



IP•Express
DLT1/DLE1
GT1/GE1
RS530/V.35
E²

User's Guide

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Chapter 1

Introduction

The IP•Express User's Guide provides the information network administrators require to install and operate any of the IP•Express WAN routers/bridges offered by Engage Communication, Inc.

The IP•Express family of WAN routers/bridges supports Internet Protocol, (IP), and is ideally suited for connections to the Internet as well as for Enterprise IP interconnectivity. IP•Express routers are available with a wide variety of WAN and LAN interface options offering flexibility and exceptional value for a wide range of routing environments.

About this Guide

Organization

Chapter 1 - *Introduction* provides a description of the User's Guide as well as a feature description for the DL, G, RS530, V.35 and E² router/bridge series which make up the IP•Express family.

Chapter 2 - *QuickStart* provides concise installation configuration to get the experienced user up and running in a minimum of time.

Chapter 3 - The *Network Planning* chapter offers a broad overview of IP addressing and routing.

Chapter 4 - *Installation* covers the physical environment and connections required when installing the routers.

Chapter 5 - *Configuration and Operation* discusses the initial configuration and ongoing operation utilizing the Command Line Interface, (CLI).

Chapter 6 - *Command Line Reference* provides a command-by-command description of the Engage CLI.

Chapter 7 - *Network Security* discusses IP filtering and other security concerns, with specific filter examples.

Chapter 8 - *Troubleshooting* common problems occurring during installation and normal operation.

Appendices - Router specifications, connector pinouts and crossover wiring details.

Glossary - Routing, Telecommunication and TCP/IP terminology.

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 IP•Express routers be familiar with network concepts and terms, such as network addressing and internets. This knowledge is central to an understanding of router services. Many terms are covered in the Glossary section.

The IP•Express Router Family

The IP•Express router family is made up of the DL and G models for connectivity to T1's and E1's, RS530 and V.35 routers and the IP•Express E². The following sections provide a breakdown of the different models and describe the wide range of features available.

DLT1

MUX WAN Router and Bridge with two intergrated T1 DSU/CSU's

The IP•Express DLT1 interconnects remote LANs and addresses the connectivity in the multi-megabit bandwidth range such as high quality MPEG Video delivery. The Integration of the T1 CSU provides for a complete solution with a straight forward configuration.

GT1

WAN Router and Bridge with four intergrated T1 DSU/CSU's

The IP•Express GT1 interconnects remote LANs and addresses connectivity in the multi-megabit bandwidth range such as high quality MPEG Video delivery. The Integration of the T1 CSUs provide for a complete solution with a straight forward configuration.

GT1-DI

IP T1 WAN Router and Bridge with T1 Drop and Insert Mux

IP•Express•MLT-DI-Hub is a Wide Area Network router that routes the Internet Protocol through an T1 Interface that is Multiplexed with a built-in Drop and Insert Mux. Wide Area Networking Point to Point and Frame Relay Protocols, with 24/7 proven interoperability, are fully supported on the T1 channels allocated to the internal WAN Router.

MLT-DI-H

IP T1 WAN Router with T1 Drop and Insert Mux and four port 10/100BaseT Hub

IP•Express•MLT-DI-Hub is a Wide Area Network router that routes the Internet Protocol through an T1 Interface that is Multiplexed with a built-in Drop and Insert Mux. Wide Area Networking Point to Point and Frame Relay Protocols, with 24/7 proven interoperability, are fully supported on the T1 channels allocated to the internal WAN Router. An integrated Four Port 10/100BaseT Ethernet Hub provides a complete branch office T1 Mux solution.

DLE1

MUX WAN Router and Bridge with two intergrated E1 DSU/CSU's

The IP•Express DLE1 interconnects remote LANs and addresses the large market for connectivity in the multi-megabit bandwidth range such as high quality MPEG Video delivery. The Integration of the E1 CSUs provide for a complete solution with a straight forward configuration.

GE1

WAN Router and Bridge with four integrated E1 DSU/CSU's

The IP•Express GE1 interconnects remote LANs and addresses the large market for connectivity in the multi-megabit bandwidth range such as high quality MPEG Video delivery. The Integration of the E1 CSUs provide for a complete solution with a straight forward configuration.

