IP•Express Router
User's Guide

Engage
Communication, Inc.

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Product Warranty

Seller warrants to Buyer that any unit shipped to Buyer, under normal and proper use, be free from defects in material and workmanship for a period of 12 months from the date of shipment to Buyer. This warranty will not be extended to items repaired by anyone other than the Seller or its authorized agent. The foregoing warranty is exclusive and in lieu of all other warranties of merchantability, fitness for purpose, or any other type, whether express or implied.

Remedies and Limitation of Liability

A. All claims for breach of the foregoing warranty shall be deemed waived unless notice of such claim is received by Seller during the applicable warranty period and unless the items to be defective are returned to Seller within thirty (30) days after such claim. Failure of Seller to receive written notice of any such claim within the applicable time period shall be deemed an absolute and unconditional waiver by buyer of such claim irrespective of whether the facts giving rise to such a claim shall have been discovered or whether processing, further manufacturing, other use or resale of such items shall have then taken place.

B. Buyer's exclusive remedy, and Seller's total liability, for any and all losses and damages arising out of any cause whatsoever (whether such cause be based in contract, negligence, strict liability, other tort or otherwise) shall in no event exceed the repair price of the work to which such cause arises. In no event shall Seller be liable for incidental, consequential, or punitive damages resulting from any such cause. Seller may, at its sole option, either repair or replace defective goods or work, and shall have no further obligations to Buyer. Return of the defective items to Seller shall be at Buyer's risk and expense.

C. Seller shall not be liable for failure to perform its obligations under the contract if such failure results directly or indirectly from, or is contributed to by any act of God or of Buyer; riot; fire; explosion; accident; flood; sabotage; epidemics; delays in transportation; lack of or inability to obtain raw materials, components, labor, fuel or supplies; governmental laws, regulations or orders; other circumstances beyond Seller's reasonable control, whether similar or dissimilar to the foregoing; or labor trouble, strike, lockout or injunction (whether or not such labor event is within the reasonable control of Seller).

FCC Radio Frequency Interference Statement

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. **Shielded cables must be used with Engage routers to ensure compliance with FCC Part 15 Class A limits.**

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Introduction

Introduction

This guide provides the information users require to install and operate any of the IP•Express routers manufactured by Engage Communication, Inc.

IP•Express Family - A single protocol router line which supports the Internet Protocol - TCP/IP. The IP•Express router line is frequently selected for connections to the Internet. IP•Express models support up to three WAN interfaces which may be configured as:

- Standard DTE synchronous/asynchronous serial interfaces supporting RS232, RS530 and V.35.
- Optional integrated DSU/CSU for direct connection to 56/64 Kbps data services including DDS and Frame Relay
- Optional Integrated T1 DSU/CSU for direct connection to T1/ fractional T1 data services utilizing leased line or Frame Relay connections at speeds up to 1.544 Mbps.
- Optional Integrated E1 DSU/CSU for direct connection to E1/ fractional E1 data services utilizing leased line or Frame Relay connections at speeds up to 2.048 Mbps.

Intended Audience

This manual is intended for administrators of network systems. The technical content is written for a reader who has basic computer and networking experience.

It is important that any administrator responsible for the installation and operation of Engage routers be familiar with network concepts and terms, such as network addressing and internets. These terms are central to an understanding of router services, and are covered in the Glossary section.

Router Function

Engage IP•Express routers interconnect remote TCP/IP networks and route information between them, forming an internet. The internet allows users on these networks to exchange information efficiently and share services at data rates up to 2.048 Mbps. With optional inverse multiplexing these data transfer rates can double.

Router Administration

EngageView

Engage routers may be administered using the EngageView™ network management program. EngageView is used for the configuration of the IP•Express router, including protocol parameters and internal telco equipment settings. Additionally, EngageView provides status on the operation of any Engage router on the internet, including: serial link status; local and remote network configuration; packets received and transmitted; firmware version, etc.

EngageView is available for Microsoft Windows (3.1 and 95) and Macintosh platforms.

Command Line

Alternatively, Engage IP•Express units may be administered using the Command Line Interface via the Telnet protocol or the Console port. Engage routers respond to standard TCP/IP SNMP queries.

Digital Phone Services

Engage routers utilize digital phone services. The types of services that are available vary according to location and service provider. The following is a brief overview of available digital phone services.

Dial-up Services

Switched 56K:
Provides a 56,000 bit per second (bps) connection. Charges for dial-up are usually the same as for analog modems, yet files transfer less expensively, faster and far more reliably than via modem.

ISDN (Integrated Services Digital Network) :
Achieves connection speeds up to 128,000 bps per channel. It is available in most areas of the United States and is used extensively in Europe and Japan.

Engage ISDN routers are used with Basic Rate Interface (BRI) ISDN lines which are comprised of two B channels and one D channel (2B+D). In router applications, the two B channels are generally configured for circuit switched data (CSD) calls at 56 or 64 kbps. These B channels can be combined into a single channel, for an aggregate connection speed of 112 or 128 kbps. The D channel is used for call control information.

Dedicated Connections

Dedicated lines allow the user continuous access to a remote site. Dedicated connections may be made over leased lines, or through Frame Relay services.

The line is always open and ready for data transfer. For busy companies with a heavy load of data traffic, these lines provide a fast, reliable connection, 24 hours a day.

DDS (dedicated digital service) :
Provides a 56,000 or 64,000 bps connection. Due to a wealth of providers, DDS may be less costly than dial-up services and is ideal for businesses with many network users.

T1:
Is a higher-performance service which provides a maximum transfer speed of 1.544 million bps. T1 lines are bundled as 24 circuits of 64Kbps.

One or more of these 64Kbps segments may be leased as a fractional T1 (fT1) line. A company may choose to send data over one or multiple segments, and use other portions of the line for voice, video, etc. Companies with more than one remote site to network may find T1 or frT1 lines more cost-effective than using multiple 56Kbps lines, especially in terms of increased productivity and expandability.

E1:
Is another higher-performance service which provides a maximum transfer speed of 2.048 million bps. E1 lines are bundled as 32 circuits of 64Kbps and fractional E1 services are available.

Chapter 2:
Installation QuickStart

Chapter 2

Installation QuickStart

This QuickStart Chapter is intended for users who know how they want their Engage router configured and only require the mechanics of performing that configuration.

The first topic discussed is the initial communication with the router, including assignment of an IP address. Example configurations follow. The examples cover the most common Engage router configurations and deal only with TCP/IP routing.

Initial Communication with the Router

TCP/IP

There are several methods of communication with the Engage router for initial assignment of an IP address. Use any method when configuring a new router or a router with an unknown IP address.

Console Port: Advanced and XL router models include a Console port. The Console port utilizes the Command Line interface, detailed in Chapter 7: Command Line Interface, and in the Appendices.

Communication to the Console port should be set as: 9600 baud, 1 stop bit, no parity, 8 bit fixed.

The Console port on Advanced router models is a female, 9 pin "D" connector. A 9 pin male/25 pin female adapter is provided for use with 25 pin cables. The Console port is configured as a DTE (data terminal equipment) port. For connection to other DTE, such as a terminal, a Null Modem adapter is required. A 25 pin female/25 pin male null modem

adapter is provided with the router.

The Console port on XL router models is an RJ45 jack. The Console port is configured as a DTE port. An RJ45/db25 adapter is provided with the router which, in addition to providing a physical interface, performs the null modem operation permitting direct connection to other DTE equipment, such as a PC.

Telnet: A second method employs Telnet to actually assign an IP address to the router. The user should power up the router and immediately attempt a Telnet connection to the desired IP address. If the Telnet session returns a timeout failure, the user should retry immediately - without restarting the router. Repeat these retries for up to two minutes.

When the sequence is successful, the **login:** prompt will appear. Enter the username **root** to open the Telnet session. The user will be asked to confirm that the router should adopt the new IP address.

If the method does not work the first time, the router should be restarted and the procedure retried, as timing constraints may not have been met. See Chapter 7: Command Line Interface.

Configure via EngageView/MacOS: IP configuration may be performed from within EngageView/MacOS, which communicates to the router via AppleTalk. The Macintosh application allows direct configuration of IP parameters. See Chapter 6: EngageView.

Note on communication with the router: Connection of an improperly configured WAN interface to a digital telephone service can adversely affect communication with the router. It is suggested that the serial or WAN connection not be made until configuration of that serial interface is complete.

Example Configurations

Four common IP router configurations are detailed in this section. The command line configuration listing and EngageView configuration screens are shown for each example.

Editing, Pasting and Saving a Router Configuration

Users of the command line interface have the option of editing standard Engage config listings and "pasting" that configuration to the router. Each example includes the name of a configuration file found on the shipping disks as well as at Engage's FTP and Web sites.

Edit the desired configuration listing example using a simple text editor. Connect to the router through Telnet or the console port, then enter the configuration mode with the command: **config**

Paste the edited text, comments and all, to the router, then issue the command: **save** . The router will reset and come up with the new configuration. *Note that existing static routes configured in the router may not be alterred, resulting in bad routes.*

To save a router configuration, issue the command: **show configuration all** and save the response listing to a file.

Static Route Note

All Static Routes require an explicit TCP/IP Network Address, including the route to the Default Router. A route to IP Address 0.0.0.0 is **not** permitted, instead the default router's IP network is specified.

Example 1: T1/fracT1 over Frame Relay to an ISP

Scenario

This sample configuration details an Engage Router connection to an Internet Service Provider (ISP) over Frame Relay. The hardware in this example is the IP•Express with internal T1 DSU/CSU running fractional

T1 at 384 Kbps. Full T1 configuration is discussed in the comments

The TCP/IP configuration in this example has the following addressing:

- ISP assigns User a full Class C for LAN: 205.1.1.0/255.255.255.0
- ISP assigns User serial port IP addr: 10.223.10.18/255.255.255.248
- ISP has as its serial port IP addr: 10.223.10.17/255.255.255.248
- User has a PVC to ISP with a DLCI of 17

Config File Name

T1frame.txt

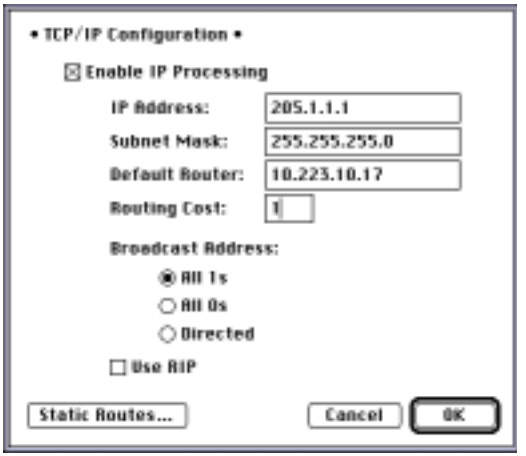
Command Line Listing

```
Router Name "Acme ExpressRouter"
Router Contact "James Acme"
Router Location "Phone Closet"

IP Default-router 10.223.10.17
IP Cost 1

!Static Routes:   Network              Next Hop       Cost  Interface     DLCI
IP Route        10.223.10.16/29      10.223.10.17       1       S1          17

Interface E1

 IP Address 205.1.1.1/24
 IP RIP Off

Interface S1
 Type T1
 Protocol Frame-Relay
 Poll-CD Off
 Wait-CD Off
 DTR On
 Timeout 0


 T1 Data          Normal
 T1 Clocking      Network
 T1 LBO           CSU           0dB
 T1 Framing       ESF
 T1 Coding        B8ZS
 T1 Speed         64K
 T1 Spacing       Contiguous
```

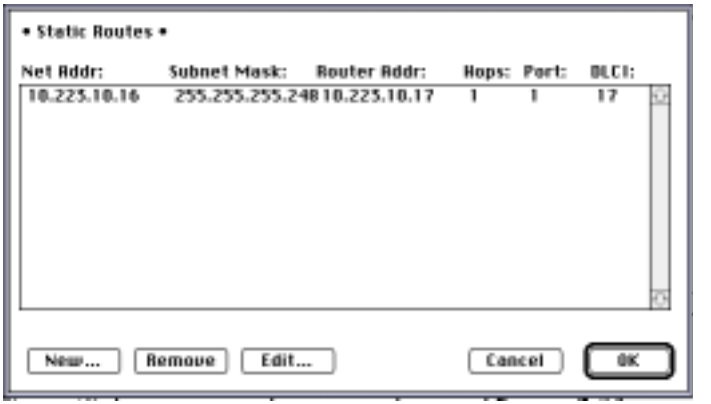
```
!                                START CHANNEL   NUMBER OF CHANNELS
 T1 Channels      Fractional         1               6

!  If using full T1, that command reads:
!  T1 Channels    Full
 Frame-Relay Management LMI
 Frame-Relay N391   6
 Frame-Relay T391  10

 IP Address 10.223.10.18/29
 IP RIP Off
```

EngageView Configuration

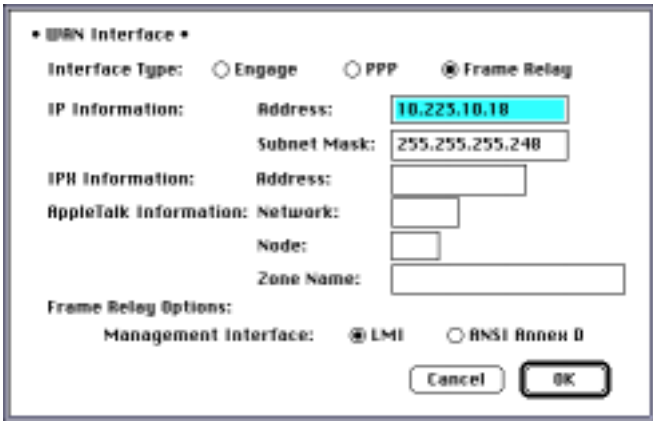
Network Configuration Screen



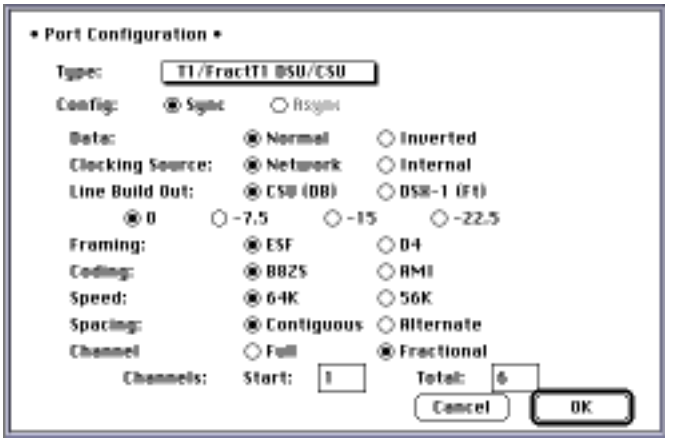
Static Route List



WAN Interface Screen



T1 Port Configuration



Example 2: T1/fractional T1 Leased Line to an ISP

Scenario

This sample configuration details an Engage Router connection to an Internet Service Provider (ISP) with a leased connection running PPP. The hardware in this example is the IP•Express with internal T1 DSU/CSU running fractional T1 at 512 Kbps. Full T1 configuration is discussed in the comments.

The TCP/IP configuration in this example has the following addressing:

- ISP assigns User a full Class C for LAN: 205.1.1.0/255.255.255.0
- ISP assigns User serial port IP addr: 10.223.10.18/255.255.255.248
- ISP has as its serial port IP addr: 10.223.10.17/255.255.255.248

Config File Name

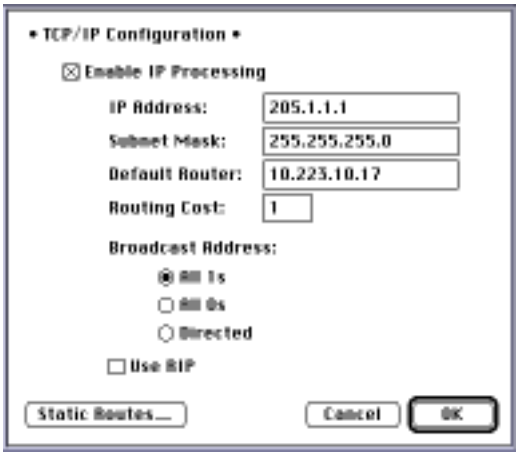
T1ppp.txt

Command Line Listing

```
Router Name “Acme ExpressRouter”
Router Contact “James Acme”
Router Location “Phone Closet”

!  Specify the default router, here the ISP serial port IP addr
IP Default-router 10.223.10.17
IP Cost 1

!  Here one static route is included to the default router.  Access to default
!  router is through this router’s serial port 1.  Note DLCI is left blank.
!
#Static Routes:   Network              Next Hop       Cost  Interface     DLCI
IP Route        10.223.10.16/29      10.223.10.17       1       S1

!  Router’s ethernet parameters, incl. IP address:

Interface E1

 IP Address 205.1.1.1/24
 IP RIP Off

!  Router Serial port parameters:

Interface S1
 Type T1
 Protocol PPP
!If it’s an Engage-Engage connection, you could use Protocol ENGAGE
 Poll-CD Off
 Wait-CD Off
 DTR On
 Timeout 0

 T1 Data          Normal
 T1 Clocking      Network
 T1 LBO           CSU           0dB
 T1 Framing       ESF
 T1 Coding        B8ZS
 T1 Speed         64K
 T1 Spacing       Contiguous
#                             START CHANNEL   NUMBER OF CHANNELS
 T1 Channels      Fractional        1              8

!  If using full T1, that command reads:
!  T1 Channels    Full

 IP Address 10.223.10.18/29
 IP RIP Off
```

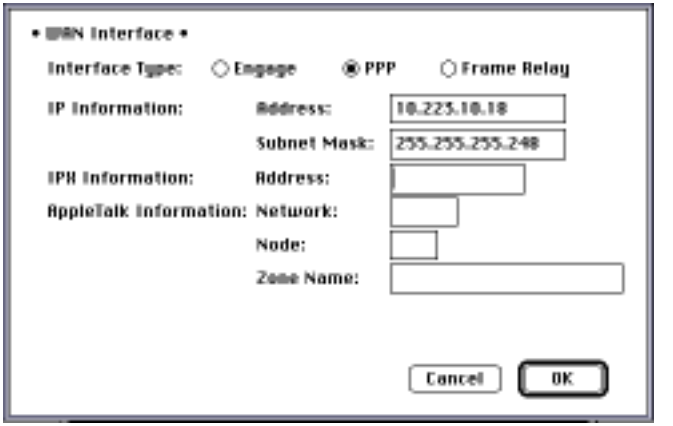
EngageView Configuration

Network Configuration Screen

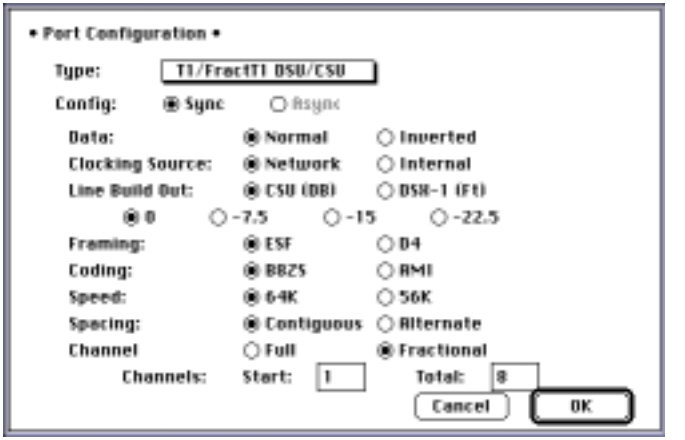


Static Route List

WAN InterfaceScreen



T1 Port Configuration



Example 3: 56Kbps Frame Relay to an ISP

Scenario

This sample configuration details an Engage Router connection to an Internet Service Provider (ISP) over a Frame Relay connection. The hardware in this example is the IP•Express with internal 56 Kbps DSU/CSU.

