /opt/SUNWconn/snm/agents/na.fr  na.fr
```

4. **Add the following line to either the** `/etc/rpc` **file (if you are not using a naming service such as NIS), or to your** `rpc.bynumber` **map (if you are using a naming service).**

```
fr              100128  na.fr
```

5. **If the SunNet Manager console is not running locally, add the following line to the file** `/etc/opt/SUNWconn/snm/snm.conf`

```
na.fr.trap.host hostname
```

   where *hostname* is the name of the system where the SunNet Manager console is running.

6. **Kill then restart** `inetd`**.**
   Use the `ps –e` command to display the process number of the `inetd` process. Then, as root, enter a `kill -HUP` command to restart the `inetd` daemon. For example:

```
hostname# ps -e | grep inetd | grep -v grep
120 ? 0:02 inetd
hostname# kill -HUP 120
```

Repeat steps two to four and step six on the SunNet Manager Console.

On the SunNet Manager Console machine, to retrieve information on an Solstice Frame Relay virtual circuit from a target Solstice Frame Relay machine, use the “quick dump” or “data report” SNM requests.

Glossary

Access Line

A communications line connecting a Frame Relay system to a switch.

American National Standards Institute (ANSI)

Devises and proposes recommendations for international communications standards.

ANSI

See American National Standards Institute.

Backward Explicit Congestion Notification (BECN)

A flag placed in a frame indicating that there is congestion on the network.

Bandwidth

The range of frequencies, in Kilobits per second, that can pass over a given data transmission channel within a network. The bandwidth determines the rate at which information can be sent through a channel—the greater the bandwidth, the more information that can be sent in a given amount of time.

Call

Communication between two DTEs across a virtual circuit.

B_c

See Committed Burst Size.

B_e

See Excess Burst Size.

CIR

See Committed Information Rate.

Committed Burst Size (B_c)

A peak level of traffic that the network provider guarantees to forward periodically, but not constantly.

Committed Information Rate (CIR)

A level of traffic that the network provider guarantees to forward at all times.

CRC

See Cyclic Redundancy Check.

Cyclic Redundancy Check

A standard way of checking whether a frame has been corrupted while on the network.

Data Circuit-terminating Equipment (DCE)

The network side of a user-to-network interface. For example the switch used to connect to a Frame Relay network.

Data Link Connection Identifier (DLCI)

An address identifying a particular destination. DLCIs do not have end to end significance. A DLCI tells the receiving node which interface to forward data on. Each node on a Frame Relay network maintains a table, mapping DLCIs to destinations.

Data Terminal Equipment (DTE)

The system at the user's side of a user-to-network interface. For example, a system running Solstice Frame Relay.

DCE

See Data Circuit-terminating Equipment.

DE bit

See Discard Eligibility bit.

Discard Eligibility (DE) bit

A marker placed in a frame indicating that it should be discard first in the event of congestion.

DLCI

See Data Link Connection Identifier.

DTE

See Data Terminal Equipment.

Excess Burst Size(B_e)

The maximum amount of data that the network will attempt to deliver during a particular time interval. This data contains the DE flag.

FCS

See Frame Check Sequence.

FECN

See Forward Explicit Congestion Notification.

Flag

A sequence of bits marking the beginning and end of a frame.

Frame

The data unit used by the datalink layer.

Frame Check Sequence

A numerical sequence used when running the cyclic redundancy check, to make sure that a frame has not been corrupted while on the network.

Forward Explicit Congestion Notification (FECN)

A flag placed in a frame indicating that there is congestion on the network.

HDLC

See High Level Data Link Control.

High Level Data Link control (HDLC)

A link-level communications protocol developed by the International Organization for Standardization (ISO). HDLC manages synchronous, code-transparent, serial information transfer over a link.

I-Frame

An Information Frame, that is a frame that contains data.

Internet Protocol (IP)

The network layer protocol used by the TCP/IP protocol suite, the *de facto* networking standard for UNIX systems.

IP

See Internet Protocol.

LMI

See Local Management Interface.

Local Management Interface (LMI)

A set of procedures used to monitor link integrity and PVC status.

node

A system on a network.

Permanent Virtual Circuit (PVC)

A dedicated, *logical* communication path between two systems that does not require call set-up procedures.

PVC

See Permanent Virtual Circuit.

Throughput

The rate at which data is passed through a system.

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