GE1-DI

IP E1 WAN Router and Bridge with E1 Drop and Insert Mux

IP•Express•MLE-DI-H is a Wide Area Network router that routes the Internet Protocol through an E1 Interface that is Multiplexed with a built-in Drop and Insert Mux. Wide Area Networking Point to Point and Frame Relay Protocols, with 24/7 proven interoperability, are fully supported on the E1 channels allocated to the internal WAN Router.

MLE-DI-H

IP E1 WAN Router with E1 Drop and Insert Mux and four port 10/100BaseT Hub

IP•Express·MLE-DI-H is a Wide Area Network router that routes the Internet Protocol through an E1 Interface that is Multiplexed with a built-in Drop and Insert Mux. Wide Area Networking Point to Point and Frame Relay Protocols, with 24/7 proven interoperability, are fully supported on the E1 channels allocated to the internal WAN Router. An integrated Four Port 10BaseT Ethernet Hub provides a complete branch office E1 Mux solution.

Routers RS530, RS232, V.35

IP•Express RS530, RS232 and V.35 are Wide Area Network routers that route the Internet Protocol through a synchronous serial WAN port. The RS530/RS232/V.35 WAN ports support Point to Point and Frame Relay Wide Area Networking Protocols with 24/7 proven interoperability.

LAN to LAN IP•Express E2

The IP•Tube E2 is used to interconnect Ethernet LANs through an IP network. Ethernet frames that are destined for a device located on the remote network are encapsulated into IP packets. The IP packets, with the encapsulated Ethernet frames, are sent to the IP address of the destination network's IP•Tube E2 where the IP envelope is removed and the original Ethernet Frames are delivered to the destination network's Ethernet device.

Special Features

The Inverse Packet Multiplexer feature

Engage's Inverse Mux technology truly doubles, triples or quadruples the bandwidth between two locations by splitting each packet in half, thirds, quarters and sending the fragments on line 1,2,3,4 for reassembly at the receiving side. Fault tolerance is built-in so that if one line goes down the packet traffic is sent over the working connections.

Internet Protocol T1 Inverse Packet Multiplexor Inverse Multiplexing is an optional feature of the IP•Express·DLT1-IPM. The T1 Inverse Mux delivers 3 Megabits of interconnectivity over Dedicated and Frame Relay WANs. Built in T1 line fault detection provides for automatic bandwidth backup.

Internet Protocol E1 Inverse Packet Multiplexor Inverse Multiplexing is an optional feature of the IP•Express·DLE1-IPM. The E1 Inverse Mux delivers 4 Megabits of interconnectivity over Dedicated and Frame Relay WANs. Built in E1 line fault detection provides for automatic bandwidth backup.

IP•Express GT1-IPM is a high performance, bandwidth scalable, IP WAN router with 4 T1 ports offering a standards-based inverse packet multiplexing, (N x T1), capability. The 4 T1 ports are able to be N x T1 inverse packet multiplexed to remote locations from 3 Mbps to 6 Mbps.

IP•Express GE1-IPM is a high performance, bandwidth scalable, IP WAN router with 4 E1 ports offering a standards-based inverse multiplexing, (N x E1,) capability. The 4 E1 ports are able to connect to 4 remote locations or to be N x E1 inverse packet multiplexed to remote locations from 4 Mbps to 8 Mbps.

SNMP Support

All Engage products support Simple Network Management Protocol, (SNMP) version 1. SNMP support provides access via IP to groups of administrative, configuration-related, and statistical information objects about the Engage device. An Ethernet connection to the device and a PC with an application which provides an SNMP version 1 client are required.

Chapter 2

Installation QuickStart

This QuickStart is intended for users familiar with the configuration of IP routers using a command line interface who require only the specifics of Engage IP•Express configuration.

Initial communication with the router, including assignment of IP addresses, is covered first. Example configurations follow. The examples cover the most common applications for the IP•Express DLT1/DLE1, GT1/GE1, RS530/232, V.35 and E2 series.

Initial Communication with the Router

The following are methods of communicating with the Engage router for initial assignment of an IP address. Use either method when configuring a new router or a router with an unknown IP address.

Console Port

IP•Express router and bridge models are equipped with a Console port permitting serial communication using the Command Line Interface, (CLI), detailed in Chapter 6: *Command Line Interface*.

The Console port is an RJ45 to DB9 adapter. The port is configured as a DTE, (data terminal equipment), port. The RJ45 to DB9 adapter is provided with the router which provides a physical interface, permitting direct connection to DCE equipment, such as a workstation or PC.