The TCP/IP configuration in this example has the following addressing:

- ISP assigns User Class C for LAN: 205.1.1.0/255.255.255.0
- ISP assigns User serial port IP addr: 10.223.10.18/255.255.255.248
- ISP has as its serial port IP addr: 10.223.10.17/255.255.255.248
- User has PVC to ISP w/ a DLCI: 17

Config File Name

56KFram.txt

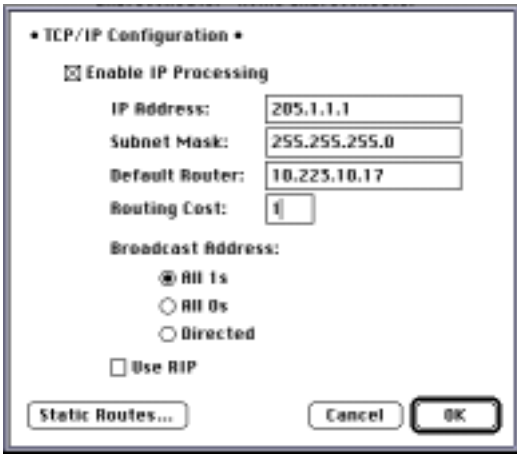
Command Line Listing

```
!  The following items are informational only
Router Name “Acme ExpressRouter”
Router Contact “James Acme”
Router Location “Phone Closet”

!  Specify the default router, here the ISP serial port IP addr
IP Default-router 10.223.10.17
IP Cost 1

!  Here one static route is included to the default router.  Access to default
!  router is through this router’s serial port 1, w/ 17 as DLCI to the ISP
#Static Routes:   Network              Next Hop       Cost  Interface     DLCI
IP Route        10.223.10.16/29      10.223.10.17       1       S1          17

!  Router’s ethernet parameters, incl. IP address:

Interface E1

 IP Address 205.1.1.1/24
 IP RIP Off
```

```
!  Router Serial port parameters:

Interface S1
 Type 56K
 Protocol Frame-Relay
 Poll-CD On
 Wait-CD On
 DTR On
 Timeout 0

 Frame-Relay Management LMI
 Frame-Relay N391   6
 Frame-Relay T391  10

 IP Address 10.223.10.18/29
 IP RIP Off
```

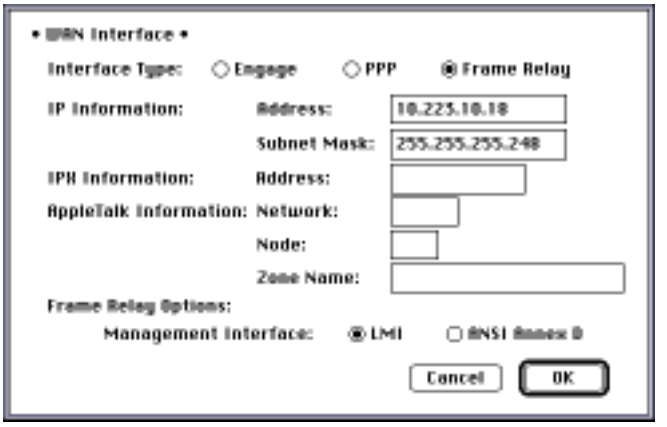
EngageView Configuration

Network Configuration Screen



Static Route List

WAN Interface Screen



Example 4: 56Kbps Leased Line to an ISP

Scenario

This sample configuration details an Engage Router connection to an Internet Service Provider (ISP) over a leased 56K line running PPP. The hardware in this example is the IP•Express with internal 56 Kbps DSU/CSU.

The TCP/IP configuration in this example has the following addressing:

- ISP assigns User a full Class C for LAN: 205.1.1.0/255.255.255.0
- ISP assigns User serial port IP addr: 10.223.10.18/255.255.255.248
- ISP has as its serial port IP addr: 10.223.10.17/255.255.255.248

Config File Name

56Kppp.txt

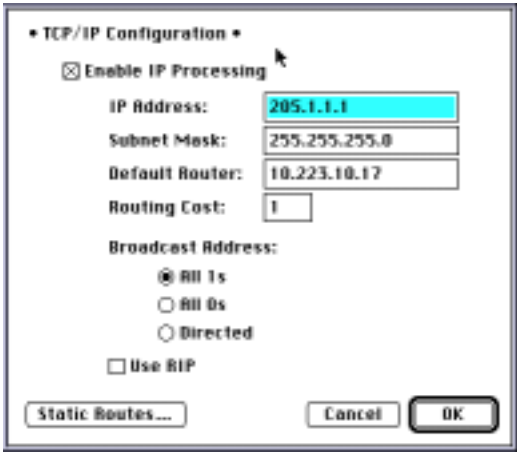
Command Line Listing

```
!  The following items are informational only
Router Name “Acme ExpressRouter”
Router Contact “James Acme”
Router Location “Phone Closet”

!  Specify the default router, here the ISP serial port IP addr
IP Default-router 10.223.10.17
IP Cost 1

!  Here one static route is included to the default router.  Access to default
!  router is through this router’s serial port 1.  Note DLCI is left blank
#Static Routes:   Network             Next Hop       Cost  Interface     DLCI
IP Route        10.223.10.16/29      10.223.10.17       1       S1

!  Router’s ethernet parameters, incl. IP address:

Interface E1

 IP Address 205.1.1.1/24
 IP RIP Off
```

```
!  Router Serial port parameters:

Interface S1
 Type 56K
 Protocol PPP
!If it's an Engage-Engage connection, you could use Protocol ENGAGE
 Poll-CD On
 Wait-CD On
 DTR On
 Timeout 0

 IP Address 10.223.10.18/29
 IP RIP Off
```

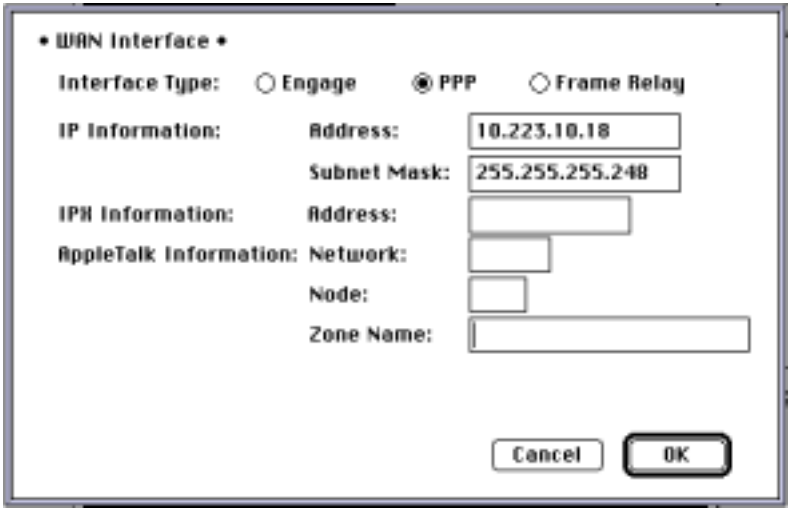
EngageView Configuration

Network Configuration Screen



Static Route List

WAN Interface Screen



Example 5: Hub Site: Multiple Routes through Multiple Ports

Scenario

This sample configuration shows a MultiPort Engage Router which has multiple static routes directed through three serial ports as well as the ethernet. The hardware in this example is a three port router with T1 DSU/CSU for serial port 1 and 56/64K DSU/CSU for ports 2 and 3.

This example is a more general one, showing static routes created for multiple IP networks/subnetworks. Routes are shown to remote Class C's and subnetted Class C's, via serial ports. Other networks are accessed via other routers (200.10.10.2 and 200.10.10.3) on the same LAN segment.

Because of the general nature of this example, screen shots are not provided.

Config File Name

multrout.txt

Command Line Listing

```
Router Name "San Jose Router"
Router Contact "Spiedo"
Router Location "Santa Clara St."
IP Default-router 200.10.10.1
IP Cost 1

#Static Routes:   Network              Next Hop       Cost  Interface  DLCI
IP Route        157.22.234.0/23      200.10.10.1       1       E1
IP Route        201.11.11.0/24       201.11.11.1       1       S1       16
IP Route        201.21.21.0/24       201.11.11.1       1       S1       16
IP Route        202.12.12.64/26      202.12.12.65      1       S2
IP Route        203.13.13.128/25     203.13.13.129     1       S3       17
IP Route        204.14.14.0/24       200.10.10.3       1       E1

Interface E1
 IP Address 200.10.10.2/24
 IP Broadcast ONES, address 255.255.255.255
 IP RIP Off
```

Command Line Listing (cont'd)

```
Interface S1
 Type T1
 Protocol Frame-Relay
 Poll-CD On
 Wait-CD On
 DTR On
 Timeout 0
 T1 Data          Normal
 T1 Clocking      Network
 T1 LBO           CSU           0dB
 T1 Framing       ESF
 T1 Coding        B8ZS
 T1 Speed         64K
 T1 Spacing       Contiguous
#                               START CHANNEL   NUMBER OF CHANNELS
 T1 Channels      Fractional        1               8
 Frame-Relay Management LMI
 Frame-Relay N391   6
 Frame-Relay T391  10
 IP RIP Off

Interface S2
 Type 64K
 Protocol PPP
 Poll-CD Off
 Wait-CD Off
 DTR Off
 Timeout 0
 IP RIP Off

Interface S3
 Type 56K
 Protocol Frame-Relay
 Poll-CD Off
 Wait-CD Off
 DTR Off
 Timeout 0
 Frame-Relay Management LMI
 Frame-Relay N391   6
 Frame-Relay T391  10
 IP RIP Off
```

Chapter 3:
Network Planning

Chapter 3

Network Planning

This chapter provides information about network planning for TCP/IP networks.

The primary rules for internets are:

1. the IP network address for every physical network must be unique;
2. the IP host address of devices within a net/subnet must be unique.

TCP/IP Networks

TCP/IP Addressing

Every host on a TCP/IP network must be assigned a unique IP address. An IP address is a 32 bit binary value. When writing an IP address, each byte of the address is converted into a decimal number and the numbers are separated by dots. e.g. 148.92.127.5

The IP address contains both the network address (Net ID) and the local address (Host ID). To determine which portion of the IP address is the Net ID and which portion is the Host ID another 32 bit value, the subnet mask, is required. The subnet mask is written in the same four byte fashion as the IP address. e.g. 255.255.255.0.

The Net ID is a unique identifier for the network to which the Host is attached - it must not conflict with any other Net ID on the internet. The Host ID is a unique identifier for the device on that network - it must not conflict with any other Host ID on that physical network.

The IP address is assigned by InterNIC, the Internet Network Information

Center, so that there is no duplication within companies on the Internet. Although the network may only be an internal one, it may have external communications in the future, so it is best to get an address assigned to you by the governing body to avoid major difficulties later.

There are three formats of internet addresses defined for small (Class C), medium (Class B) and large (Class A) networks.

For Class A addresses, InterNIC assigns a fixed value for the first byte address (in the range of 0 to 127) and the last three bytes are managed by the organization. The address space for a Class A network is 16,777,216 host addresses.

For Class B addresses, the first two bytes are assigned (starting with a number in the range of 128 to 191), with the last two bytes managed by the organization. Therefore, there are 65,636 host addresses for a Class B network.

Class C addresses are given a fixed value for the first three bytes of the address, with the organization managing the last byte. A Class C network has a range of 256 addresses.

Class A and Class B networks make use of their ability to name bytes by breaking their networks into subnets, reflected in the address. Subnet addressing is often done at a byte boundary, so in a Class B address, the third byte would reflect the subnetwork and the fourth byte would identify individual hosts.

A Class C network could also address its subnetworks, using one portion of the fourth byte for the subnet address and the remaining portion for the individual host address.

Chapter 4: Engage Router Hardware

Chapter 4

Engage Router Hardware

Engage routers are configured with one Ethernet interface and up to three wide area interfaces. Engage routers are fully interoperable with non-Engage routers through the use of Point-to-Point (PPP) and Frame Relay wide area protocols.

This chapter describes the Engage router hardware. A second generation of the IP•Express, the Advanced Router version, was introduced which supplies greater functionality. Advanced Engage Routers are identified by the presence of a Console Port on the rear panel.

The XL router line varies in supplying only a 10BaseT ethernet port and offering a single WAN interface.

Ethernet Interface

Engage routers (other than XL models) provide a Twisted Pair (10BaseT) and a ThinNet (10Base2) interface. Only one of the interfaces can be active.

Advanced Engage router models, those with a Console port on the rear panel, have Auto-Sensing ethernet ports. Models which *do not* have a Console port require the user to set motherboard DIP Switch 1 as:

DIP Sw1 Setting	Active Interface
ON (default)	Twisted Pair (10BaseT)
OFF	ThinNet (10Base2)

The ThinNet interface utilizes a BNC connector to connect to RG-58 (or other 50 ohm) coaxial cabling.

The Twisted Pair interface utilizes an RJ48 modular connector for use with the twisted pair cable commonly used in office telephone wiring.

Ethernet Hardware (Physical) Address

On routers with serial number 9000 and greater, the ethernet hardware address may be determined from the unit serial number as:

00:c0:f7:00:wx:yz where wxyz is the unit serial number.

For example, a router with serial number 9025 has ethernet hardware address:

00:c0:f7:00:90:25

Serial Port Interfaces

Engage routers (except XL models) may be configured with up to three serial ports for Wide Area Network (WAN) connections.

The built-in db25 interfaces can be configured for the following electrical interfaces (even if an internal DSU/CSU is installed).

- RS-232
- RS-530
- RS-449
- V.35

On earlier models, DTE-3 is a mini-DIN8 port and can be configured for use with RS232, RS449 or RS530 cabling through the EngageView Port Configuration selection of the Port menu.

To change the Serial Port Configuration of a db25 port:

1) Open the unit by removing one screw on the top of the rear panel and slide the cover forward.

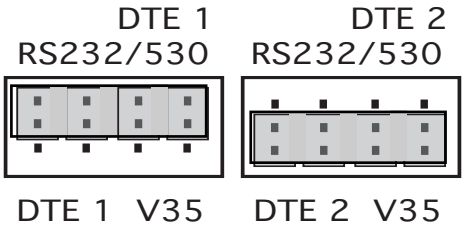
2) Set the serial port to the desired configuration by changing the Jumper

position (ganged jumpers on the main board - see diagram) **and** the Port Configuration (in the EngageView Port menu) to the following settings:

Desired Port Type	JumperPos.	EngageView Port Config
RS-232	RS-232/530	RS-232
RS-530	RS-232/530	RS-530
RS-449	RS-232/530	RS-449
V.35	V.35	V.35*

* Requires a DB25 to V.35 adapter cable.

3) Once the jumper setting has been made, replace the cover and rear plate/screw.



The above illustration shows an example of an IP•Express's internal jumper settings, where DTE 1 is configured for use with either RS-232, RS-530, or RS-449 (to be specified in EngageView as described); DTE 2 is configured for V.35. DTE3 on the Advanced Engage router is located on a daughter board, which has a single DTE jumper similar to those for DTE1 and DTE2.

XL router models have one ganged jumper for the single DTE port. If the board does not indicate V.35 vs. RS232 position, note that the jumper should be placed towards the rear of the unit for RS232/530 and towards the front of the unit for V.35.

Interface LEDs

Front panel LEDs provide status on the Ethernet and serial WAN ports. The Power LED is normally green, although at startup it briefly turns amber as internal memory devices are loaded.

The Ethernet LED flashes green each time a packet is transmitted out the Ethernet port.

The Port LEDs have three states. If no valid data is received on the active port, the interface LED displays a solid red. If the Engage Router detects reception of its own serial link HELLO packet, such as occurs in a loopback condition, the LED turns amber.

When the Engage Router receives HELLO packets from a remote router the interface LED turns green and remains green as long as a remote packet is received every 30 seconds. If remote packets are interrupted for more than 30 seconds, the LED returns to red.

Internal DIP Switches.

Standard/Advanced Models

Standard router models, those which do not have a rear panel Console port, and Advanced router models, those with a db9 Console port, utilize the following DIP Switches:

Sw1 - ON for 10BaseT, OFF for Thinnet. Factory Setting is 10BaseT. *Note: Advanced router models have auto-sensing ethernet port.*

Sw4 - Clears any IP filters which have been configured for the Engage router. When the router is reset or powered up with this switch set to the ON position, all filters will be cleared.

Sw6 - In the ON position, the router will use IEEE 802.3 Ethernet format for IP broadcasts. When in the OFF position the router will use DIX Ethernet format. Factory Setting is OFF. Switch 6 has no effect on IPX ethernet frame type, which is set in EngageView.

Sw7 - Turn to ON position to force router to its factory default settings. **The primary effect is that any downloaded upgrade will be erased.**

XL Router Models

Sw1 -Turn to ON position to force router to its factory default settings. **The primary effect is that any downloaded upgrade will be erased.**

Sw3 - In the ON position, the router will use IEEE 802.3 Ethernet format for IP broadcasts. When in the OFF position the router will use DIX Ethernet format. Factory Setting is OFF.

Sw4 - Clears any IP filters which have been configured for the Engage router. When the router is reset or powered up with this switch set to the ON position, all filters will be cleared.

Console Port

Advanced and XL router models include a Console port for configuring the router. The Console port may be used to communicate with the router locally through a terminal, or remotely by dialing in through a modem.

The Console port is configured as a DTE (data terminal equipment) port. This allows direct connection to a DCE (data communication equipment) device such as a modem. For connection to other DTE, such as a terminal or PC, a Null Modem adapter is required.

On Advanced router models, the Console port is a female, 9 pin subminiature "D" connector. A 9 pin male/25 pin female adapter is provided for use with standard 25 pin cabling. Additionally, a 25 pin female/25 pin male null modem adapter is provided for direct connection to another DTE device.

XL router models uitlized an RJ45 jack for the Console port. An RJ45/db25 adapter is provided with the router which, in addition to providing a physical interface, performs the null modem operation permitting direct connection to other DTE equipment, such as a PC.

The Console port utilizes the command line interface. Telnet/Console port commands are detailed in Chapter 7: Command Line Interface. Communication to the console port should be set as:

9600 baud, 1 stop bit, no parity, 8 bit fixed

Pinouts for the Console port, as well as Engage supplied adapters, are provided in the Appendices.

56/64 Kbps DSU/CSU Option for DDS

Engage routers can be configured with 1, 2 or 3 internal 56/64 Kbps DSU/CSU ports. This configuration allows direct connection to a 4-Wire DDS or Clear Channel interface using rear panel RJ48 jacks.

Note 1: Models shipped prior to May '97 support only 56 Kbps rate
Note 2: Selection of 56 vs. 64 Kbps is only possible through Command Line interface

The RJ48 jack uses the same 8 pin modular phone connector used in 10BaseT ethernet, but care must be taken not to mix the cables as the pinout is different.

DDS circuits use pins 1&2 for TxData and 7&8 for RxData. See Appendices for DDS pinout. The correct cable for DDS connection provides for 1 to 1 pin connection on, at a minimum, pins 1, 2, 7 and 8.

EngageView settings allow inverting the data. DDS data **must** be inverted when the router is to communicate with a SyncRouter or an older model of the ExpressRouter running version 2.XX or 3.XX firmware (beige, "shoebox" models).

The db25 port(s) on the router are fully operational with the internal 56 Kbps DSU/CSU option installed. Through the combination of EngageView configuration and internal jumpers, as outlined in the previous section, the internal DSU/CSU may be disabled and that WAN port used for RS232, RS530, etc.

Two Engage routers with internal 56/64Kbps DSU/CSU interfaces can be connected "back-to-back" for bench testing. A crossover cable connecting pin 1 to 8, 2 to 7, etc. is required. Additionally, one of the two units should be set for Internal, rather than Network, timing. This provides a master-slave timing scheme.

T1/fractionalT1 DSU/CSU Option

The internal T1/fracT1 DSU/CSU permits direct connection to a T1/fracT1 interface provided by the telco. This connection uses a rear panel RJ48 jack and accepts 8 pin modular plugs. T1/fracT1 circuits use pins 1&2 for RxData and 4&5 for TxData. See Appendices for T1 pinout.

The T1/fracT1 interface can be set to run at rates from 56Kbps up to full T1 at 1.544 Mbps.

Note : fracT1 running at 56Kbps is not interoperable with 56Kbps DDS service.

All configurations items, including Line Coding, Framing and TxData timing, are configurable using EngageView or the Command Line Interface. See Chapter 7 for T1 Configuration.