The terminal program for use with the Console port should be configured for serial communication at:

9600 Baud, 1 Stop Bit, No Parity, 8 bit fixed, flow control none

On first establishing the connection the user should login as **root**.

No password is configured initially.

Telnet (This method is specifically for the ML-DI)

Another method of assigning an IP address to the router employs telnet. Power up the router and immediately attempt a telnet connection to the desired IP address. If the Telnet session returns a timeout failure, 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. There is no password set initially. Set the password with the command, **Passwd**. 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 5: *Configuration and Operation* for further detail on this method of IP address assignment.

Note: 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.

Editing and Saving Configurations

Users of the Command Line Interface have the option of editing standard Engage configuration examples and “pasting” them to the router. 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. Existing static routes configured in the router may not necessarily be altered, resulting in bad routes.

To obtain a router configuration for offline editing, from a configured router, issue the command:

show configuration all

and save the response listing to a file.

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 Configurations

Common IP•Express configurations are detailed in this section. The command line configuration listing is shown for each example and text file versions of the listings are provided on a disk which ships with each IP•Express router.

Example 1: Basic IP•Express Connection for Enterprise

Scenario

This basic IP•Express router example illustrates the minimum configuration required to achieve a fully functional network connection between two sites which are not connected to the global Internet. IP addressing requirements are greatly simplified when the user can assign private, (or reserved), IP addresses, such as those shown here, rather than work within the constraint of globally unique IP addresses. For further information on IP addressing, see Chapter 3: *Network Planning*.

The IP networks must be unique at each site. This differs from bridged networks which maintain a single IP network across the two sites.

For example, site 1 uses an IP addresses within network 192.168.1.0/24 and site 2 utilizes the network address 192.168.2.0/24. Note the following:

- A typical convention is to assign the routers the first address in the block. Here the first ethernet router is configured to 192.168.1.1 and the remaining addresses, 192.168.1.2 to 192.168.1.254 are available for devices on the site 1 network.
- If the enterprise network contains more IP networks than the two created here, the IP•Express routers should be configured with a default gateway to enable them to route to other networks. Consider another site 1 router 192.168.1.254 provides connectivity to other enterprise networks. This will serve as the default gateway for both IP•Express routers.
- The use of numbered serial interfaces, IP addresses assigned to the serial ports, is optional. In this example the serial interfaces are unnumbered.
- RIP, a routing protocol, is enabled on the serial interfaces. Router 2 learns of the 192.168.1.0 network from router 1, and router 1 learns of the 192.168.2.0 network from router 2, eliminating the need to configure those static routes. Further information is available in the description of RIP provided in Chapter 5: *Command Line Interface*.
- Although the complete router configuration is listed below, the majority of the parameters

remain at their default setting. In fact, this configuration will function properly with the configuration of a just the ethernet IP address and, if required, the default gateway for each router.

Command Line Listing - Router 1

Config

Router Name "Router 1"
Router Contact "Admin"
Router Location "5 Broad St."

IP Default-router 192.168.1.254

IP Cost 1

#Static Routes: Network Next Hop Cost Interface DLCI

IP Address 192.168.1.1/24

IP Broadcast ONES, address 255.255.255.255

IP RIP On

Interface TEL1

Type T1

Protocol PPP

DTR On

T1 Data Normal
T1 Clocking Network
T1 LBO CSU 0dB
T1 Framing ESF
T1 Coding B8ZS

IP RIP On

Command Line Listing - Router 2

Note: The configuration for router 2 can be identical to that above with the exception of the ethernet IP address and the optional router informational items. Router 2 should be configured as:

IP Address 192.168.2.1/24

Example 2: IP•Express - Multiple Routes to Multiple Sites

Scenario

This sample configuration shows a dual port IP•Express which has multiple static routes, pointing to multiple IP networks/subnetworks. Routes are shown to remote networks and subnetworks via serial ports. Other networks are accessed via other routers, (200.10.10.1 and 200.10.10.3), on the same ethernet LAN segment.

Only the relevant configuration commands are included.

Command Line Listing

IP Default-router 200.10.10.1

#Static Routes:	Network	Next Hop	Cost	Interface	DLCI
IP Route	157.22.234.0/23	200.10.10.1	1	T1	
IP Route	201.21.21.0/24	201.11.11.1	1	S1	
IP Route	202.12.12.64/26	202.12.12.65	1	S2	
IP Route	203.13.13.128/25	202.12.12.65	1	S2	
IP Route	204.14.14.0/24	200.10.10.3	1	T1	

```
IP Address 200.10.10.2/24
IP Broadcast ONES, address 255.255.255.255
IP RIP On
```

Interface S1

```
Type          T1
Protocol      PPP
DTR           On
T1 Data       Normal
```

```
IP Address 201.11.11.2/30
IP RIP Off
```

Interface S2

```
Type          T1
Protocol      PPP
DTR           On
T1 Data       Normal
```

```
IP Address 202.12.12.66/26
IP RIP Off
```

Example 3: IP•Express DLT1-IPM Inverse Multiplexing 2 T1 lines

Scenario

This sample configuration shows a connection between two dual port T1 IP•Express routers utilizing Engage's Inverse Packet Multiplexing (IPM). By combining the bandwidth of two T1s, the user obtains a throughput of 3 Mbps. The configuration for one of the routers is provided below. Note the following:

- The RIP routing protocol is enabled over the WAN connections. This ensures a level of redundancy. Should one T1 link fail all traffic is automatically routed over the working link. Additionally, no static routes are required pointing to the opposite LAN
- Inverse Packet Multiplexing functions only with the PPP WAN protocol
- Inverse Packet Multiplexing requires that port 1 of the local router connect to port 1 of the remote unit and port 2 to port 2
- Query the status of the IPM with the command **Show Inverse-Mux**
- The default router resides on the same LAN as the IP•Express Ethernet interface, therefore no static route is required to point to the default router

Command Line Listing

```
config
Router Name "IPEXpress DL-2T1-IPM"
Router Contact "John Hill"
Router Location "6th Street"
```

```
IP Default-router 10.1.1.1
Inverse-Mux      On
```

Interface LAN1

```
Autonegotiation On
IP Address 10.1.1.2/24
IP RIP On
Arp Off
```

Interface TEL1

```

Type T1
Protocol PPP
T1 Data          Normal
T1 Clocking      Network
T1 LBO           CSU      0dB T1 Framing      ESF
T1 Framing       ESF
T1 Coding        B8ZS
T1 IdleCharacter 0x7e
T1 Channels      Full

```

```
IP Address 000.000.000.000
```

```
IP RIP On
```

Interface TEL2

```

Type T1
Protocol PPP

T1 Data          Normal
T1 Clocking      Network

T1 LBO           CSU      0dB
T1 Framing       ESF
T1 Coding        B8ZS
T1 IdleCharacter 0x7e
T1 Channels      Full

```

```
IP Address 000.000.000.00
```

```
IP RIP On
```

Example 4: Drop and Insert Mux Application with IP•Express ML-DI-E1**Scenario**

Engage IP•Express MLDI models provide dual T1 or E1 ports plus the Drop and Insert Mux capability to permit the utilization of a single T1 or E1 line for both IP data traffic and PBX voice traffic. Additionally, the unit has an integrated four port 10BaseT hub, providing a one-box networking solution in many applications.

The customer data network (LAN) connects to any of the ethernet ports and data traffic is routed between the IP•Express ethernet interface (designated interface **e1** in the CLI) and the TELCO interface (designated interface **s1**).

The customer voice network, typically a connection to a PBX, connects to the DS1 port. This connection typically requires a T1 crossover cable - see *Appendices* for pinout. PBX voice traffic is carried between the DS1 port (interface **s2**) and the TELCO port (interface **s1**).

In this example the E1 bandwidth is divided evenly between data and voice traffic, with E1 channels 1-15 utilized for data and E1 channels 16-30 utilized for voice.

Also note the following:

- Bandwidth configuration is required for interface **s1** only. The remaining E1 bandwidth is automatically assigned to interface **s2**. If interface **s2** is allocated partial bandwidth, idle characters are transmitted out the unallocated channels, disrupting the IP data routing path.
- In contrast, the PBX which connects to the DS1 interface (**s2**) must be configured for just the channels of the E1 interface which it will utilize - in this example E1 channels 15-30.

- The T1 or E1 clock source must be synchronous between the TELCO interface (s1) and the DS1 interface (s2). This is accomplished by setting the E1 Clocking to Network for interfaces s1 and s2.
- One potential issue for T1 applications involves the use of the 24th channel for "D" signaling by some PBX systems. This can result in the PBX mistakenly interpreting IP data on that channel as voice calls. The PBX should be configured to not utilize this 24th channel as signalling.