Two Engage routers with internal T1/fracT1 DSU/CSU interfaces can be connected "back-to-back" for bench testing. A crossover cable is required (see Appendices). Additionally, one of the two units should be set for Internal, rather than Network, timing. This provides a master-slave timing scheme.

Note: Always configure the T1 DSU/CSU before connecting to a T1 line, as improperly configured T1 circuitry can result in excessive serial errors which can impair communication to the router, even over ethernet.

E1/fracE1 DSU/CSU Option

The internal E1/fractional E1 DSU/CSU permits direct connection to a E1/fracE1 interface as provided by the telco. This connection uses a rear panel RJ48 jack and accepts 8 pin modular plugs. E1/fracE1 circuits use pins 1&2 for RxData and 4&5 for TxData. An RJ48/db15 adapter cable is available if the E1 line is terminated in a 15 pin "D" connector. See Appendices for E1 pinout and cable specification.

The E1/fracE1 interface can be set to run at rates from 64Kbps up to full E1 speed of 2.048 Mbps.

All configurations items, including Line Coding and Clock Source, are configurable using EngageView or the Command Line Interface.

Two Engage routers with internal E1/fracE1 DSU/CSU interfaces can be connected "back-to-back" for bench testing. A crossover cable is required (see Appendices). Additionally, one of the two units should be set for Internal, rather than Network, timing. This provides a master-slave timing scheme.

Chapter 5: Installation

Chapter 5
Installation of the Engage Router

This chapter provides an overview of the sequence of steps followed in setting up a wide area connection using Engage routers. References are made to network planning, Engage router hardware and EngageView software. These topics are covered in detail in their respective chapters.

Installation Requirements

The use of Engage routers to create a wide area network requires one router at each side of a synchronous connection. Any Engage router, whether an ExpressRouter or IP•Express, can be connected to any other Engage router. Engage routers, with support for Point-to-Point Protocol (PPP) and Frame Relay interoperability standards, can also connect to any other manufacturer's routers which support these WAN protocols.

Configuration of Engage routers is performed by use of EngageView software or through the command line interface via Telnet or the Console Port. Refer to the chapters on EngageView and/or the Command Line Interface for more information on configuration.

A standard IP•Express router package includes:

- One Engage IP•Express router
- One or more installed WAN interfaces (V.35, T1 DSU/CSU, etc.)
- Console port adapter(s)
- RJ45 or other cables for optionally installed WAN interfaces
- An appropriate 24 VAC power converter (110 or 220 VAC input)
- The Engage software installation diskettes (Windows & Mac)
- Engage Router User's Guide
- Owner registration card

Router Installation Steps

The process of installing an Engage router on the network involves the following steps:

1. Planning for network configuration and security
2. Installing the router software
3. Installing the router hardware
4. Configuring the router for the local area network (LAN)
5. Connecting and configuring the data comm equipment (DCE)
6. Verifying the WAN connection

Planning for Network Configuration & Security

To avoid conflicts with network addressing as well as unauthorized access to sensitive areas of your network, it is advisable to have complete network address information available to verify that your new network address(es) are unique. Determine in advance which networks/subnetworks you wish to filter - to block from access by remote network users.

For more information on network planning, please see Chapter 3: Network Planning.

Installing Engage Software for Windows

Engage software for Windows provides executable files which communicate to the router using the TCP/IP protocol.

To install, insert the disk and select the IP subdirectory. Run the program setup.exe in the selected subdirectory and follow installation instructions.

Part of the installation is assigning proper values to an engage.ini file. These values relate to the network addressing of the host workstation on which EngageView is run.

TCP/IP Networks

For TCP/IP, the user is prompted to enter the IP address and Subnet mask for the Windows workstation running EngageView. Standard dotted decimal notation is used:

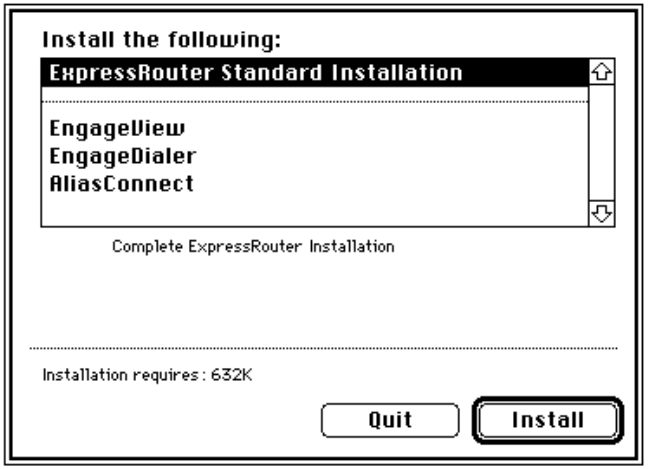
eg: 201.45.194.1 or 255.255.255.0

Installing Engage Software for Macintosh

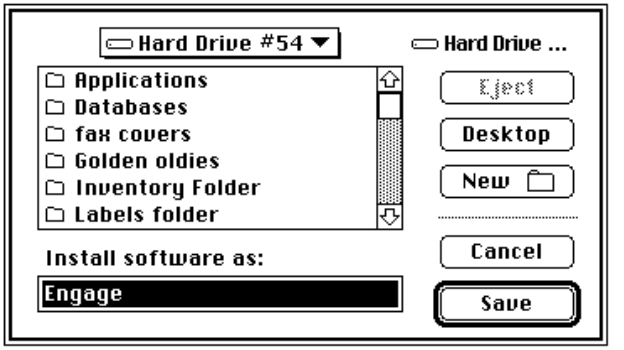
For the Macintosh there are three applications included with the Engage router. EngageView, the router management application, is of most importance to IP•Express users. EngageDialer and AliasConnect are used for establishing dial-up connections and are intended primarily for AppleTalk users.

To install all or any of the software and their related files, insert the EngageView disk into a disk drive. The disk contains the appropriate software installer for your Engage router. Double click on the installer.

An option will appear asking which files to install.



The standard Macintosh dialog box will prompt the user for an installation location. Click **Save**.



Installing the Hardware

Locating the Engage router

The Engage router can be placed at any point along the length of a network. Placement should be based on the following considerations:

- A well-ventilated indoor location
- Access within six feet of a power outlet

As an option, the Engage router can be mounted in a standard 19 inch equipment rack (rack mounts are available from Engage)

To operate properly, the Engage router must be connected to the appropriate LAN cable. If you will be using the ThinNet interface (not available on XL models) a coaxial cable with a T-connector must be attached. The cable must be properly terminated in order for the Ethernet connection to operate properly.

If you will be using the Twisted Pair interface, a standard twisted pair cable with an RJ45 plug must be attached to the Twisted Pair interface on the rear of the unit. This cable must then be connected to an Ethernet hub.

Note Early Engage router models (identified by the absence of a rear panel Console Port) require selecting the ethernet interface with a DIP switch. See Chapter 4: Engage Router Hardware, DIP Switches.

Powering up the Router

It is recommended that the power adapter be connected to the rear panel POWER input of the Engage router before connecting to the AC outlet.

After turning on unit power, check the POWER LED on the front panel of the Engage router.

The POWER LED will be GREEN when the internal diagnostics have completed successfully. If the internal diagnostics have failed, it is YELLOW. If the power is not connected, the LED will be OFF.

The function of the other LED indicators is detailed in the hardware description of the specific models.

Verifying the Ethernet Interface

A second indicator, ETHERNET, provides a simple verification of the connection of the Engage router to its network segment:

- The ETHERNET LED will blink GREEN during normal packet transmission.
- If, after power-on, the Engage router is unable to acquire a unique network address on the LAN, it will show a steady RED.
- If the ETHERNET LED is a steady GREEN or AMBER, then the network interface is faulty - the Engage router is unable to complete a packet transmission.

Configuring the Engage Router for the LAN

The Engage router needs to be configured with a number of parameters which determine the router's operation in the network including:

- IP address and subnet mask
- Default router IP address
- Security options: passwords and/or packet filtering

The configuration procedure depends on the network environment in which the Engage router is to be installed.

Note: It is strongly suggested that you configure your router with its unique network identity **before** making any Wide Area Connection.

Initial Communication with the Router in a TCP/IP environment

Several methods exist for configuring the IP address of an "unknown" router for use on an IP network. One of these methods must be employed when configuring a new router or a router with an unknown address.

The first method consists of communication through the router's Console port. The console port utilizes the same command line interface as Telnet and an IP address can be directly assigned. See Chapter 4 for a hardware description and Chapter 7 for Command Line Interface.

The second method is performed by using the Boot Router sequence of the EngageView/IP application. The user provides the desired IP address and subnet mask and a power-on handshake sequence between the EngageRouter and the Windows EngageView/IP application results in the router adopting the desired IP address. See Chapter 6: EngageView.

A third method employs Telnet to assign an IP address. The router is powered on and the user immediately initiates a Telnet session to the unused IP address which is intended for the router. The user is then asked to confirm the IP address which the router has adopted on a provisional basis. See Chapter 7: Command Line Interface.

A fourth method utilizes the EngageView application on the Macintosh. The IP•Express router will appear as a node on the AppleTalk network and configuration of all TCP/IP parameters can be performed directly.

Finally, the Engage ExpressRouter will obtain an IP address on power up from a local BootP or DHCP server.

Note: Any IP address assignment method (BootRouter, Telnet or DHCP) requires that the router be assigned an IP address which is on the same subnet as the workstation itself.

Connecting and Configuring the Data Communication Equipment

The Data Communication Equipment (DCE) required is determined by the type of communication service used for the router connection. This includes DSU/CSU units, ISDN Terminal Adapters, modems and Multiplexers.

This communication equipment is configured to provide a full duplex connection between the Engage routers. The configuration may be as simple as connecting 56 Kbps DSU/CSUs to a leased line, or as complex as determining how to allocate the desired bandwidth from a Multiplexer.

Many Engage models integrate synchronous communication equipment into the Router. Examples include the ExpressRouter DDS, with an internal 56/64 Kbps DSU/CSU, and the ExpressRouter T1 model, with a built-in T1/fracT1 DSU/CSU.

Cabling Concerns

A standard synchronous or asynchronous, male-to-male, one-to-one cable is used to connect the Engage router (the data terminal equipment or DTE) and the telecom equipment (data communication equipment or DCE).

- Male-to-male refers to the connectors at each end of the cable.
- Straight (one-to-one) means that each of the signals of the interface used by the Engage router is connected directly from its pin number at one end of the cable to the same pin number at the other end of the cable.
- Synchronous means that the cable has a connection for the transmit data clocking signal(s), external transmit data clocking signal(s), and receive data clocking signal(s). Asynchronous cables do not utilize the clocking signals.

A simple way to handle the synchronous clocking signal connections is to use cables that interconnect all of the connector pins to the corresponding pins at the other end.

Because synchronous clocking signals are not used by asynchronous links

there is no guarantee that a cable used in successfully interconnecting a device to an asynchronous modem will work for synchronous operation.

Telco Connection

The connection from the DCE, whether integrated in the Engage router or external, to the telephone network is defined by the type of communication service used for the router connection. It may be a simple RJ11 cable, as in the case of 2Wire SW56, or a more complex connection to an NT-1 as in the case of an ISDN connection.

Specifics of router models

Each Engage router model is described in detail in the Hardware Description chapters. Included here are brief details relating to installation on certain of the models.

- IP•Express T1: Ensure that the T1 settings are configured, using EngageView or Telnet, prior to connection to the T1 line.

  Note: Connection to a T1 line with incorrect line coding, number of channels, etc. can overload the router with framing errors, making communication with the router over the LAN difficult.

Verifying the WAN Connection

The Engage router's connection to a remote router can be verified by the active port interface LEDs. Although the port LEDs are specific to the Engage router model used (and are detailed in the Router Hardware chapter) they do share common characteristics.

- If, after an initial power-up period, the Engage router does not receive a HELLO packet from another Engage router on the other side of the serial interface, the port LED will remain RED.
- When the Engage router receives HELLO packets from the remote Engage router the port LED turns GREEN, and remains GREEN as long as a remote packets continue to be received. If none are received for a thirty second period, the port LED returns to RED.
- When the Engage router detects reception of its own transmitted HELLO packet, as is the case in a Loopback condition, the LED will turn AMBER.

Chapter 6: EngageView

Chapter 6

EngageView

EngageView network management software is used to monitor and configure any accessible Engage router on the internet. EngageView is available for Windows and Macintosh operating systems. Note: EngageView for Windows is Windows95 only!

For information on installing EngageView, see Chapter 5, Installing the Engage Router.

Starting EngageView

The first time EngageView is launched, the program will open with the Status Window. The Status Window will be blank initially, as the user has not selected a router.

The first step when using EngageView is to select a router.

If EngageView has been previously launched, it will attempt to connect to the router that was selected the last time EngageView was run. This is based on previously saved settings.

If no router has been selected or you wish to select a different router, follow the steps outlined below.

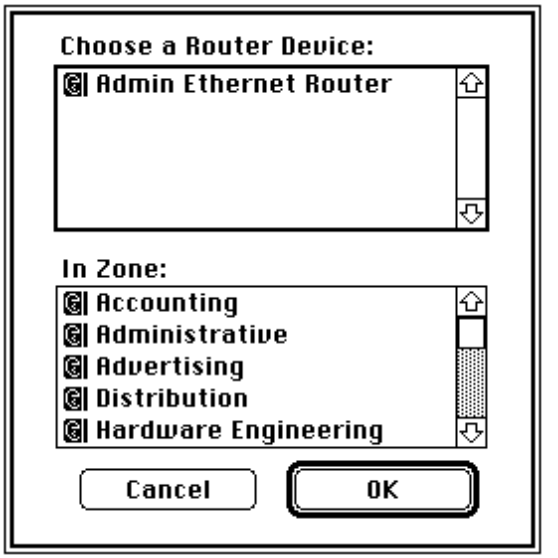
Selecting a Router Device (Macintosh)

Choose **Select Router** under the EngageView menu.

A list of available routers will appear. If there is more than one AppleTalk zone on the internet, there will be a list of zone names. Select the zone you wish to access, and a list of Engage routers in that zone will appear.

If no zones have been defined on the local network, the list won't be displayed.

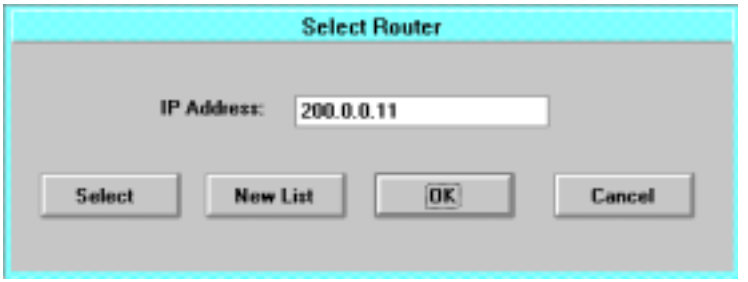
Select a router and click **OK**



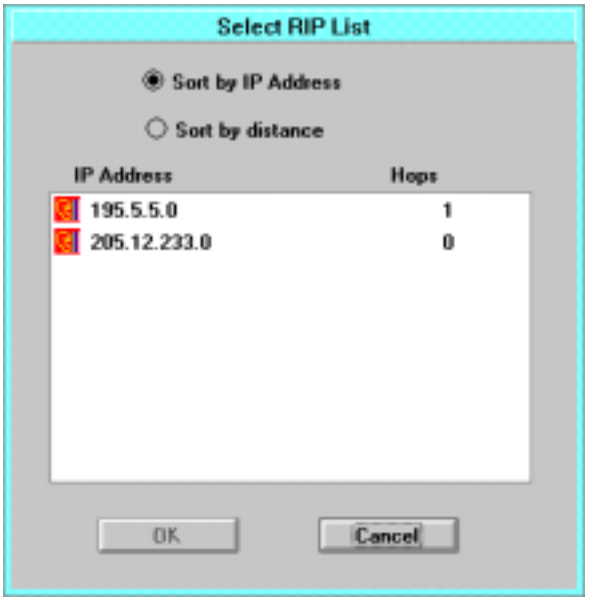
Selecting a Router Device (Windows/IP)

Choose **Select Router** under the EngageView menu.

If you know the IP address of the router to be selected, enter it in the space provided and click OK. If not, click New List to create a list of all Engage routers on the IP network.



The list provides the IP address and hop distance for each router.



Select the desired router(s) and click OK. The router(s) will be added to the router list.

Using EngageView

Now that a router has been selected, EngageView can be used. Central to EngageView's operation are the File, EngageView, Router, and Port menus.

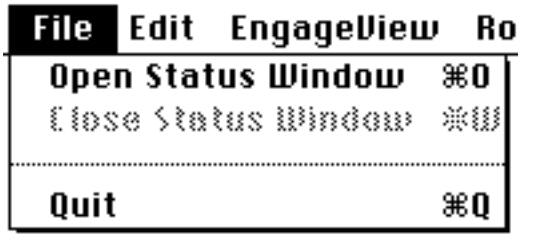
Note: IP•Express routers support only the TCP/IP protocol suite. EngageView menu items relating to the IPX and AppleTalk LAN protocols are not available to IP•Express users.

The File menu allows the user to open and close the EngageView status window. The EngageView menu allows the user to choose the router connection and set preferences. The Router menu allows the user to set a router name, configure ethernet IP parameters and set an administrative password. The Port menu allows the user to change the interface type, configuration and dialing passwords for individual ports.

Configuring Engage routers is done via the EngageView, Router and Port menus.

This section describes the interface and function of these EngageView menus.

File Menu (Macintosh)



There are three choices under the file menu:

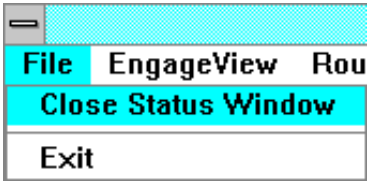
Open Status Window : Will open the Status window. This selection will be grayed out if the Status Window is already open.

Close Status Window : Will close the Status window. This selection will be grayed out if the Status Window is already closed.

Quit: Will quit EngageView.

The Status Window is discussed in the next section

File Menu (Windows)



There are two choices under the File menu:

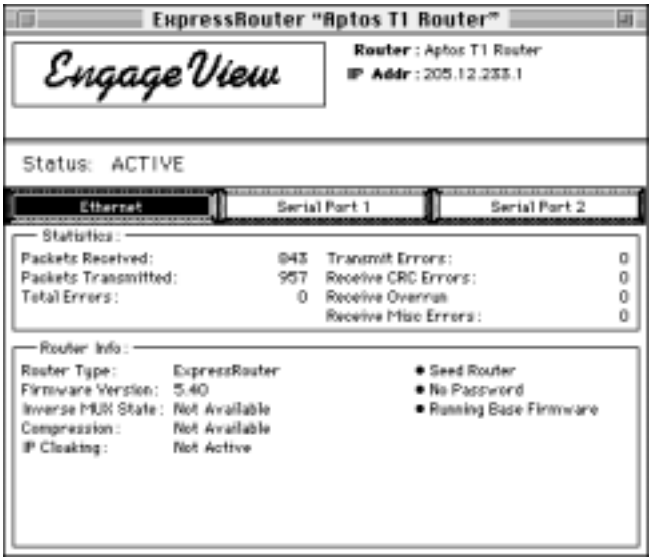
Open/Close Status Window : Will open/close the Status window.

Exit: Will exit the EngageView program.

The Status Window is discussed in the next section

Status Window

The EngageView Status Window shows information on the LAN port and active serial ports, as well as the current router's name, protocol address, and network/zone information if applicable. The router's name and address information appear in the upper right hand corner of the window. Depending on the protocol chosen in Preferences, TCP/IP, IPX or AppleTalk information will be displayed. The status of the router appears on the left side of the window.



Information on the status of the network connection and each serial port can be obtained via a line of buttons. When clicked, the button color reverses to show it is active. To show information about a serial port, click on the desired Serial Port button.

Network Information

The following packet information appears in the middle of the window for both the network and active serial ports:

Packets Received:
The current total number of packets received by the router since it was powered on or since the statistics were last cleared.

Packets Transmitted:
The current total number of packets transmitted by the router since it was powered on or since the statistics were last cleared.

Total Errors:
Total number of Transmit, Receive CRC, Receive Overrun and Receive Miscellaneous errors recorded since the router was powered on or since

the statistics were last cleared.

Transmit Errors:
Number of packet errors recorded since the router began transmitting or since the statistics were last cleared; these are packets which did not reach the network.

Receive CRC Errors:
Number of incoming packets which did not match the Cyclic Redundancy Check which verifies that data was received correctly.

Receive Overrun Errors:
Number of packets received before adequate buffer space was made available.

Receive Misc. Errors:
Number of errors on received packets which do not fall into any of the above categories.

In the bottom section of the window, when the Ethernet button is selected, the following information is given:

Router Type:
The type of router being monitored.

Firmware Version:
The current firmware version running in the router.

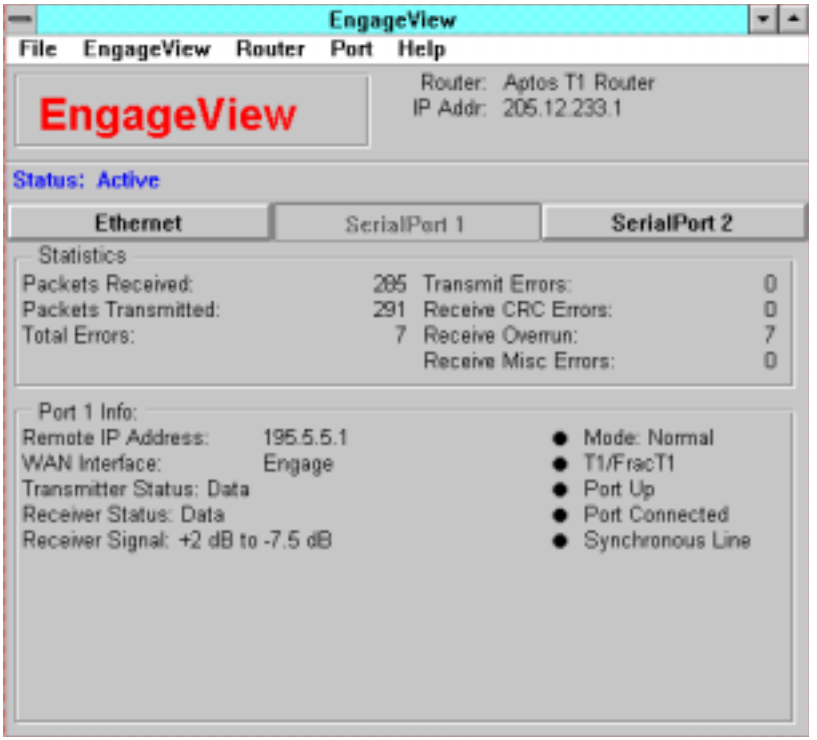
Inverse Multiplex State:
Shows which ports, if any, have been configured for inverse multiplexing. This is only available with the two port ExpressRouter.

Compression:
Shows if compression is enabled - available on LocalTalk routers only.

Cloaking:
Shows if the router has cloaking, an AppleTalk feature, enabled.

Port Statistics Information

To view port information, one of the active port buttons must be selected.



Remote Network Information

Information is provided for the network to which the selected serial port is connected. If TCP/IP has been chosen as the display preference, the remote network's IP address is shown.

Inverse MUX State:

Shows which serial ports are available for inverse multiplexing. This is displayed only if Inverse MUX is enabled on the router.

Multiplex State:
Shows the state of Inverse MUX on this port if Inverse MUX is enabled. This will either be "Waiting" or "Multiplexing."

Mode:
The port will be in Normal operating mode when it is routing data. It will be in Command mode when it is servicing requests from an Engage Dialer script for a dial-up connection.

Interface Type (V.35 or other) **:**
This displays the port interface. Types available include V.35, RS232, RS449, 56K DSU/CSU, T1 DSU/CSU and E1 DSU/CSU.

Port Up/No Port Activity:
When the port is up, it is an active interface and is transmitting and receiving data.

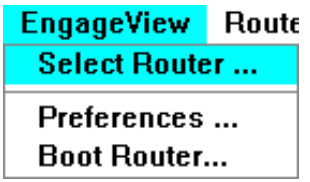
Connection:
This shows the status of the connection to the remote router. It can be:

Port Not Connected: Not connected to remote router
Port Connected: Connected and exchanging data with remote router

Password required:
Indicates that the remote router requires a correct dial-in password before connecting.

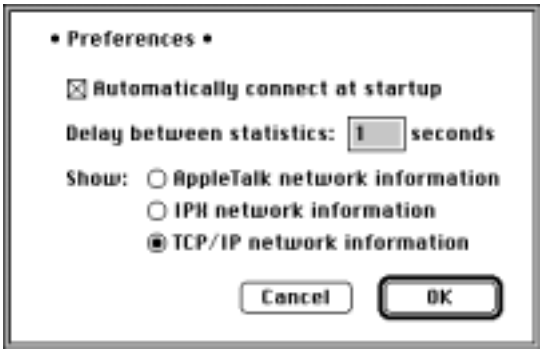
Line Type:
This indicates whether there is synchronous or asynchronous communication.

The EngageView Menu



Select Router:
To remotely manage routers on the internet, choose **Select Router** under the EngageView menu. The sequence for selecting the router varies according the platform on which EngageView is run, as detailed in the beginning of this chapter.

Preferences:



When the "Automatically connect at startup" option is checked, EngageView bypasses the device connect dialog box and automatically defaults to the last router to which it was previously connected.

As long as the network does not change on a regular basis, this is a convenient preference to set.

"Delay between statistics" allows the user to set the number of seconds between updates to the statistics section of the Status Window. A longer interval between updates prevents extra traffic which could tie up the network by taking processing power away.

The radio buttons allow the user to choose which protocol information, TCP/IP, IPX or AppleTalk, to show in the Status Window. This also affects the serial port information shown in the Status window.

Boot Router (Windows/IP version only)

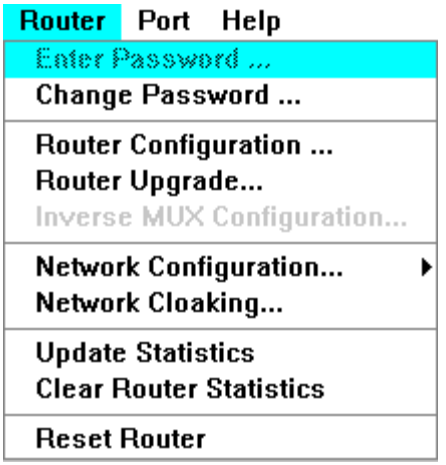
This item only applies to the Window/IP version. To initially communicate with a new or unknown ExpressRouter from a Windows machine, use the BOOT ROUTER item to assign an IP address and subnet mask to the router.

In the BOOT ROUTER item, enter an IP address and subnet mask for the ExpressRouter. The ExpressRouter and the host Windows machine must

- be on the same physical network
- have IP addresses specifying the same IP network
- have the same subnet mask

After entering the IP address and Subnet Mask, click OK. Turn the ExpressRouter OFF, then back ON. On powerup, the router will communicate with the Windows machine. The EngageView Boot Router window will close, and the user should be able to connect to the router by providing the newly assigned IP address in the Select Router menu item.

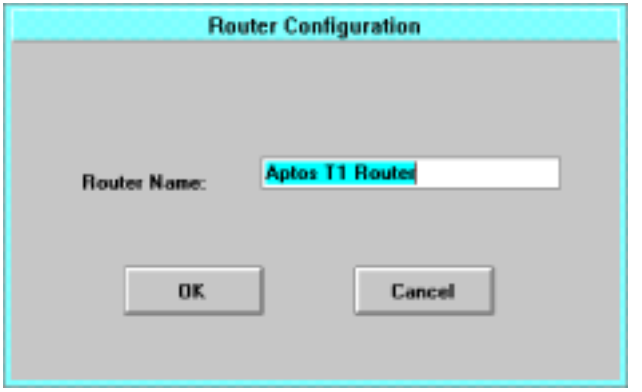
Router Menu



Enter Password/Change Password…:
Change Password allows you to create or edit an administrative password for the router. Once defined, this password must be entered when running EngageView to access the Router and Port menus. Otherwise, only the Status Window will be displayed.

Note: To clear the password, select Change Password, then click OK with no password entered in the dialog box.

Router Configuration:
All Engage routers are shipped with a default name. This name may be changed to suit the needs of the network. After selecting this menu item, type a new name in the box. If you have more than one Engage router on the same local network, you should assign different names.

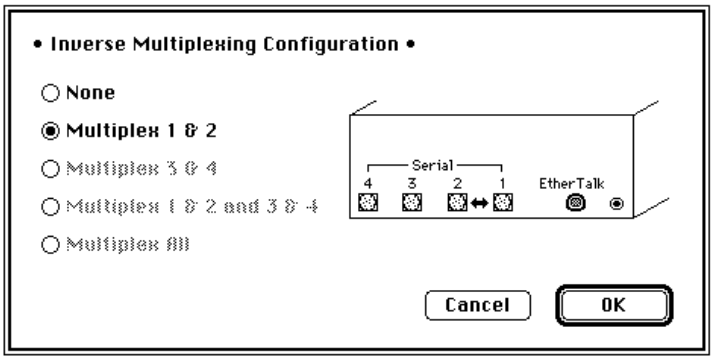


Router Upgrade
This allows you to upgrade the router with new firmware from Engage. Choosing this option will display a dialog box from which you select the firmware file to be used to upgrade the router.

Note this feature is only available on the Macintosh version of EngageView. Windows users are requested to perform upgrades through the Command Line interface (see Chapter 7).

Inverse MUX Configuration
This feature is available with the two port ExpressRouters, but only if it

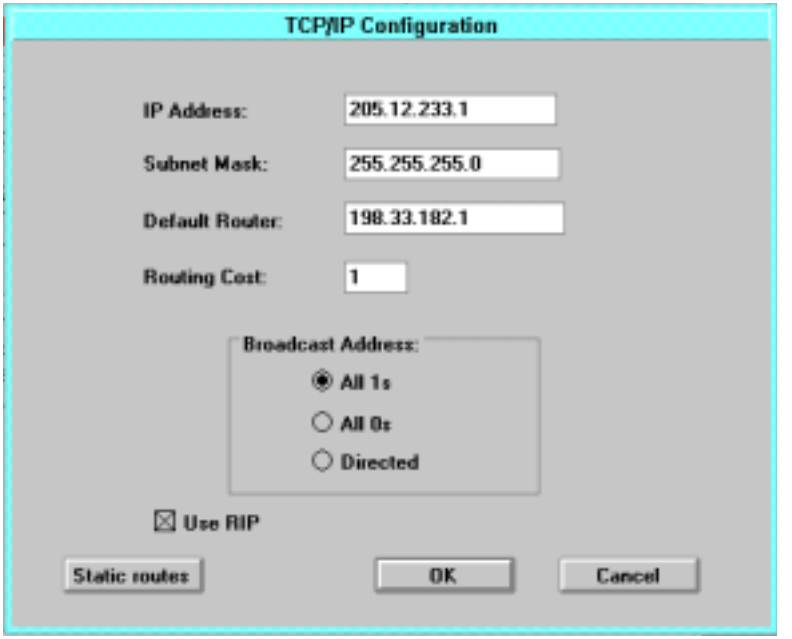
has been ordered from Engage; otherwise the item will be "grayed out" on the menu. The user configures inverse multiplexing by checking the radio button. Arrows appear between the cables in the diagram to indicate that MUXing is on.



Network Configuration:

Select the Network Configuration option under the Router menu and select the TCP/IP heirarchical menu item to configure the router for the network.

TCP/IP Network:
For a TCP/IP network, choose TCP/IP under Network Configuration.



IP Address:
An address must be entered to configure the router for IP, and each IP address must be unique. EngageView will alert the user if there is a duplicate IP address on the local network, so an alternate address can be entered.

Subnet Mask:
This value is dependent upon the class of the IP network the router is on and if subnetting is in effect. A value needs to be entered if the IP network is subnetted.

Default Router:
To specify a default router, enter the IP address of the router to be used. Specifying a default router allows the ExpressRouter to forward packets

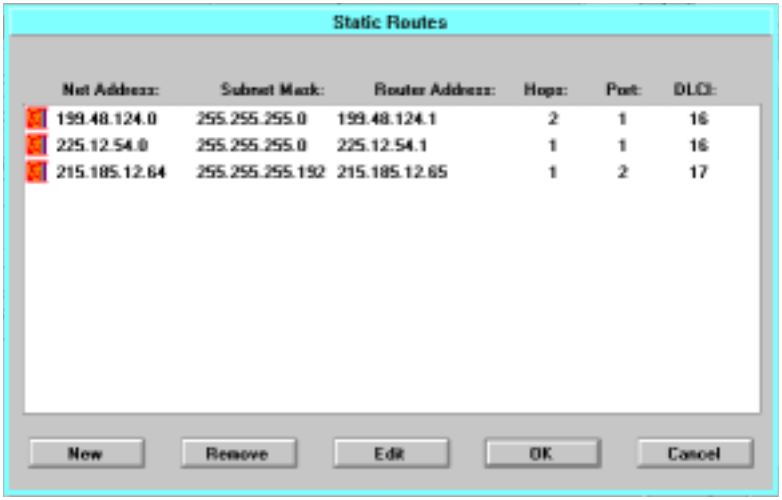
to this router when it doesn't know the destination network defined within the packet.

Routing cost:
Way of artificially increasing the cost of a route. This is done to lessen the network traffic along a certain route, or to guide the traffic through a particular route. This value may range from 1 to 16.

Broadcast Address:
This radio button configures the IP address used when broadcasting IP packets on the local network. Most installations use the default all 1's

Use RIP:
RIP (Routing Information Protocol) allows the router to exchange IP routing information automatically with other IP routers on the local network and across the WAN. Subnet information cannot always be exchanged this way. If RIP is not enabled or not supported by all routers, routing information must be entered by configuring Static Routes.

Static Routes:
May be entered if the user has a list of networks to be accessed. Static routes may be used in conjunction with or separate from RIP. To set static routes, click on the **Static Routes** button. To Edit or Remove an existing route, click the appropriate button. Click New to add a route and OK or Cancel when done modifying static routes.



Users enter the Network Address and Subnet Mask of the remote net to which the static route points. The Network Address is designated by the first (the "zero") address of the subnet. Examples of Network Addresses:

Example Net/Subnet		**Network Address**
Class C network -	Subnet Mask 255.255.255.0	202.55.33.0
Six bit subnet -	Subnet Mask 255.255.255.192	202.55.33.64
Three bit subnet -	Subnet Mask 255.255.255.248	202.55.33.8

Note: All Static Routes require an explicit TCP/IP Network Address, including the route to the Default Router. A route to IP Address 0.0.0.0 is ***not*** *permitted, instead the default router's IP network is specified.*

Also entered is the IP address of the next hop router, the number of hops to the remote network, and the router port used to access the remote network. Enter the serial port number, or "E" for ethernet. Enter the Frame Relay DLCI to reach that remote network. If not Frame Relay, leave this field blank.

Static routes may not be required if RIP is enabled or if the Default Router is in the same IP network as the router's ethernet port or the router's IP numbered serial (WAN) port.

For many sites, a single static route specifying the port used to reach the Default Router is sufficient.

Click on the OK button when configuration of the network is complete. This causes the ExpressRouter to reset and initialize itself with the specified IP network information. The router is now configured for IP routing.

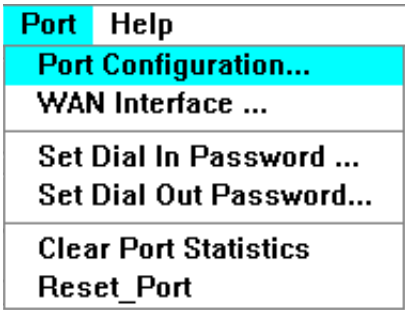
Update Statistics:
This controls the continuous update of packet information in the Status Window. A check mark in front of this item means that it is enabled. The user may wish to halt continuous updates because sending out more packets to poll the router creates unnecessary traffic, especially on a busy network. Note that you can also control the frequency of update in the Preferences dialog.

Clear Router Statistics:
This clears all previous packet and error information for the EtherTalk port, and sets the numbers to zero. A dialog box will confirm that you wish to implement this action.

Reset Router:
This resets the currently selected router. A dialog box will confirm that you wish to implement this action.

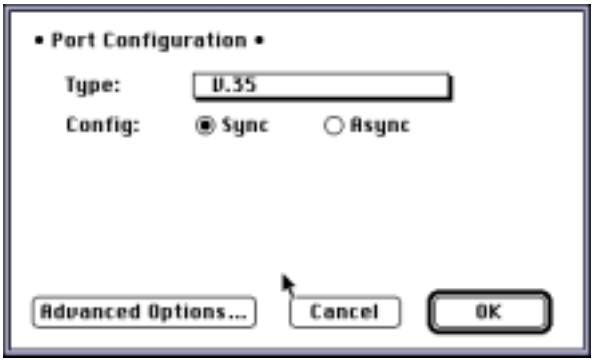
Port Menu

The Port menu allows configuration of the Engage router serial (WAN) ports. The Port menu is only available when one of the serial ports on the main status window is selected, and changes made under the Port menu affect only the selected serial port.



Port Configuration

This item lets the user configure hardware and electrical parameters for the Engage router serial communication ports. The Engage router supports a variety of standard serial interfaces for communication to external data communication equipment (DCE), as well as providing integrated DCE options, such as the 56 Kbps DSU/CSU.



Type:
RS232, RS449, RS530 and V.35 are all electrical interfaces supported through rear panel connectors. The choice of interface is dictated by the external telecommunication equipment (the DCE, such as ISDN Terminal Adapter or T1 DSU/CSU) used.

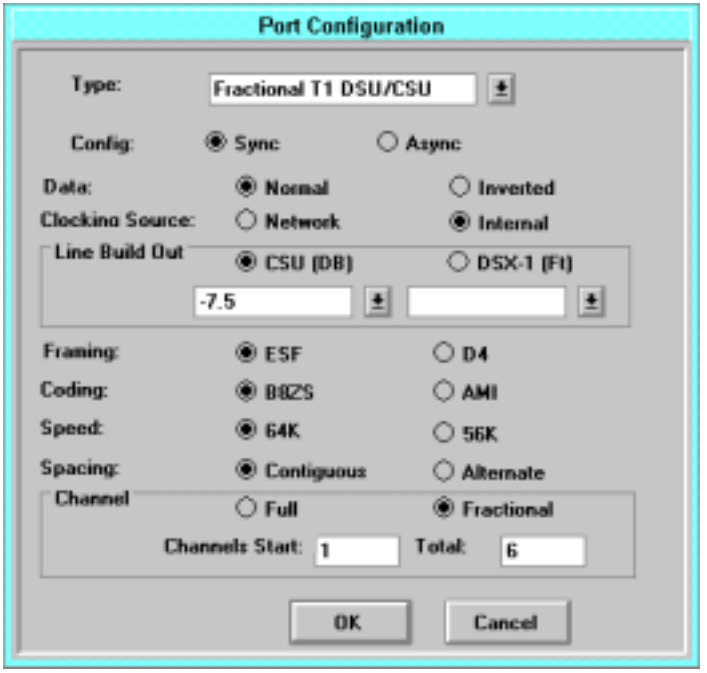
Configuration for any of these is accomplished through this EngageView Port Configuration setting along with the proper setting of hardware jumpers inside the unit (ExpressRouter only). Chapter 4 details the internal jumpers.

Synchronous or Asynchronous communication can be set. If asynchronous is selected, a list of options is displayed for line rate, parity and number of stop bits.

56Kbps DSU/CSU
This option selects the internal 56 Kbps DSU/CSU for connection to 4Wire leased digital lines. This interface is not interoperable with fractional T1 operating at 56 Kbps.

The default Data mode is Normal. The Data must be set to Inverted when connecting to an Engage SyncRouter or an older ExpressRouter running firmware versions 2.XX or 3.XX.