Command Line Listing

```
Router Name "IPEXpress MLDI-E1"
Router Contact "Ted Arnold"
Router Location "1101 Broadway"
```

```
IP Default-router 10.1.1.1
```

```
#Static Routes:Network      Next Hop      Cost Interface  DLCI
IP Route  201.34.22.0/24    10.5.1.1     1    S1
```

```
IP Address 10.1.1.2/24
IP RIP On
```

Interface S1

```
Type E1
Protocol Engage
DTR On
E1 Data      Normal
E1 Clocking  Network
E1 Framing   CRC4
E1 Coding    HDB3
E1 Channels  Fractional 1 15
IP RIP On
```

Interface S2

```
Type E1
Protocol Engage
DTR On

E1 Data      Normal
E1 Clocking  Network
E1 Framing   CRC4
E1 Coding    HDB3
E1 Channels  Full
```

```
#Note that TEL2 configuration is set to FULL
#Interface TEL2 is automatically assigned the bandwidth not utilized by TEL1
```

```
IP RIP Off
```

Example 5: IP•Express GT1 - Leased Line to an ISP

Scenario

This sample configuration details an IP•Express connection to an Internet Service Provider (ISP) with a leased fractional T1 (FT1) connection running PPP. The hardware in this example is the IP•Express XL with internal T1 DSU/CSU configured for fractional T1 at 512 Kbps.

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

- ISP assigns User a full Class C for LAN: 205.1.1.0/24

- ISP assigns User serial port IP addr: 10.223.10.18/30
- ISP has as its serial port IP addr: 10.223.10.17/30

Command Line Listing

```
Router Name "Anders Corp"
Router Contact "Bob Smith"
Router Location "1st St"
```

```
#Specify the default router, here the ISP serial port IP addr
IP Default-router 10.223.10.17
```

```
#One static route is included to the default router. Access to default router
#is through serial port 1. DLCI is blank since connection is not frame relay.
```

```
# Static Routes: Network      Next Hop    Cost Interface  DLCI
IP Route      10.223.10.16/30  10.223.10.17  1   S1
```

```
#Router Ethernet Interface parameters:
```

```
IP Address 205.1.1.1/24
IP RIP On
```

```
#Router Serial Interface 1 parameters:
```

Interface S1

```
Type T1
Protocol PPP
DTR On
```

```
T1 Data          Normal
T1 Clocking Network
T1 LBO           CSU      0dB
T1 Framing       ESF
T1 Coding        B8ZS
```

```
#
T1 Channels      Fractional      START CHANNEL  NUMBER OF CHANNELS
                  1                8
```

```
#If using full T1, that command reads:
```

```
#T1 Channels      Full
```

```
IP Address 10.223.10.18/30
IP RIP Off
```

```
#ISP will not be running RIP over the serial interface
```

Example 6: IP•Express DL-E1**Scenario**

This sample configuration details an IP•Express connection over a leased E1 connection running PPP. The hardware in this example is the IP•Express XL-E1 with internal E1 DSU/CSU configured for full E1.

Command Line Listing

```
Router Name "IPEXpress DLE1"
Router Contact "Francois"
Router Location "HQ"
```

```
IP Default-router 205.1.34.1
```



```
# Static Routes: Network      Next Hop      Cost  Interface  DLCI
IP Route      209.23.44.0/24  10.223.10.17  1       s1
```

```
#Router Ethernet Interface parameters:
Interface E1
IP Address 205.1.34.2/24
IP RIP On
```

```
#Router Serial Interface1 parameters:
```

Interface S1

```
Type E1
Protocol   Engage
DTR        On
```

```
E1 Data           Normal
E1 ClockingNetwork
E1 Framing CRC4
E1 Coding   HDB3
E1 Channels           Full
```

```
IP Address 10.223.10.18/30
IP RIP Off
```

Example 7: Network and Port Address Translation

Scenario

This sample configuration shows an Engage IP Express router translating private network addresses to a global IP address. The NAT function performs IP Port Address Translation (PAT) on a single Global IP address. The NAT also provides a type of firewall by only allowing communication to those connections that are established from the internal side of the network. NAT enables users to create networks with large blocks of internal addresses without being restricted to a very limited supply of global addresses. NAT simplifies network administration by permitting more flexible internal addressing schemes.