T1/fracT1 DSU/CSU
This option selects the internal T1/fractional T1 DSU/CSU for connection at speeds from 56 Kbps to full T1 at 1.544 Mbps. This interface is not interoperable with a 56 Kbps DSU/CSU for DDS usage.



The configuration options are all defaulted to the left selection, which is often correct for a Full T1 interface.

Data: Can be set for Normal or Inverted and must match the setting of the DSU/CSU on the other end. For AMI line coding, user generally will select Inverted.

Clocking Source: Determines the source of Transmit Clock (TxCk). When set to Network, the DSU/CSU derives its transmit timing from the received data (RxD) and is therefore synchronized with the telco (the phone network). This is generally used when connecting through commercial carriers and is also referred to as Slave timing.

When set to Internal, the DSU/CSU transmits data at a rate set by an internal clock. This mode is also referred to as Master timing and is used when testing on the bench - one unit set to Master, the other to Slave.

The T1 service provider should specify the mode of operation.

Line Build Out: This setting determines the transmitted data (TxD) waveform to compensate for attenuation on the T1 line. Typically Line Build Out is set to the CSU mode, where the build out is specified in dB. In applications where the T1 cabling is short - the ExpressRouter is within 20 feet of the network termination - set for 0 dB.

Framing: Selects whether Extended Super Frame (ESF) or D4 framing is to be used. Typically the T1 service provider specifies.

Coding: Selects whether B8ZS or Alternate Mark Inversion line coding is used. Typically the T1 service provider will specify.

Speed: Sets the DS0 speed. If set to 56K the maximum full T1 speed is 1.344 Mbps. Typical setting is for 64K channels

Spacing: Associated only with fractional T1, this specifies whether the channels are contiguous (adjacent) or alternating (every other channel).

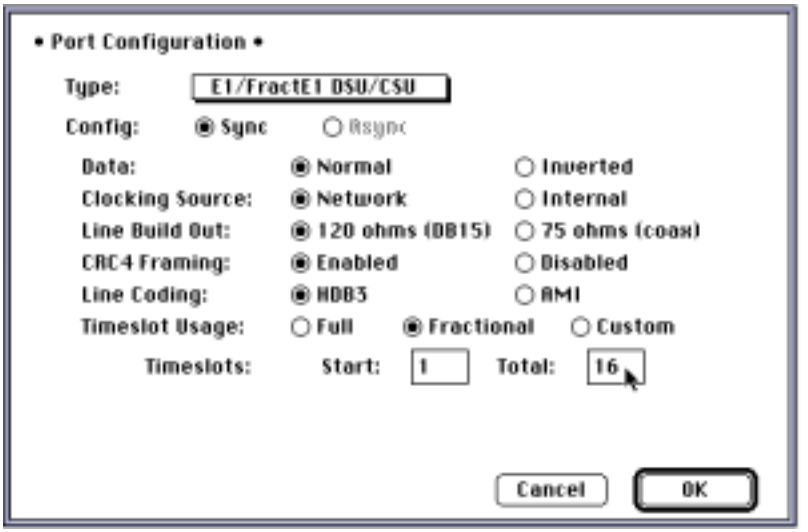
Channel: Full will utilize all channels. When Fractional is selected, additional options are presented:

Start Channel: Enter the location of the first channel, or DS0, of the fractional service. Minimum entry is "1".

Total Channels: Enter the total number of channels used

For example, 384 Kbps fractional T1 typically uses channels 1 through 6. Set Spacing: Contiguous, Start Channel: 1 and Total Channels: 6.

E1/fracE1 DSU/CSU
This option selects the internal E1/fracE1 DSU/CSU for connection at speeds from 64 Kbps to 2.048 Mbps.



Data: Can be set for Normal or Inverted and must agree with the setting of the DSU/CSU on the other end.

Clocking Source: Determines the source of Transmit Clock (TxCk). When set to Network, the DSU/CSU derives its transmit timing from the received data (RxD). This is also referred to as Slave timing.

When set to Internal, the DSU/CSU transmits data at a rate set by an internal clock. This mode is also referred to as Master timing and is often used when testing E1 connections on the bench.

Line Build Out: Engage E1 hardware supports only 120 ohm build out through an RJ48 or a db15 connection.

CRC Framing: Selects whether CRC4 Framing is enabled.

Line Coding: Selects whether HDB3 or Alternate Mark Inversion line coding is used.

Timeslot Usage: FULL utilizes all channels. When Fractional is selected, additional options are presented:

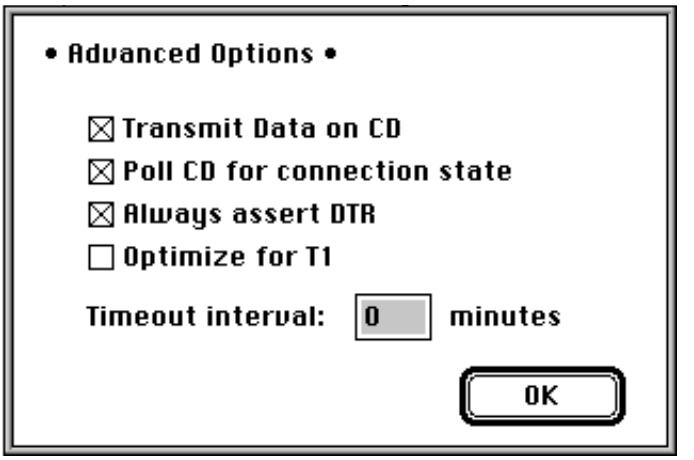
Start: Enter the location of the first channel, or DS0, of the fractional service. Minimum entry is "1".

Total Channels: Enter the total number of channels used

For example, 384 Kbps fractional E1 typically uses channels 1 through 6. Set Start: 1 and Total: 6.

Advanced Options:

This button will display a menu of features that are useful when operating over dial-up or switched lines.



"Transmit Data on CD" The default is ON. This option will prevent the router from operating in synchronous mode until a connection is established and Carrier Detect (CD) is asserted.

"Poll CD for connection state" The default is ON. This option allows the router to use CD as a means of monitoring the state of the connection. Turning this option off for WAN connections over dedicated lines serviced by external DSU/CDUs that do not assert CD.

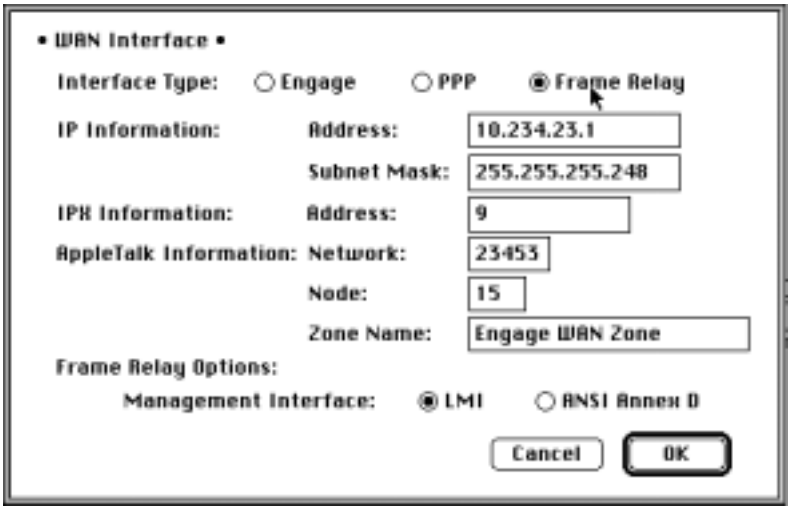
Note: CD is a control signal generally used in switched (dial-up) applications. As a general rule, the two CD options should be checked for switched applications and should be unchecked for leased or dedicated connections.

"Always assert DTR" The default is ON. This option is used for stored-number dialing, so the external device will dial when DTR (dial terminal ready) has been asserted by the router. Uncheck for stored-number dialing applications.

"Optimize for T1" The default is OFF. This option applies to older ExpressRouters, operating with firmware 2.XX or 3.XX.

The Timeout interval will cause the router to automatically disconnect the port when data has not been received for a period exceeding the timeout. A timeout interval of 0 will keep the port up indefinitely.

WAN Interface



This lets the user select the protocol to be used for the Wide Area connection to a remote router.

Interface Type lets the user select one of three WAN protocols for the remote connection. For connecting to another Engage router, except in the case of a Frame Relay connection, select "Engage"; if the connection

is to a non-Engage router, select "PPP" (the non-Engage router must also support PPP protocol). For any connection over a Frame Relay link, select "Frame Relay."

IP Information, IPX Information, AppleTalk Information
These fields are usually applicable to Frame Relay and PPP connections. Generally, they must be filled out only if the router(s) to which the Engage router connects require a numbered serial interface. Engage routers are able to operate in either the numbered or the un-numbered mode.

If "Engage" is selected as the WAN Interface Type, there is no need to enter information into these fields. Engage Routers will "learn" the necessary information automatically.

If the WAN connection requires numbered serial interfaces for any of the protocols, ensure that the following two conditions are met:

• The network address/number of the serial interface must be unique, it cannot be the same as the network address/number of the ethernet interface.

For IP, this means the network portion of the IP address, for AppleTalk this is the network number and for IPX it is the network address.

The WAN connection may be viewed as a virtual network having two or more nodes - the Engage router's serial port and the serial port(s) of all other routers connected to the "WAN network".

• The host portion of the WAN interface must be unique for all nodes on this virtual network. For IP this means the Host ID portion of the IP address and for AppleTalk this is the Node Number.

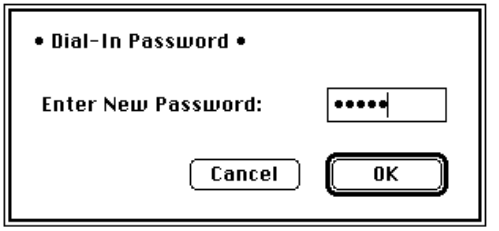
Generally, if a numbered serial interface is required for the Engage router, the network manager in charge of the other routers is responsible for defining the virtual WAN network. They will provide network information for the Engage router LAN interface, generally a range of valid host/node addresses, and a single address and node for the WAN interface.

Frame Relay Options
If the WAN connection is via Frame Relay, the user must select the

management interface corresponding to that used by the service provider's Frame Relay switch. This will be LMI or ANSI Annex D.

Set Dial-In Password

This allows access through this port from a remote router only when the correct password is given. This prevents unauthorized personnel from dialing into this router.



Set Dial-Out Password

Allows calls to be made from this port to remote routers only when the correct password is given.

Note: To clear the password, leave the password text box blank and click OK..

Clear Port Statistics

Like Clear Router Statistics, this menu item clears all previous packet and error information and sets the numbers to zero. This is useful if the user wishes to check statistics on a timed basis. A dialog box will confirm that you wish to implement this action.

Reset Port:

This will reset the port selected on the Status Window. This is a useful option when there has been a change to a network's zone name. A dialog box will ask you to confirm your choice. Click OK to reset the selected port, or CANCEL to return to the Status Window with no changes.

Quitting EngageView

When you select the Quit command on the File menu, the EngageView program terminates. This does not interfere with the operation of the routers.

EngageView automatically saves any changes made in the Preferences dialog box.

Chapter 7: Command Line Interface

Chapter 7

Command Line Interface

An alternative to configuration with the EngageView application is the Command Line Interface. Command Line access to the router may be made through the Ethernet port, across a WAN connection or via the Console port.

For communication through Ethernet or across a WAN, Telnet is used. Telnet, part of the TCP/IP Protocol Suite, provides a general communications facility defining a standard method of interfacing terminal devices to each other. Any standard Telnet application can be used to communicate to an Engage router provided there is a TCP/IP connection between the User Host and the router.

For communication through the Console port, standard serial communication software is used. The console port may be used to communicate with the router locally through a terminal, or remotely by dialing in through a modem.

Communication to the console port should be set as:

9600 baud, 1 stop bit, no parity, 8 bit fixed

The console port is a female, 9 pin db9 connector or an RJ45 jack, depending on IP•Express model. Adapters are provided for use with standard 25 pin cabling.

The db9 console port is configured as a DTE (data terminal equipment) port, as are all the router WAN ports. This allows direct connection to a DCE (data communication equipment) device such as a modem. For connection to other DTE, such as a terminal, a Null Modem adapter is required. A 25 pin female/25 pin male null modem adapter is provided with the router.

The RJ45 console port is configured as DCE, therefore a null modem is not required for connection to a terminal

Addressing conventions:

IP Address and Subnet Mask

The Engage command line interface makes use of a compact IP Address/ Subnet Mask format which defines the subnet mask by its integer number of "1's". Examples:

IP Address	Subnet Mask	No. of "1's"	Addr/Mask format
157.22.23.41	255.255.0.0	16	157.22.23.41/16
202.55.33.50	255.255.255.0	24	202.55.33.50/24
204.11.39.18	255.255.255.192	26	204.11.39.18/26
207.22.88.92	255.255.255.248	29	207.22.88.92/29

The long form of the subnet mask is also accepted:

207.22.88.92/255.255.255.248

If no mask is entered, the subnet mask for the address' class is used. Below is a list of standard Class C Subnets:

4 Byte Representation	Number of 1's
255.255.255.0	24
255.255.255.128	25
255.255.255.192	26
255.255.255.224	27
255.255.255.240	28
255.255.255.248	29
255.255.255.252	30

IP Network Representation

The Engage command line interface identifies a Network or Subnet by using the first (the "zero") address of the subnet. Examples of this convention:

IP Address Range	Subnet Mask	Network Representation
202.55.33.0 to 202.55.33.255	255.255.255.0	202.55.33.0/24
204.99.13.64 to 204.99.13.127	255.255.255.192	204.99.13.64/26
207.22.88.8 to 207.22.88.15	255.255.255.248	207.22.88.8/29

Establishing a Telnet session

A Telnet session is opened by providing the IP address of the router. On opening a Telnet session with an Engage router, the **login** prompt requires entry of a User ID. The default User ID: **root.**

Engage routers are shipped with no password set. Passwords are set or modified with the **passwd** command, detailed below. The Telnet password is the same as the EngageView Administrator's password.

Overview of Engage Commands

A full description of the Engage command line interface follows. Additionally, the entire list is provided in the Appendices section.

Categories

The command set can be divided into four categories:

General
Show
Config
Config Interface

HELP

Included in the General commands is the HELP command, providing information on the entire command set.

Configuration Modes

For the Config and Config Interface commands, Engage employs a modal approach. The user enters the Config mode, makes changes, then Saves those changes. On Saving the changes the user leaves the Config mode.

The Config Interface mode, within the Config mode, is used to set parameters for a specified interface. Once in the Configuration mode, the user enters the Interface command. All subsequent commands apply to the specified interface.

The Telnet prompt indicates the mode of operation:

router name#	the single "#" indicates standard Telnet mode
router name##	indicates the router is in the Config mode
router name(S1)##	router is in the Config Interface mode for Serial Port 1

Syntax for Command Parameters (Arguments)

{}== one of the parameters in set is required
[ ] = = one of the parameters in set is allowed (optional)

Show Config All

The SHOW CONFIG ALL command, outlined below, provides the means to store and replay an entire configuration. Using a cut and paste operation, configurations may be edited off-line and stored.

Commands

General Commands

PASSWD

Allows setting or modifying the login password. The router ships with no password set. On entering the **passwd** command, the user is prompted

to enter, and confirm, the new password. This password is equivalent to the Admin password set in EngageView.

BYE | QUIT | LOGOUT

Any of these commands will terminate the Telnet session. If you have unsaved configuration changes, you will be prompted to save or discard the new configuration.

RESET

Resets the Engage router.

HELP [HELP | ALL | CONFIG | SHOW]

Provides Help information on a selected list of topics. Typing **help** with no argument provides the Help summary screen which is the top-level list of commands.

CLEAR {E1 | S1 | S2 }| S3

Clears the port statistics on the selected port: Ethernet, Serial Port 1, Serial Port 2 or Serial Port 3.

TERM NN

Allows the user to tailor the number of display lines to their terminal screen size

PING{dest.address}[src.address][[{number}]|spr

Sends an ICMP ECHO message to the specified address. Any source address from an interface on the router can be used. This can be useful to

test routes across a LAN or WAN interface.

By default, only 1 message (packet) is sent. A numeric value can be entered to send more than one message. Also, SPRAY can be used to continually send messages until the ESC key is pressed.

UPGRADE {TFTP SERVER} [DNS Address] [Filename]

TFTP (trivial file transfer protocol) provides a means for upgrading Engage router firmware in a TCP/IP environment. A TFTP upgrade may be accomplished over the Internet from Engage Communication's TFTP site, or the user can configure their own local TFTP server.

To upgrade over the Internet, obtain the filename for the latest version from Engage (support@engage.com), then issue the command from within a Telnet session:

```
UPGRADE TFTP.ENGAGE.COM [Filename]
```

In the event this is unsuccessful, it may be necessary to specify the IP address of your local Domain Name Server as follows

```
UPGRADE  TFTP.ENGAGE.COM  157.22.1.1[Filename]
```

To upgrade locally, obtain the upgrade file from Engage Tech Support or ftp.engage.com. Configure a local TFTP server with this file and upgrade with the local server's address as:

```
UPGRADE  {TFTP  SERVER}  [Filename]
```

Note that a router which is running an upgrade must go through two resets when performing an upgrade. This may cause a Telnet connection to drop. If this does occur, simply re-establish the Telnet connection.

SHOW Commands

SHOW [INTERFACE [E1|S1|S2|S3]] {INFO|STATISTICS| FRAME-RELAY-DLCI}

Provides details on any LAN or serial interface. If no interface is specified, either the current interface per "interface" command will be used, or all interfaces will be shown.

INFO	details the port type, port state, etc.
STATISTICS	lists the packets transmitted, received, etc.
FRAME-RELAY-DLCI	lists all active DLCIs on the specified port, and their status.

SHOW ROUTER provides general configuration and status information, including the ethernet hardware address and the firmware version.

SHOW IP ROUTES [LOCAL|RIP|STATIC] lists IP routes. If no argument is provided, all IP route types are listed. The IP Route type indicates the source from which the router learned the route.

Local routes are those to networks to which the router is directly attached.

If RIP, the Routing Information Protocol, is enabled in the router configuration, routes learned through the exchange of RIP packets will be listed.

Static routes are those defined explicitly in the router configuration.

SHOW FILTERS provides a listing of all filters on all interfaces.

SHOW IP STATISTICS provides more detailed statistics on IP packets only.

SHOW CONFIG ALL provides a list of all configuration parameters. No argument is the same as ALL. This list provides the basis for storing a router configuration into a local text file. The full configuration can be edited offline.

SHOW CONFIG INTERFACE {E1|S1|S2|S3}

If no interface is specified, either the current interface per the "interface" command will be used, or all interfaces will be shown.

SHOW CONFIG IP [ALL|ROUTES] details the IP configuration. No argument is the same as ALL, which provides routes as well as IP configuration items which don't pertain to a specific port, i.e. default router, routing cost, etc.

SHOW CONFIG ROUTER lists Router Name, etc.

CONFIGURATION Commands

Engage employs a modal approach to Telnet router configuration. The user enters the Configuration mode, makes changes, then Saves those changes. On Saving the changes the user leaves the Configuration mode.

A further mode, within the Configuration mode, is used to set parameters for a specified interface. Once in the Configuration mode, the user enters the Interface command. All subsequent commands apply to the specified interface.

The Telnet prompt indicates the mode of operation as follows:

routername#	the single "#" indicates standard Telnet mode
routername##	indicates the router is in the Configuration mode
routername(S1)##	outer is in Interface Config mode, Serial Port 1

CONFIG

Enter the configuration mode, at which point the following commands may be used:

SAVE

Save the changes and exit Configuration mode

END [SAVE]

Exit Configuration mode. The optional SAVE instructs the router to save configuration chnages.

RESTORE

Restores the current router configuration, ignoring any changes which have been made during the current Telnet CONFIG session.

ROUTER NAME namestring

ROUTER CONTACT contactstring

ROUTER LOCATION locationstring

These three text fields allow the user to assign site specific information which would be used by SNMP network management applications.

IP DEFAULT-ROUTER address

Enter the IP address of the default router or gateway.

IP COST NN

Enter the routing cost, in hops

IP ROUTE addr[/mask] next-hop cost port dlci

Enter a static route. The address convention used provides the first (the "zero") address of the subnet. The Subnet mask convention uses the integer number of 1's in the subnet mask. Examples of this addr/mask convention:

IP Address Range	Subnet Mask	addr/mask value
202.55.33.0 through .255	255.255.255.0	202.55.33.0/24
204.99.13.64 through .127	255.255.255.192	204.99.13.64/26
207.22.88.8 through .15	255.255.255.248	207.22.88.8/29

The next-hop entry is the IP address of the next-hop router/gateway.

Routing cost is an integer value.

Valid port entries include e1, s1, s2 and s3.

DLCI is left blank if the route is not a Frame Relay connection

Examples of valid static route entries:

```
ip  route  202.55.33.0/24      202.55.33.50  1  s1
ip  route  204.99.13.64/26    204.99.13.65  1  s2
ip  route  207.22.88.8/29      207.22.88.9    1  e
```

Note: All Static Routes require an explicit IP Network Address, including the route to the Default Router. A route to 0.0.0.0 is not permitted, instead the default router's IP network is specified.

IP DELETE addr

Delete a static route. Example of format:

```
ip   delete   157.22.234.0
```

CONFIG INTERFACE Commands

INTERFACE [E1|S1|S2|S3]

Places router in the Interface Configuration mode for a specific Interface, or Port. Once in this mode, the following commands are available:

IP ADDRESS addr[/mask]

Used to configure the IP address and subnet mask for the selected interface, whether ethernet or serial.

IP RIP {OFF|ON|LISTEN|SEND}

Sets the Routing Information Protocol configuration for the selected port:

OFF	RIP not enabled
ON	router will transmit RIP information out the selected port and will process RIP information received through the port
LISTEN	router will process incoming RIP packets, but will not transmit RIP.
SEND	router will transmit RIP information but ignore received RIP packets.

TYPE {RS232|RS449|RS530|56K|64KDDS|T1|E1|V.35}

Sets the port type. Port types 56K, 64KDDS, T1 and E1 are used with models which have the internal DSU/CSU installed.

The following five commands set Serial Port parameters outlined in the EngageView chapter.

PROTOCOL {ENGAGE|PPP|FRAME-RELAY}

POLL-CD {ON|OFF}

WAIT-CD {ON|OFF}

DTR {ON|OFF}

TIMEOUT NN

T1 Port Configuration Commands:

`T1 DATA {NORMAL|INVERTED}`

`T1 CLOCKING {NETWORK|INTERNAL}`

`T1 LBO {CSU {0dB|-7.5dB|-15 dB|-22.5dB}|DSX-1 NN}`

`T1 FRAMING {ESF|D4}`

`T1 CODING {B8ZS|AMI}`

`T1 SPEED {56k|64k}`

`T1 SPACING {ALTERNATE|CONTIGUOUS}`

`T1 CHANNELS {FULL | FRACTIONAL {NN XX}}`

where NN defines the Start Channel; XX is the number of channels

E1 Port Configuration Commands:

`E1 DATA {NORMAL | INVERTED}`

`E1 CLOCKING {NETWORK | INTERNAL}`

`E1 FRAMING {CRC4 | FAS}`

`E1 CODING {HDB3 | AMI}`

`E1 CHANNELS {FULL | FRACTIONAL {NN XX}}`

where NN is first E1 channel (1 - 31), XX is the number of channels

Frame Relay Configuration Commands:

`FRAME-RELAY T391 NN`

`FRAME-RELAY N391 NN`

`FRAME-RELAY MANAGEMENT {ANNEX-D|LMI}`

Frame Relay configuration commands. The T391 timer specifies the time between Status Enquiries sent to the Frame Relay switch, i.e. a status enquiry is sent every T391 seconds. The default value is 10 seconds. The N391 counter sets the frequency of Full Status Enquiries, i.e. every N391 Status Enquiries a Full Status Enquiry is sent. Default N391 is 6.

Management interface should be set to match that used by the Frame Relay service provider.

Config Filter Commands

Filter commands are detailed in Chapter 8: Network Security

```
FILTER [IN|OUT]

PERMIT|DENY [INTERFACE {E1|S1|S2} .....

DELETE ALL
```

Initial IP Address Assignment with Telnet

Telnet can be used to assign an IP address to an "unknown" router - one in which IP is not enabled or has an unknown IP address.

The user should power up the router and immediately attempt a Telnet connection to the desired IP address. If the Telnet session returns a connection failure, the user should retry immediately - without restarting the router. Repeat these retries for a total of two minutes.

When the sequence is successful, the user will be asked to confirm that the router should adopt the new IP address. If the response is yes, the router adopts the new address permanently and restarts. If the response is no, the router ends the Telnet session and reverts to the previously configured IP address. If there was no IP address configured, IP will become unavailable.

Once the address assignment is complete, the user will need to assign further IP parameters including the subnet mask.

If the method does not work the first time, the router should be restarted to initiate the procedure again, as some of the timing constraints may not have been met. This method relies on the Telnet workstation generating ARP requests to the desired IP address. It may be helpful to restart the workstation to clear its ARP cache.

Chapter 8:
Network Security

Chapter 8

Network Security

Engage routers provide a number of network security options. For TCP/IP networks, Engage's IP Packet Filtering allows creation of highly selective filters to permit or deny access in any direction through any router port.

IP Packet Filtering

Engage IP packet filtering allows the creation of rule sets which selectively block TCP/IP packets on a specified interface. Filters are applied independently to all interfaces, ethernet and serial, as well as independently to interface direction: input (packets coming in to the router) or output (packets transmitted out of the router).

Packet filtering is used to prevent unauthorized access to your internal network as well as to limit internal user access to services across the WAN. Complex filters can be constructed. One example would be a filter which prevents external users from establishing Telnet sessions to any internal hosts while permitting selected internal users to establish Telnet sessions to external hosts.

Improperly constructed filters can yield unexpected results. Example filters are provided, but it is recommended that users completely familiarize themselves with the filtering rules in the next section before applying filters to their own routers.

Basic Filtering Rules

WAN Router Filters

Filters are often applied to WAN routers by a network administrator via the internal LAN. To avoid inadvertantly restricting the administrator's own access to the router, it is advisable to apply all filters to the serial (WAN) port rather than the ethernet (LAN) port.

Default Packet Deny

Filters are applied to an interface and direction, for example to **s1 out** . If a single filter command is applied to an interface-direction, **all** packets not explicitly permitted will be denied.

If no filter is applied to an interface-direction, all packets are permitted.

Filter Rule Ordering

a. Filter rules are applied in the order in which they were entered by the user.

b. A packet will be checked against the rules until a match, either a permit or deny, is encountered. No further rules are checked.

c. If possible, place filters which will apply to the largest number of packets at the beginning of the list. This increases efficiency.

Ramifications of these rules

a. Generally the user will place Permit filters before Deny filters

b. One exception is a wild card Permit rule placed at the end of the rule list which will Permit all packets not explicitly denied:

Permit all *or* Permit 0.0.0.0 0.0.0.0

Clearing Filters

Filters may be cleared through the use of the **delete** command, outlined below.

Additionally, power cycling the Engage router with DIP Switch 4 turned ON will delete all filters, useful if users lock themselves out.

Command Format

Filter Entry Mode

Filter entry is accomplished through a Command Line session with the router. The default login is `root` after which the router responds with the prompt:

RouterName#

To enter filters, you must be in Configuration mode by typing **config**. The prompt changes to:

RouterName##

An interface must be selected using the command:

interface[e1|s1|s2|s3] .

The next prompt indicates selected interface:

RouterName(S2)##

The filter command is used to define the direction of filters.

filter [in|out]

filter in - Begin command entry for input filters. Input filters apply to packets received IN to the router through the specified port. The Command Line prompt indicates a left arrow:

RouterName(S2)##<

filter out - Begin command entry for output filters. Output filters apply to packets transmitted OUT of the router through the specified port.

Command Line prompt indicates a right arrow:

RouterName(S2)##>

Filter Command Format

The format for the filter command:

```
permit|deny [interface{e1|s1|s2|s3}] [in|out][src-addr[dest-addr]] [type] [options]
```

permit or deny designates what action should be performed on the packet

[interface{e1|s1|s2|s3}] is used to define the rule for a given port. If an interface is not explicitly defined, the default will be the current interface defined via the **interface** command. If no interface is current, an error is displayed.

[in|out] is used to define the direction of the filter. If not used, the direction defined in the **filter** command will be used. If no interface is current, an error is displayed.

[src-addr[dest-addr]] src-addr and dest-addr define the source and destination IP address(es) to be filtered. These addresses can be either discrete host IP addresses or network addresses in the format a.b.c.d/x, where x is the number of bits for the network mask.

Source and destination addresses are optional. If neither is specified, the rule applies to all source and destination addresses - same as the wild card IP address 0.0.0.0. If only one address is specified it is interpreted as the source address.

type is the protocol to be acted on. Valid choices are TCP, UDP, ICMP and IP. If no protocol type is specified, the filter applies to all protocols.

options allows more specific filtering on protocols. If no expression is specified, all ports and protocol flags are filtered. Valid expressions depend on the protocol selected as follows:

• TCP expressions are used to filter on TCP source/destination ports as well as control flags and have the format:

TCP [SRC <op> <value>] [DST <op> <value>] [<tcp-flags>]

where

op is a relational operator of the following set:

=, !=, >, >=, <, <=

value indicates the protocol port to be filtered. Common TCP ports include:

ftp-data	20	File Transfer (Default Data)
ftp-control	21	File Transfer (Control)
telnet	23	Telnet
smtp	25	Simple Mail Transfer (email)
nicname	43	Who Is
domain	53	Domain Name Server
gopher	70	Gopher
finger	79	Finger
www-http	80	World Wide Web HTTP

tcp-flags can be one or more of the following:

ACK | URG | PSH | RST

• UDP expressions are identical to TCP expressions, though the values of Protocol Ports differ:

UDP [[SRC <op> <value>] [DST <op> <value>]]

Common UDP ports include:

nicname	43	Who Is
domain	53	Domain Name Server
tftp	69	Trivial File Transfer
gopher	70	Gopher
finger	79	Finger

• ICMP expressions are used to filter on ICMP datagram types and have the format:

ICMP [TYPE <op> <value>]

where

op is a relational operator of the following set:

=, !=, >, >=, <, <=

value is an integer ICMP type. Examples include:

0 ICMP Echo Reply

8 ICMP Echo Request

• IP expressions are used to filter on IP fragments and options and include

FRAGMENTS

SOURCE-ROUTE

RECORD-ROUTE

Other Commands

delete [interface{e1|s1|s2|s3}] [in|out][src-addr[dest-addr]] [type] [options] [all]

This command is used to delete a packet filter. The arguments are similar to the **permit/deny** commands.

By default, filters will only be deleted if they match the arguments exactly. If ALL is used, then the arguments are used as a wildcard and filters will be deleted if they match the arguments as entered.

For example, **delete ip all** would delete the filters permit in ip and deny out ip fragments.

show filter [all | [interface <interface>]] [in|out]

This will show the packet filters for the router. The format of the display will match the syntax of the configuration command.

For example:

Interface: S1

Direction: In

Action	Source Address	Destination Address	Protocol Type	Protocol Options
Permit	0.0.0.0	0.0.0.0	ICMP	Type = 1
Deny	0.0.0.0	0.0.0.0	ICMP	Type = 8
Permit	0.0.0.0	0.0.0.0	TCP	Src >= 1024Dst = 23
Deny	128.14.0.0/16	0.0.0.0	TCP	Dst = 21

If an interface and filter direction is defined, then filters will only be shown for that interface and direction. Otherwise, filters for all directions and interfaces will be shown. ALL or an explicit interface/direction can also be entered to show filters from an interface/direction other than what's current.

Examples

Included are examples of common filters which might be created for Wide Area routers.

Note: Filter examples are provided for sample purposes only. The design of IP packet filters is a complex process and requires a solid familiarity with the TCP/IP protocol. It is STRONGLY suggested that the user fully tests the security of any filters applied to Engage routers prior to placing them into secured locations.

Example 1

IP Spoofing is best prevented by applying an input filter to your WAN port which denies incoming packets whose source address matches your own internal IP network. For example, if you have a Class C IP network 156.22.235.0/24, apply the following filter

```
interface s1
filter in
deny 156.22.235.0/24 0.0.0.0 ip
permit 0.0.0.0 0.0.0.0 ip
```

Example 2

This example shows how a user can set up input filters on the ethernet port to allow only incoming FTP and Telnet packets but reject incoming FTP packets from network 128.14.0.0.

```
interface e1
filter in
permit tcp dst=21
permit tcp dst=23 src>=1024
deny 128.14.0.0/16 tcp dst=21
```

Example 3

This example shows a complex filter permitting *only*:

a. One host to FTP out: 157.22.234.114

b. Only FTP server 157.22.234.115 is accessible from the Internet:

c. All users on subnet 157.22.234.112/28 can Telnet out, but no outside user may Telnet in:

```
interface S1
! configure to permit .114 to ftp out
filter out
permit 157.22.234.114 0.0.0.0 tcp dst = 21
permit 157.22.234.114 0.0.0.0 tcp src > 1023 dst = 20 ack
filter in
permit 0.0.0.0 157.22.234.114 tcp src = 21 ack
permit 0.0.0.0 157.22.234.114 tcp src = 20 dst >1023
! configure to permit Internet access to .115
filter in
permit 0.0.0.0 157.22.234.115 tcp src > 1023 dst = 21
permit 0.0.0.0 157.22.234.115 tcp src > 1023 dst = 20 ack
filter out
permit 157.22.234.115 0.0.0.0 tcp src = 21 dst > 1023 ack
permit 157.22.234.115 0.0.0.0 tcp src = 20 dst > 1023
! configure so those on 157.22.234.112 can Telnet out
filter in
permit 0.0.0.0 157.22.234.112/28 tcp src = 23 dst > 1023 ack
filter out
permit 157.22.234.112/28 0.0.0.0 tcp src > 1023 dst = 23
```

Example 4

This filter, applied to serial port input of a router on the 204.22.233/24 network, permits HTTP, DNS and SMTP. By default, all other services, including, FTP and Telnet, are denied. The standard anti-spoofing filter is also present. Note that since there are no filters on serial port out, all packets in that direction are allowed.

```
interface s1
filter in
! prevent spoofing
deny 204.22.233.0/24 0.0.0.0 ip
! permit HTTP
permit 0.0.0.0 204.22.233.0/24 tcp src > 1023 dst = 80
permit 0.0.0.0 204.22.233.0/24 tcp src = 80 dst > 1023
! permit DNS
permit 0.0.0.0 204.22.233.0/24 udp src > 1023 dst = 25
permit 0.0.0.0 204.22.233.0/24 udp src = 25 dst > 1023
permit 0.0.0.0 204.22.233.0/24 tcp src > 1023 dst = 25
permit 0.0.0.0 204.22.233.0/24 tcp src = 25 dst > 1023
! permit SMTP
permit 0.0.0.0 204.22.233.0/24 tcp src > 1023 dst = 25
permit 0.0.0.0 204.22.233.0/24 tcp src = 25 dst > 1023
```

Chapter 9: Troubleshooting

Chapter 9

Troubleshooting

Wide Area Network system are subject to problems from a variety of sources. Fortunately, an organized troubleshooting approach usually leads to the area of the problem in short order. It is essential to distinguish between problems caused by the LAN (network system), the WAN equipment (communication equipment), the digital phone service and the Engage router configuration.

This troubleshooting chapter is structured with symptoms in the order the user might encounter them.

Unable to Communicate with the Local Router

Most installations first require communication with a local router, usually from the same network as the router itself. Proceed through the following symptoms if you are unable to communicate with the local router using Telnet, EngageView, Ping, etc.

Ethernet/General

Cause: Network Cabling is faulty

Solution: Verify cabling is good by swapping router cabling with a known good connection. Check the status LEDs on the 10BaseT hub to confirm a good connection. If necessary, create a stand-alone LAN with just the workstation and the router.

Cause: Ethernet interface set improperly on the router

Solution: On earlier Engage Routers, identified by the absence of a Console port on the rear panel, the ethernet port is selected by internal motherboard DIP Switch 1. Switch 1 is OFF for Thinnet, ON for 10BaseT. Models with a Console port have auto-sensing ethernet. See Chapter 4: Engage Router Hardware.

Cause: User has connected the Engage router model w/ internal T1 DSU/CSU to the T1 line prior to configuration.

Solution: Improper T1 configuration or a large T1 error count can generate errors which so overload the processor that communication to the router is slowed or stopped. Unplug the router from the T1 line. The router should immediately recover. Configure the T1 DSU/CSU properly for T1 line parameters.

Cause: Router ethernet LED on solid or not flashing

Solution: Normally, the ethernet LED flashes each time a packet is transmitted on to the ethernet. If no activity is observed, router may be defective. If LED is on solid, the router may have difficulty completing a transmission. In either case, a good test is to remove the router to a stand-alone network and retest.

Can't Communicate with Router - TCP/IP

Cause: IP address is not set properly on the router

Solution: A variety of methods exist for assigning an IP address to an Engage router with an unknown IP address. Telnet, BootRouter and DHCP rely on powering up the router on a LAN with a workstation ready to assign a new address. The application EngageView can assign the IP address directly (a non-IP version of EngageView), or the user can configure directly through the Console port. These methods are described in chapters on Command Line Interface and EngageView.

Cause: Workstation not on the same subnet as the router

Solution: During an initial configuration of a router, communication should come from within the same net/subnet. With no default router, the Engage router will not be able to reply to communication off its own net.

Cause: IP stack on the workstation not configured

Solution: Ensure that other devices on the same LAN can be pinged, or otherwise'seen'

Can't Communicate with Router - EngageView/Macintosh

Cause: Macintosh set to LocalTalk

Solution: In the AppleTalk (or Network) Control Panel, select Ethertalk.

Can't communicate to the router - Console Port

Cause: Baud Rate, Stop Bits, etc. set wrong on communication application

Solution: Ensure the communication software is configured for a fixed, asynchronous data rate of 9600 bps, 1 stop bit, no parity, 8 bit fixed

Cause: Transmit and Receive Data swapped

Solution: The console port is configured as a DTE (data terminal equipment) port. For connection to other DTE, such as a terminal, a Null Modem adapter is required. A 25 pin female/25 pin male null modem adapter is provided with the router.

High Ethernet Error Count

Cause: Bad cabling

Solution: Check all cabling. Ensure proper 50 ohm termination for Thinnet connections. Swap ports on 10BaseT hub to troubleshoot.

Solution: Use alternate ethernet type on the router to prove its ethernet interface.

Unable to Communicate with the Remote Site

Local Router Port LED Stays Red

All equipment has been configured and connected, and the digital phone service has been "turned up", yet the port LED remains Red, rather than turning Green. On a leased or dedicated link, Green indicates reception of good data from a remote router. On a Frame Relay link, it indicates successful handshake with the telco.

Proceed through the following steps in sequence:

No Serial Port Transmit Data

Check whether the Serial Port Transmit Packet count is increasing by selecting the Serial Port in EngageView and monitoring "Packets Transmitted" or by repeatedly issuing the command SHOW INTERFACE S1 (or S2 or S3) STATISTICS.

Solution: Router is configured to transmit data only when the Carrier Detect (CD) signal is active. Ensure that the DCE does supply CD (aka DCD) *or* turn off the Engage router's senstivity to Carrier Detect. CD parameters are found in EngageView's Port menu, under Port Configuration - Advanced Options. Command line uses POLL-CD and WAIT-CD, both of which would be set to OFF.

Note : CD is an important control signal and *should* be monitored for dial-up connections.

Solution: Router is not receiving a Transmit Clock (TxCk) signal from the DCE. Verify the cabling between the router and DCE. If using V.35, ensure the use of an Engage cable since there are multiple standards for implementing V.35 signaling through db25 connectors. Ensure the DCE does supply TxCk - a modem only supplies TxCk when configured to operate in Synchronous mode.