- Internal, private address range: 192.168.1.0/24
- External globally routable address: 200.100.50.1/32

Command Line Listing

```
Router Name "Corp Router"
Router Contact "James"
Router Location "Cook Rd."
```

```
IP Default-router 10.10.10.2
```

```
NAT ON
NAT GLOBAL ADDRESS 200.100.50.1
```

```
#Static Routes:      Network      Next Hop      Cost  Interface  DLCI
```

```
Interface E1
IP Address 192.168.1.1/24
IP Broadcast ONES, address 255.255.255.255
IP RIP On
```

Interface S1

```
Type T1
Protocol PPP
DTR On

IP Address 10.10.10.1/30
IP RIP Off
```

Example 6: IP•Express G-E1

Scenario

This sample configuration details an IP•Express connection over a leased E1 connection running PPP. The hardware in this example is the IP•Express XL-E1 with internal E1 DSU/CSU configured for full E1.

Command Line Listing

```
Router Name "IPEXpress GE1"
Router Contact "Francois"
Router Location "HQ"
```

```
IP Default-router 205.1.34.1
```

```
# Static Routes: Network Next Hop Cost Interface DLCI
IP Route 209.23.44.0/24 10.223.10.17 1 s1
```

```
#Router Ethernet Interface parameters:
```

```
Interface E1
IP Address 205.1.34.2/24
IP RIP On
```

```
#Router Serial Interface1 parameters:
```

```
Interface S1
Type E1
Protocol Engage
DTR On
```

```
E1 Data Normal
E1 Clocking Network
E1 Framing CRC4
E1 Coding HDB3
E1 Channels Full
```

```
IP Address 10.223.10.18/30
IP RIP Off
```

Example 7: Network and Port Address Translation

Scenario

This sample configuration shows an Engage IP Express router translating private network addresses to a global IP address. The NAT function performs IP Port Address Translation (PAT) on a single Global IP address. The NAT also provides a type of firewall by only allowing communication to those connections that are established from the internal side of the network. NAT enables users to create networks with large blocks of internal addresses without being restricted to a very limited supply of global addresses. NAT simplifies network administration by permitting more flexible internal addressing schemes.

- Internal, private address range: 192.168.1.0/24
- External globally routable address: 200.100.50.1/32

Command Line Listing

Router Name "Corp Router"
 Router Contact "James"
 Router Location "Cook Rd."

IP Default-router 10.10.10.2

NAT ON
 NAT GLOBAL ADDRESS 200.100.50.1

#Static Routes:	Network	Next Hop	Cost	Interface	DLCI
-----------------	---------	----------	------	-----------	------

Interface E1
 IP Address 192.168.1.1/24
 IP Broadcast ONES, address 255.255.255.255
 IP RIP On

Interface S1

Type T1
 Protocol PPP
 DTR On

IP Address 10.10.10.1/30
 IP RIP Off

Example 8: IP•Express GT1/GE1**Scenario**

This sample configuration shows a four port IP•Express QT1/QE1 which has one static route, pointing to a single IP network. All of the four WAN ports are active. When the inverse multiplex option is on as in this example, and the WAN ports are configured to run PPP the IP•Express QT1/QE1 will run multilink PPP.

Command Line Listing

Router Name "Receiver"
 Router Contact "No contact specified"
 Router Location "No location specified"

IP Default-router

Inverse-Mux On

Interface LAN1

IP Address 192.68.10.1/24
 IP Broadcast ONES, address 255.255.255.255
 IP RIP On

Interface TEL1

Type T1
 Protocol PPP

T1 Data	Normal		
T1 Clocking	Network		
T1 LBO		CSU	0dB
T1 Framing	ESF		
T1 Coding	B8ZS		
T1 Channels	Full		

IP Address

IP RIP On

Interface TEL2

Type T1

Protocol PPP

T1 Data	Normal		
T1 Clocking	Network		
T1 LBO	CSU	0dB	
T1 Framing	ESF		
T1 Coding	B8ZS		
T1 Channels	Full		

IP Address

IP RIP On

Interface TEL3

Type T1

Protocol PPP

T1 Data	Normal		
T1 Clocking	Network		
T1 LBO	CSU	0dB	
T1 Framing	ESF		
T1 Coding	B8ZS		
T1 Channels	Full		

IP Address

IP RIP On

Interface TEL4

Type T1

Protocol PPP

T1 Data	Normal		
T1 Clocking	Network		
T1 LBO	CSU	0dB	
T1 Framing	ESF		
T1 Coding	B8ZS		
T1 Channels	Full		

IP Address

IP RIP On

Example 9: IP•Express E2

Scenario

This sample configuration shows a IP•Express E2 interconnecting two LANs and having a default router that is on the second LAN.