No Serial Port Receive Data

Check whether the Serial Port Receive Packet count is increasing by selecting the Serial Port in EngageView and monitoring "Packets Received" or by repeatedly issuing the command SHOW INTERFACE S1 (or S2 or S3) STATISTICS.

Solution: Router is not getting a Receive Clock (RxCk) signal from the DCE. Verify the cabling between the router and DCE. If using V.35,

ensure the use of an Engage cable since there are multiple standards for implementing V.35 signaling through db25 connectors. Ensure the DCE does supply RxCk.

Solution: Router is not getting Receive Data (RxD) from the DCE. Same cabling issues as previous item on RxCk.

Solution: Remote router is not transmitting data. Have a user at remote site verify the router is transmitting data.

Solution: Telco path is not complete. Have the telephone company perform loop tests to ensure their connection to both end points is working. On leased lines, this simply involves breaking the link and performing Loop Tests to the DSU/CSU or other customer equipment in each direction. Frame Relay involves more parties, but the local loop to the customer router equipment can be "looped up" and tested.

Solution: All Receive Data (RxD) is arriving in error. Receive Packet count is not moving, but the Total Error Count is increasing, and all are Receive Errors. Quality of the line is very poor - have the telco test it out.

Solution: All Receive Data (RxD) is arriving in error. Receive Packet count is not moving, but the Total Error Count is increasing, and all are Receive Errors. DSU/CSU is improperly configured for the line - usually only the case in T1/fractional T1 lines. Unplug from T1 line and confirm the line coding, framing, etc. with the T1 provider.

Received Data is of a Different Protocol

Receive Packet count is increasing, but the port LED remains Red.

Solution: Check that the WAN protocol agrees between the Engage router and the remote unit: Engage, PPP or Frame Relay.

Test Suggestion: Local DTE Loop

If the DCE can perform it, configure the external DCE for a Local (or DTE) Loop. When configured in Local Loop, a data communication device will loop back the router's Transmit Data to its Receive Data port. If connected to a device providing loop, the router will show TxD and RxD packets incrementing at the same rate, and the Port LED should turn

to amber (yellow). Successful Local Loop testing proves the router's TxD, RxD, TxC and RxC circuitry, the cable to the external DCE, and the DTE interface circuitry of the DCE.

Note: Temporarily set WAN Configuration to Engage for DCE loop tests

Note: DCE must supply TxC and RxC during Local Loop for the test to pass.

Port LED Goes Amber (Yellow)

As noted in Local DTE/DCE Loop section, the router Port LED will go amber or yellow when it detects a loop somewhere on its WAN connection. If the Port LED goes Amber during normal operatin, suspect a loop somewhere in the circuit, whether at the local data communication equipment, somewhere in telephone company equipment, or at the remote data communication equipment.

Port LED Alternates Green/Red

Cause: The external DCE is not supplying Carrier Detect (CD)

Solution: Set the router to ignore the CD signal through EngageView or the commands POLL-CD and WAIT-CD, both of which would be set to OFF.

Port LED Green on One Router, Red on the Other

This situation arises when data is transferred properly in one direction, but not in the reverse. Data in each direction is somewhat independent and, for example, a bad RxD circuit on a DSU/CSU can cause this effect. The fact that data is transferring properly in one direction helps narrow the troubleshooting. Using the points mentioned earlier regarding No TxD and/or no RxD, the user should be able to examine the "bad" data direction and narrow down the problem.

Port LED Green, but Cannot Communicate across WAN

Leased/Dedicated Circuit - If the Port LED on the local router is Green and the remote router indicates it also has a good connection (Port LED Green if an Engage router), you may assume data is flowing in both directions.

Cause: A poor quality connection may provide sufficient data exchange to turn Port LEDs green, but not permit real traffic. Check the errors on the serial port of each router. Total Errors should not exceed 1-2% of either Receive or Transmit Packets. If there are many errors, actions include having line tested for quality and verifying configuration of the DSU/CSU or other DCE for items such as TxCk Source (usually Network vs. Internal)

Frame Relay - A green Port LED in a Frame Relay environment only indicates the router is exchanging status packets properly with the local Frame Relay switch. It provides no indication of a connection across the Frame "Cloud" to another router.

Cause: No router on the other end. Ensure the router(s) which are part of your frame network are up and connected.

Cause: PVCs (Permanent Virtual Circuits) not in place. Ensure that the telco really has "turned up" all of the necessary PVCs.

Cause: Router on the other end not running IETF Frame Relay. Ensure that no proprietary Frame Relay protocol is in use.

TCP/IP Connection

An IP Ping program is the best tool for troubleshooting TCP/IP connectivity. As a sanity check, *first* ensure you can ping the local router. If unsuccessful, go back to "Can't Communicate with the Local Router" section.

Can't IP Ping Remote Router

Cause: Ping workstation does not have Default Gateway (or Router) set. In the workstation's IP configuration, alongside workstation's own IP address and subnet mask, you must provide the IP address of the device (a router) to which all packets destined off the local net should be sent. If the Engage router is the only router on the IP network, use its IP address for Default Gateway. If there is another router on the net, see next item.

Cause: Another router on the net, serving as Default Gateway for all net workstations, does not know about the remote IP nets the new Engage router brings to the picture. This device must be provided with static route(s), through the local Engage router, to the remote IP nets/subnets.

Cause: Engage router improperly configured to use RIP. Engage routers support one routing protocol, RIP, which automates the exchange of routing information between routers and is suitable for simple IP network configurations. RIP is not suitable for subnetted IP networks, in which case Static Routes must be used.

Cause: Static Route(s) are not entered properly. Each router vendor's approach to Static Route entry is different. Ensure that each static route has its six components: destination network (the starting or "0" address), subnet mask at that dest. network, address of next router in path to destination, number of hops to dest. network, port of *local* Engage router to go out to reach destination network and DLCI (leave blank if not a Frame Relay network).

Cause: Frame Relay DLCI in static route is improper - telco provided wrong DLCI or user entered DLCI for *other* end of the PVC. Connect via the command line interface and issue the command

```
show interface s1 frame-relay-dlci
```

will provide a list of all active DLCIs into that telco port.

Cause: Remote router does not have a route, whether through RIP or static routes, back to this network. Verify that the remote router is configured with routing information for the local IP network.

Able to Ping Remote Router, but not other devices on the Remote IP net

Cause: Devices on the remote net do not have their IP Gateway defined. Use the IP address of the Engage router if it is the only router at that site. If there are other routers, they may be used as the Default Gateway, but they must have a route, through the remote Engage router, back to this network.

Appendices

Appendix A

IP•Express Router Specifications

Ethernet Port

- 10 Mbps fixed transmission speed

LAN Protocol

- TCP/IP

WAN Protocols

- Engage Proprietary
- Point-to-Point Protocol (PPP)
- Frame Relay

Serial DTE Interfaces

- RS-232/RS-530/RS-449/V.35: DB-25 female
- optional internal 56/64 Kbps DSU/CSU
- optional T1/fracT1 DSU/CSU
- optional E1/fracE1 DSU/CSU

Power Supply

- External 24 Volts AC, 1A with standard AC plug. International power supplies available.

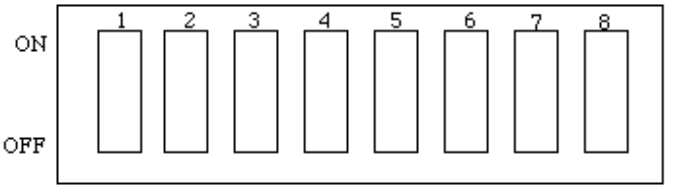
Physical

- Standard 19 inch rack mount kit available
- Std/Adv model dimensions: 7.2 x 10.2 x 1.8 inches
- XL model dimensions: 8.75 x 5.50 x 1.63 inches
- Weight: approximately 5 lbs., depending on options installed.

Appendix B

Engage Router Switch Settings

DIP switches are accessible by removing the top cover of the router.



Standard and Advanced Models

Standard and Advanced models contain an eight position DIP Switch.

Switch 1

Certain Engage router models utilize a DIP swtich to select the active ethernet interface. Models which have a Console port on the rear panel have auto-sensing ethernet and do not require setting the DIP Switch. If required, DIP Switch 1 ON selects Twisted Pair (10BaseT) Ethernet. and DIP Switch 1 OFF selects ThinNet (10Base2).

Switch 4

DIP Switch is used to clear IP filters. When the unit is powered on with DIP Switch 4 set ON, all TCP/IP filters will be deleted, a good method for getting out of a filtering jam.

Switch 6

When DIP Switch 6 is ON, the router will use IEEE 802.3 Ethernet for IP broadcasts. When OFF the router uses DIX Ethernet. This switch does

not affect IPX header type. The default setting is OFF.

Switch 7

Powering the router up when DIP Switch 7 is ON forces the router to factory default settings. Factory settings include operation from Base Flash, deleting any download upgrades, and setting AppleTalk seeding ON.

XL Router Models

XL Router models contain a four position DIP Switch:

Switch 1

Powering the router up when DIP Switch 1 is ON forces the router to factory default settings. Factory settings include operation from Base Flash, deleting any download upgrades, and setting AppleTalk seeding ON.

Switch 3

When DIP Switch 3 is ON, the router will use IEEE 802.3 Ethernet for IP broadcasts. When OFF the router uses DIX Ethernet. This switch does not affect IPX header type. The default setting is OFF.

Switch 4

DIP Switch is used to clear IP filters. When the unit is powered on with DIP Switch 4 set ON, all TCP/IP filters will be deleted, a good method for getting out of a filtering jam.

Appendix C

RS-232 Port Specification

Signal Name	Pinout (db25)
FG	1
TxD A	2
RxD A	3
RTS	4
CTS	5
DSR	6
SG	7
CD	8
TxCk A	15
RxCk A	17
LT	18
DTR	20

Appendix D

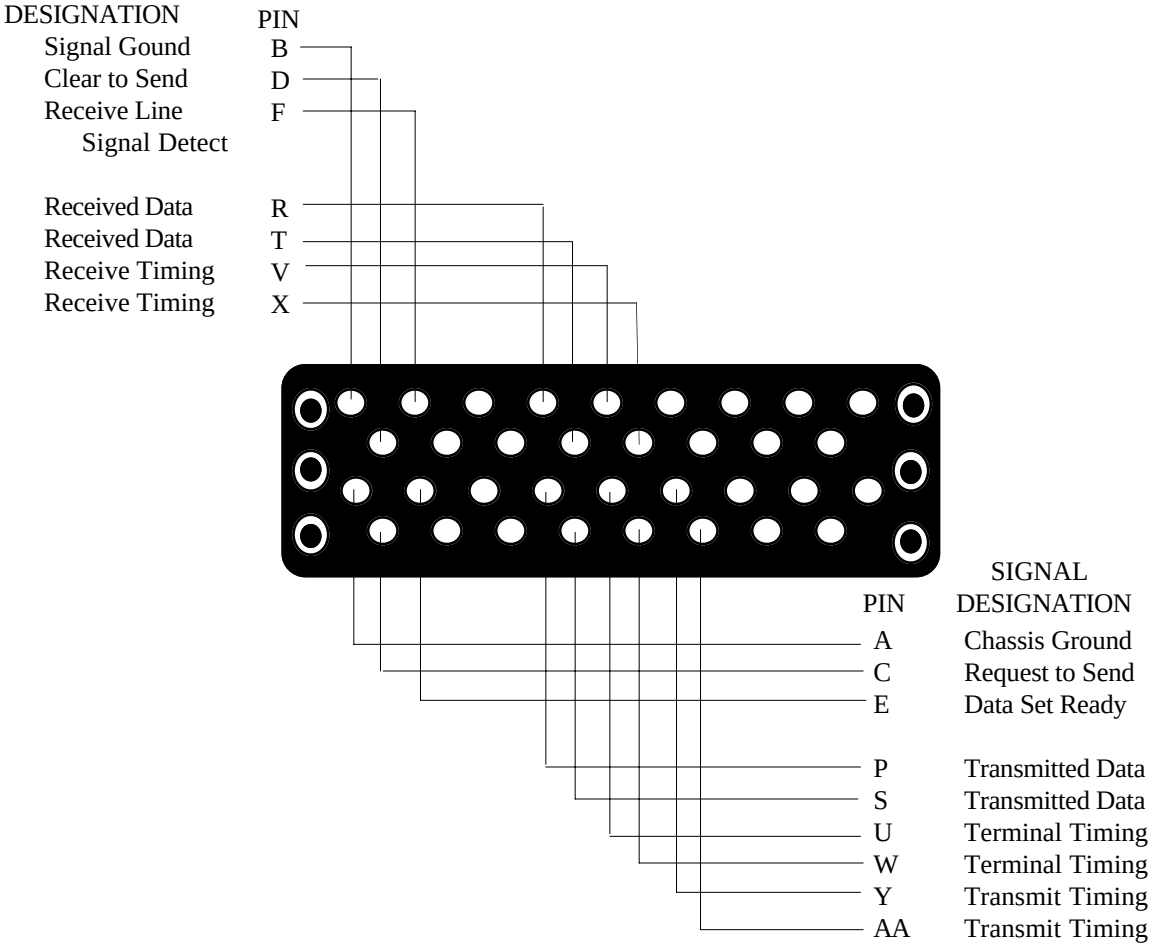
RS-530 Port Specification

RS530A Connector Specification

RS530-A db25 Male	Signal	I/O TO DCE
1	Shield	I/O
2	TD-A	I
3	RD-A	O
4	RTS-A	I
5	CTS-A	O
6	DSR-A	O
7	Gnd	I/O
8	CD-A	O
9	RC-B	O
10	CD-B	O
11	ETC-B	I
12	TC-B	O
13	CTS-B	O
14	TD-B	I
15	TC-A	O
16	RD-B	O
17	RC-A	O
18	nc	
19	RTS-B	I
20	DTR-A	I
21	nc	
22	DSR-B	O
23	DTR-B	I
24	ETC-A	I
25	nc	

Appendix E

V.35 Interface Specifications



V.35 Interface Specifications (continued)

Cable p/n: **091-3200**
Name: **"V.35, db25 vers."**
Connector 1: **db25, Male**
Connector 2: **34 pin "M" block, male**
Length: **3 feet**

Connector 1 (db25)	Connector 2 (34 pin "M")	Signal Name	Cabling note
2	P	TxD A	<- twisted
14	S	TxD B	<- pair
3	R	RxD A	<- twisted
16	T	RxD B	<- pair
17	V	RxCk A	<- twisted
9	X	RxCk B	<- pair
15	Y	TxCk A	<- twisted
12	AA	TxCk B	<- pair
24	U	ExtCk A	<- twisted
11	W	ExtCk B	<- pair
6	E	DSR	
20	H	DTR	
4	C	RTS	
5	D	CTS	
8	F	RLSD	
18	K	LT	
7	B	SG	
nc	A	FG	

Appendix F

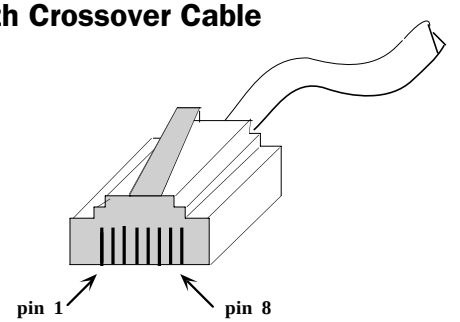
RS-449 Adapter Cable Pinout

	RS449 Cable for ExprRouter: db25 to db37 M/M			
	Connector 1		**Connector 2**	
Conn	**db37 male**	**Signal**	**db25 male**	
	RS-449		RS-530	
1	1	*Shield*	1	
2	19,37	Sig Gnd	7	
3	7	RTS-A	4	Twisted
4	25	RTS-B	19	Pair
5	6	RD-A	3	Twisted
6	24	RD-B	16	Pair
7	8	RxC-A	17	Twisted
8	26	RxC-B	9	Pair
9	4	TD-A	2	Twisted
10	22	TD-B	14	Pair
11	5	TxC-A	15	Twisted
12	23	TxC-B	12	Pair
13	9	CTS-A	5	Twisted
14	27	CTS-B	13	Pair
15	13	CD-A	8	Twisted
16	31	CD-B	10	Pair
17	11	DSR-A	22	Twisted
18	29	DSR-B	6	Pair
19	12	DTR-A	20	Twisted
20	30	DTR-B	23	Pair
	NOT CONNECTED			
	2,3,10		24	
	14,15,16,17,18		11	
	20,21,28		25	
	32,33,34,35,36		21	
			18	

Appendix G

T1 and E1 Port Specification

with Crossover Cable



T1/fracT1 DSU/CSU Pin numbering

1	**RxRing**
2	**RxTip**
4	**TxRing**
5	**TxTip**

For T1 Crossover (allowing connection directly between two T1/fracT1 DSU/CSU devices) wire:

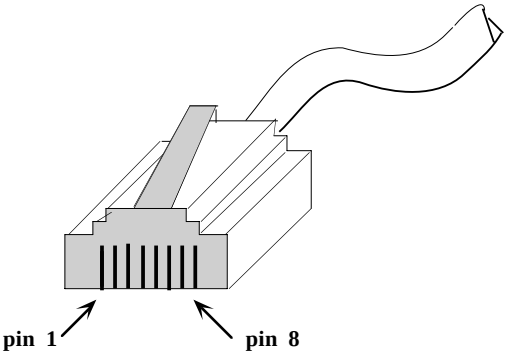
(TxTip)	**Pin 5**	**to**	**Pin 2**	**(RxTip)**
(TxRing)	**Pin 4**	**to**	**Pin 1**	**(RxRing)**
(RxRing)	**Pin 1**	**to**	**Pin4**	**(TxRing)**
(RxTip)	**Pin 2**	**to**	**Pin 5**	**(TxTip)**

E1 RJ45 to db15 Cable

Signal	RJ45	db15 Male
TxD Tip	5	1
RxD Tip	2	3
TxD Ring	4	9
RxD Ring	1	11
Frame Ground	7	2

Appendix H

56 & 64 Kbps DSU/CSU Port Specification (w/ Crossover cable pinout)



56 Kbps DSU/CSU (DDS) Pin numbering

1	TxRing
2	TxTip
7	RxTip
8	RxRing

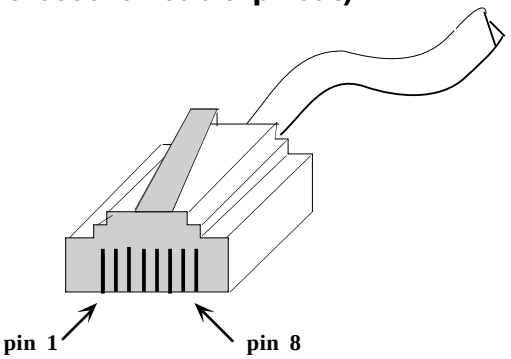
For DDS Crossover (allowing connection directly between two 56Kbps DSU/CSU devices) wire:

Signal	Conn 1	Conn 2	Signal
TxTip	2	7	RxTip
TxRing	1	8	RxRing
RxTip	7	2	TxTip
RxRing	8	1	TxRing

Appendix I

10BaseT Port Specification

(w/ Crossover cable pinout)



10BaseT Plug pin numbering

Pin 1	**TxD+**
Pin 2	**TxD-**
Pin 3	**RxD+**
Pin 6	**RxD-**

For 10BaseT Crossover (allowing connection directly between two 10BaseT devices) wire:

(TD+)	**Pin 1**	**to**	**Pin 3**	**(RD+)**
(TD-)	**Pin 2**	**to**	**Pin 6**	**(RD-)**
(RD+)	**Pin 3**	**to**	**Pin1**	**(TD+)**
(RD-)	**Pin 6**	**to**	**Pin 2**	**(TD-)**

Appendix J

Command Line Interface

```
{}  ==  one  of  parameters  in  set  is  required
[]  ==  one  of  parameters  in  set  is  allowed  (optional)
```

RESET

PASSWD

BYE | QUIT | LOGOUT

HELP [help-subtopic]

CLEAR {E1 | S1 | S2 | S3}

TERM NN

PING{dest.address}[src.address][[{number}]|spray]

UPGRADE {tftp server}[filename]

SHOW [INTERFACE [E1 | S1 | S2 | S3]] {INFO | STATISTICS | FRAME-RELAY-DLCI}

(if no interface is specified, either current interface per "interface" cmd will be used, or all interfaces will be shown.)

SHOW ROUTER

Command Line Interface (continued)

```
SHOW IP ROUTES [LOCAL | RIP | STATIC]
SHOW IP STATISTICS

SHOW CONFIG ALL  (no arg is same as ALL)
SHOW CONFIG INTERFACE {E1 | S1 | S2 | s3}
(if no interface is specified, either current interface per "interface" cmd will be
used, or all interfaces will be shown.)

SHOW CONFIG IP [ALL | ROUTES]
SHOW CONFIG ROUTER

SHOW FILTER

CONFIG [TERM]

SAVE
END [SAVE]
RESTORE

ROUTER NAME namestring
ROUTER CONTACT contactstring
ROUTER LOCATION locationstring

IP DEFAULT-ROUTER address
IP COST NN
IP ROUTE addr[/mask] next-hop cost port dlci
IP DELETE addr

INTERFACE [E1 | S1 | S2 | S3]
TYPE   {RS232|RS449|RS530|56K|64KDDS|T1|E1|V.35}
PROTOCOL {ENGAGE|PPP|FRAME-RELAY}
POLL-CD {ON | OFF}
WAIT-CD {ON | OFF}
DTR {ON | OFF}
TIMEOUT NN
```

Command Line Interface (continued)

```
IP ADDRESS [addr/]mask
IP RIP {OFF | ON | LISTEN | SEND}

T1 DATA {NORMAL | INVERTED}
T1 CLOCKING {NETWORK | INTERNAL}
T1 LBO {CSU {0dB | -7.5dB | -15 dB | -22.5dB} | DSX-1
T1 FRAMING {ESF | D4}
T1 CODING {B8ZS | AMI}
T1 SPEED {56k | 64k}
T1 SPACING {ALTERNATE | CONTIGUOUS}
T1 CHANNELS NN XX

E1 DATA {NORMAL | INVERTED}
E1 CLOCKING {NETWORK | INTERNAL}
E1 FRAMING {CRC4 | FAS}
E1 CODING {HDB3 | AMI}
E1 CHANNELS {FULL | FRACTIONAL {NN XX}}
where NN is first E1 channel (1 - 31), XX is the numb
of channels

FILTER [IN|OUT]
PERMIT|DENY [INTERFACE {E1|S1|S2} .....
DELETE ALL

FRAME-RELAY N391 NN
FRAME-RELAY T391 NN
FRAME-RELAY MANAGEMENT {ANNEX-D | LMI}
```

Appendix K: TCP/IP Example - Frame Relay to the Internet

I. Scenario: You contract with an Internet Service Provider (ISP) for Dedicated Internet access over Frame Relay at 56 Kbps, fracT1 or full T1

II. The ISP should provide you with the following information

A	TCP/IP address range	• Depending on ISP service, will range from a small subnet with 6 Host IDs (IP addresses) to a full Class C with 254 Host IDs. ISP will assign one of the addresses for your router
B	Subnet mask	• Sets number of Host IDs: 255.255.255.248 allows 6, 255.255.255.0 provides 254 Host IDs
C	Default Router or Gateway	• IP address of the router at ISP to which your router should direct all Internet traffic
D	Serial Port IP Addr & Subnet m	• IP address of your WAN port (optional)
E	DLCI	• The "address" of your Frame connection to ISP
F	Frame Mgmnt Type	• Set by the Telco, ISP should provide
G	Domain Name Server	• IP address of DNS at the ISP

III. So... you configure your Router and Software as follows:

A Router Configuration

1. Netw Config - TCP/IP	**Sample Values**	**Comment**
IP Address	205.1.1.1	One IP addr from in II A above
Subnet Mask	255.255.255.0	As provided by ISP - see II B
Default Router	197.212.13.1	As provided by ISP - see II C
Routing Cost	1	Leave with default
Broadcast Address	All 1's	Leave with default
Use RIP	not checked	Probably Not Used by ISP...
Static Route #1		....ISP will use static routes
Net Addr	197.212.13.0	"0" addr of Def Rtr's Network
Subnet Mask	255.255.255.0	Mask of Default Router's net
Router Addr	197.212.13.1	Default Router IP Addr
Hops	1	distance to Default Router
Port	1	your router port to ISP
DLCI:	16	As provided by ISP - II E above

2. Port Menu - Port Configuration

Port Type Select according to hardware configuration:

- 56K DSU/CSU if router optioned w/ internal DCE
  usually set Data: Normal
- Use fracT1/full T1 DSU if router is optioned
  usually set TxCk: Net
  Line Coding & Framing per telco frac or full T1 per service type
- RS232 or V.35 as appropriate for external DCE
  note: set Jumpers accordingly

3. Port Menu - WAN Interface

Interface Type	Frame Relay	The WAN protocol
Management Type	LMI/ANSI Annex D	Specified by ISP or Telco (II F)
IP Addr	10.223.10.17	Only if provided by ISP (II D)
Subnet Mask	255.255.255.192	Only if provided by ISP (II D)

B Workstation Settings

Each workstation must be configured to allow communication over the LAN and WAN

	Sample Values	**Comment**
1. IP Address	205.1.1.2	Any valid Host ID (II A above)
2. Subnet mask	255.255.255.0	Same for all on LAN (II B)
3. Default Gateway	205.1.1.1	Engage Router IP Addr
4. Domain Name Server	198.23.251.1	ISP provides (II H above)

Appendix L: TCP/IP Example - 2 Way Subnet to the Internet

I. Scenario: Existing Site 1 has a Router, Internet Access and a full Class C address. User must add a Site 2, using another WAN Router connection, and subnet the Class C address.

II. Current Configuration - Overview of Site 1

Site 1 Class C Network	201.99.88.0	Identified by its "0" addr
Site 1 Subnet Mask	255.255.255.0	Mask for ALL Hosts at Site 1
Site 1/Router1	201.88.99.1	IP addr of current router
ISP Router Addr	159.33.44.1	"First" IP addr at ISP
Domain Name Server	159.33.45.1	At the ISP

III. New Configuration - Overview of Site 1 & Site 2

Site1 Subnet	201.99.88.0	Valid Host IDs: .1 to .126
Site2 Subnet	201.99.88.128	Valid Host IDs: .129 to .254
Site1&2 Subnet Mask	255.255.255.128	Masks for All Hosts at all sites

Current router connection to the Internet remains at Site 1
Engage routers added at Site 1 and Site 2 for new WAN link

III. IP Configuration Highlights: All Routers and Workstations

A. Site2 Router - New Engage Router installation

1. Network Config - TCP/IP

		Comment
IP Address	201.99.88.129	
Subnet Mask	255.255.255.128	
Default Router	201.88.99.1	
Routing Cost	1	Leave with default
Broadcast Addr	All 1's	Leave with default
Use RIP	not checked	
Static Route #1		
NetAddr	201.99.88.0	"0" addr of Default Rtr's subnet
Mask	255.255.255.128	Mask of Default Router's subnet
Router	201.99.88.2	Next Router IP addr
Hops	1	distance to Default Router
Port	1	Site2 Router port to Default Rtr
DLCI:	(blank)	not used - Frame Relay only

2. WAN Interface on Port 1

Interface Type	Engage	Engage to Engage default
IP Addr		Leave blank if Engage to Engage
Subnet Mask		Leave blank if Engage to Engage

B. Site2 Workstation Settings

IP Address	201.99.88.xxx	Avail. Host IDs: .130 to .254
Mask	255.255.255.128	Masks for All Hosts at all sites
Def. Gateway	201.99.88.129	the local (Site 2) router
DNS	159.33.45.1	ISP Domain Name Server Addr

C. Site1/Router 1 – Existing Router

1. LAN Config – TCP/IP		**Comment**
IP Address	201.99.88.1	
Subnet Mask	255.255.255.128	
Default Router	159.33.44.1	ISP router
Routing Cost	1	Leave with default
Broadcast Addr	All 1's	Leave with default
Use RIP	not checked	
Static Route #1		**Existing Route to ISP**
NetAddr	159.33.44.0	Note: Existing router already
Mask	255.255.255.0	.. has this route – Static Route
Router	159.33.44.1	.. format varies w/ vendor
Hops	1	
Static Route #2		**New Static Route to Site 2**
NetAddr	201.99.88.128	"0" addr of Site 2 subnet
Mask	255.255.255.128	
Router	201.99.88.2	Next Router IP addr
Hops	1	distance to Default Router
Port	E	Site 2 accessed via Ethernet
2. WAN Configuration		Will not change

D. Site 1/Router 2 – New Engage Router Installation

1. Network Config – TCP/IP		**Comment**
IP Address	201.99.88.2	
Subnet Mask	255.255.255.128	
Default Router	201.99.88.1	Existing router – on same LAN
Routing Cost	1	
Broadcast Addr	All 1's	
Use RIP	not checked	
Static Route #1		**Static Route to Site 2**
NetAddr	201.99.88.128	"0" addr of Site 2 subnet
Mask	255.255.255.128	
Router	201.99.88.129	Next Router IP addr
Hops	1	distance to Default Router
Port	1	Site 2 accessed via Port 1
DLCI	**(blank)**	
2. WAN Interface on Port 1		
Interface Type	Engage	Engage to Engage default
IP Addr		Leave blank if Engage to Engage
Subnet Mask		Leave blank if Engage to Engage

E. Site1 Workstation Settings

IP Address	201.99.88.xxx	Avail. Host IDs: .3 to .126
Mask	255.255.255.128	Masks for All Hosts at all sites
Def. Gateway	201.99.88.1	IP addr of Existing router
DNS	159.33.45.1	ISP Domain Name Server Addr

F. ISP Router – Subnetting your Class C has no effect on ISP

Appendix M: TCP/IP Example - 4 Way Subnet to the Internet

I. Scenario: User implements a Frame Relay WAN with Internet access.

- **User has a full Class C IP network to subnet between 3 sites**
- **User will keep half the IP addresses for Site 1 and split the remaining addresses between Sites 2 and 3.**
- **User has 3 Frame PVCs: one each from Site 1 to Site 2, Site 3 & ISP**
- **User installs a one port Engage Router at each of the three sites**

II. The Facts

User's Class C			203.55.66.0	Identified by its "0" addr
DLCIs:	PVC1	Site 1: 22	Site 2: 16	PVC between Site 1 and Site 2
	PVC2	Site 1: 23	Site 3: 17	PVC between Site 1 and Site 3
	PVC3	Site 1: 24	ISP: 102	PVC between Site 1 and ISP
ISP Router Addr			159.33.44.9	Typically the ISP router serial port
ISP Router Subnet mask			255.255.255.248	Typical mask for ISP router
Domain Name Server			159.33.45.1	At the ISP
User's Serial Port Addr			159.33.44.10	Assigned to user by ISP

III. IP Configuration Highlights: All Routers and Workstations

A. Site 1 Router

1. Network Config - TCP/IP		**Comment**
IP Address	203.55.66.1	Example: use 1st address of subnet
Subnet Mask	255.255.255.128	Site 1 subnet mask
Default Router	159.33.44.9	ISP Router
Routing Cost	1	Leave with default
Broadcast Addr	All 1's	Leave with default
Use RIP	not checked	
Static Route #1		**Static Route to the ISP**
NetAddr	159.33.44.8	"0" addr of Default Rtr's subnet
Mask	255.255.255.248	Mask of Default Router's subnet
Router	159.33.44.9	Next Router IP addr
Hops	1	distance to Default Router
Port	1	port which connects to ISP
DLCI:	24	DLCI for PVC to the ISP
Static Route #2		**Static Route to Site 2**
NetAddr	203.55.66.128	"0" addr of Site 2 subnet
Mask	255.255.255.192	Site 2 subnet mask
Router	203.55.66.129	Site 2 router
Hops	1	Site 2
Port	1	port which connects to Site 2
DLCI:	22	DLCI for PVC to Site 2

A. Site 1 Router (cont'd)

Static Route #3		**Static Route to Site 3**
NetAddr	203.55.66.192	"0" addr of Site 3 subnet
Mask	255.255.255.192	Site 3 subnet mask

Router	203.55.66.193	Site 3 router
Hops	1	distance to Default Router
Port	1	port which connects to Site 3
DLCI:	23	DLCI for PVC to Site 2

2. WAN Interface on Port 1

Interface Type	Frame Relay	
Frame Mgmnt	LMI or ANNEX D	specified by Telco or ISP
IP Addr	159.33.44.10	As assigned by ISP
Subnet Mask	255.255.255.248	As assigned by ISP

B. Site 1 Workstation Settings

IP Address	203.55.66.XX	Avail. Host IDs: .2 to .126
Mask	255.255.255.128	Site 1 subnet mask
Def. Gateway	203.55.66.1	the local (Site 1) router
DNS	159.33.45.1	ISP Domain Name Server Addr

C. Site 2 Router

1. LAN Config - TCP/IP		**Comment**
IP Address	203.55.66.129	Example: use 1st address of subnet
Subnet Mask	255.255.255.192	Site 2 subnet mask
Default Router	203.55.66.1	Site 1 router
Routing Cost	1	Leave with default
Broadcast Addr	All 1's	Leave with default
Use RIP	not checked	
Static Route #1		**Static Route to Site 1**
NetAddr	203.55.66.0	Site 1 Subnet
Mask	255.255.255.128	Site 1 Subnet mask
Router	203.55.66.1	Site 1 Router
Hops	1	
DLCI:	16	DLCI for PVC to Site 1

2. WAN Interface on Port 1

Interface Type	Frame Relay	
Frame Mgmnt	LMI or ANNEX D	specified by Telco or ISP
IP Addr	leave blank	not req'd for Engage to Engage
Subnet Mask	leave blank	not req'd for Engage to Engage

D. Site 2 Workstation Settings

IP Address	203.55.66.XX	Avail. Host IDs: .130 to .190
Mask	255.255.255.192	Site 2 subnet mask
Def. Gateway	203.55.66.129	the local (Site 2) router
DNS	159.33.45.1	ISP Domain Name Server Addr

E. Site 3 Router

1. LAN Config - TCP/IP		**Comment**
IP Address	203.55.66.193	Example: use 1st address of subnet
Subnet Mask	255.255.255.192	Site 3 subnet mask
Default Router	203.55.66.1	Site 1 router
Routing Cost	1	Leave with default

Broadcast Addr	All 1's	Leave with default
Use RIP	not checked	
Static Route #1		**Static Route to Site 1**
NetAddr	203.55.66.0	Site 1 Subnet
Mask	255.255.255.128	Site 1 Subnet mask
Router	203.55.66.1	Site 1 Router
Hops	1	
DLCI:	17	DLCI for PVC to Site 1

2. WAN Interface on Port 1

Interface Type	Frame Relay	
Frame Mgmnt	LMI or ANNEX D	specified by Telco or ISP
IP Addr	leave blank	not req'd for Engage to Engage
Subnet Mask	leave blank	not req'd for Engage to Engage

F. Site 3 Workstation Settings

IP Address	203.55.66.XX	Avail. Host IDs: .194 to .254
Mask	255.255.255.192	Site 3 subnet mask
Def. Gateway	203.55.66.193	the local (Site 3) router
DNS	159.33.45.1	ISP Domain Name Server Addr

G. ISP Router Requires a single static route to Site 1
Subnetting your Class C has no effect on ISP

Appendix N

Console Port Information

Advanced /Standard Model Routers

Nine Pin (db9 female) Console Port Pinout

db9 pin	Signal Name
2	RxData
3	TxData
4	DTR
5	GND
7	RTS

Engage Supplied db9M/db25F Adapter

db9 pin	db25 pin
1	8
2	3
3	2
4	20
5	7
6	6
7	4
8	5
9	22

Engage Supplied Null Modem db25 M/F

1	1
2	3
3	2
5,6,8	20
7	7
20	5,6,8

XL Model Console Port: RJ45

RJ45 Console Port Pinout

RJ45 pin	Signal Name
3	TxData
6	RxData
1	RTS
8	CTS
4	Gnd
2	DTR

RJ45/db25F Null Modem Adapter

RJ45 pin	db25 pin
3	3
6	2
1	5
4	7
2	6

Glossary: Terms and Concepts

Glossary

Terms and Concepts

Before using the Engage Router, you should be familiar with the terms and concepts that describe TCP/IP. If you are experienced with internet routers, these terms may already be familiar to you.

General Networking Terms

Network
A network is a collection of computers, server devices, and communication devices connected together and capable of communication with one another through a transmission medium.

Internet
An internet is any grouping of two or more networks connected by one or more internet routers.

Network Services
Network services are the capabilities that the network system delivers to users, such as print servers, file servers, and electronic mail.

Addresses
Transmitting information in a network system is made possible by an addressing scheme that identifies the sender and destination of the transmission, using network and node addresses. Data is transmitted to and from these addresses in the form of packets.

Routing Table
A routing table is maintained in each router. This table lists all networks and routers in the internet and enables routers to determine the most efficient route for each packet. The routing table serves as a logical map of the internet, specifying the address of the next router in the path to a given destination network and the distance in hops. The router uses the routing table to determine where and whether to forward a packet.

Each router periodically broadcasts its routing table to other routers on each of its directly connected networks, enabling them to compare and update their own tables with the most recent record of connected networks and routes. In this way, routing tables are kept current as changes are made on the internet.

Hop
A hop is a unit count between networks on the internet. A hop signifies "one router away."

Node
Device on the network

TCP/IP Networking Terms

FTP
File Transfer Protocol gives users the ability to transfer files between IP hosts. It uses TCP to provide connection initiation and reliable data transfer.

Host
A computer with one or more uses that can act as an endpoint of communication if it has TCP/IP.

ICMP
Internet Control Message Protocol provides a means for intermediate gateways and hosts to communicate. There are several types of ICMP messages and they are used for several purposes including IP flow control, routing table correction and host availability.

IP
Internet Protocol which routes the data.

IP Datagram
The basic unit of the information passed across and IP Internet. It contains address information and data.

PING
Packet InterNet Groper is a program which uses ICMP echo request message to check if the specifies IP address is accessible from the current host.

Port
A Destination point used by transport level protocols to distinguish among multiple destinations within a given host computer.

RIP
Routing Information Protocol provides a means for routers to exchange routing information. RIP's messages are encapsulated in UDP datagrams.

SubNet Address
An extension of the IP addressing scheme which enables an IP site to use a single IP address for multiple physical networks. Subnetting is applicable when a network grows beyond the number of hosts allowed for the IP address class of the site.

TCP
Transmission Control Protocol ensures reliable, sequential, delivery of data. TCP at each end of the connection ensures that the data is delivered to the application accurately, sequential, completely and free of duplicates. The application passes a stream of bytes to TCP which breaks it into pieces, adds a header, forming a segment, and then passes each segment to IP for transmission.

Telnet
The TCP/IP standard protocol for remote terminal connection service. A user can telnet from the local host to a host at a remote site.

UDP
User Datagram Protocol provides simple, efficient protocol which is connectionless and thus unreliable. The IP address contained in the UDP header is used to direct the datagram to a specific destination host.

Well-Known Port
Any set of port numbers reserved for specific uses vy transport level protocols (TCP & UDP). Well-known ports exist for echo servers, time servers, telnet and FTP servers.

Communication Link Definitions

Data Communication Equipment (DCE)
This interfaces to the communication service's transmission/reception medium, and includes T1 Voice/Data Multiplexors, 64/56 Kilobit DSU/CSUs, and Fiber Optic Modems. The DCE provides the transmit and receive data pathways, along with their synchronous clocking signals, that are used by the Engage Router's DTE interface for full duplex communication between the remotely interconnected networks.

Data Terminal Equipment (DTE)
This equipment, such as an Engage Router, attaches to the terminal side of Data Communication Equipment.

Data Carrier Detect (DCD)
A signal that indicates to the DTE that the DCE is receiving a signal from a remote DCE.

Data Terminal Ready (DTR)
Prepares the DCE to be connected to the phone line, then the connection can be established by dialing. Enables the DCE to answer an incoming call on a switched line.