Command Line Listing

```
Router Name "IP Express E2"
Router Contact "Francisco Francisco"
Router Location "Suite 200"
```

```
IP Default-router 192.168.2.15
```

Interface LAN1

AutoNegotiation On
IP Address 192.168.3.1/24
IP Broadcast ONES, address 255.255.255.255
IP RIP On

Interface LAN2

AutoNegotiation On
IP Address 192.168.2.2/24
IP Broadcast ONES, address 255.255.255.255
IP RIP On
IP Cost 1
IP Broadcast ONES, address 255.255.255.255
IP RIP On

Chapter 3

IP Network Planning

This chapter provides basic information on network planning for IP internetworks. Included are descriptions of IP addressing conventions as well as rules for connecting IP networks with IP•Express routers to form internetworks.

TCP/IP and Wide Area Networks

TCP/IP identifies a suite of protocols used in internetworks. In addition to the TCP and IP protocols, well-known protocols in the suite include FTP, a file transfer protocol; ICMP, a control message protocol which includes ping packets; RIP, a routing protocol; and several others.

Wide Area Networking is primarily concerned with the IP protocol and the proper routing of IP packets between different physical locations. IP, the internet protocol, is the lowest level protocol of the TCP/IP suite. It operates at layer 3 - the Network Interface layer - of the ISO 7-layer Reference Model.

IP Addressing

Every device or host on an IP network must be assigned a unique IP address. Hosts include workstations, servers, printers, and routers. 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:

192.168.1.5

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:

255.255.255.0

It may be represented in a shorthand fashion indicating the number of ones, e.g. /24. In this way a typical IP address for a host on a network would be written:

192.168.1.5/24.

In this example the Net ID is the first three bytes, 192.168.1 and the Host ID is the last byte, 5. Possible values for the Host ID in a /24 subnet range from 1 to 254.

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.

An IP network is typically identified by the lowest order Host ID. Thus the above network would be identified as 192.168.1.0/24. Not that this is not a valid IP address, instead it specifies a valid IP network.

Global vs. Private IP Addresses

IP addresses on the global Internet must be unique. For any connection to the Internet, the user should obtain IP address space from their ISP or directly from ARIN, the American Registry for Internet Numbers, (www.arin.net), or other international registering bodies.

An autonomous network, not connected to the Internet, is not restricted to the use of globally unique addresses. For enterprise users not connecting to the Internet, it is advised they utilize IP addresses from the following three blocks of IP address space which are reserved for private internets:

10.0.0.0 to 10.255.255.255

172.16.0.0 to 172.31.255.255

192.168.0.0 to 192.168.255.255

An enterprise that utilizes the reserved IP addresses above can do so without coordinating with an Internet registry.

Network Address Translation (NAT) permits conservation of public IP addresses. For a simple enterprise application connecting a network of users to the Internet, a single public, (globally unique), IP address can serve a network of users who have been assigned private, (reserved), IP addresses.

Routing between Networks

The primary rules for creating internets are:

- The IP Net ID for every physical network must be unique
- The IP Host ID for all devices within a net/subnet must be unique

Routers provide interconnections between IP networks. A simple LAN router with two ethernet ports could connect two different IP networks:

192.168.1.0/24

192.168.2.0/24

The router would ensure that communication between workstation 192.168.1.45 and server 192.168.2.101, for example, can occur.

Wide Area Network routers, such as the IP•Express, route between their respective ethernet networks in the same way. A connection between two IP•Express units, one with ethernet 192.168.1.1 and the other with ethernet 192.68.2.1 provides connectivity between the networks.

Note: The IP networks on the two ethernets must be different, in compliance with the Net ID rule above.

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:

<u>4 Byte Representation</u>	<u>Number of 1's</u>
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:

<u>Address Range</u>	<u>Mask</u>	<u>Representation</u>
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

Multicasting Using Engage Routers

There are a few things needed to set up the IP•Express for Multicasting.

- Bridging must be set to ‘OFF’ for both units
- The sending IP•Express (encoder side) must have a static route to the receiving unit for the multicast address
- The receiving IP•Express (decoder side) must have ARP turned on so it can correctly formulate the MAC Address for the multicast packets

For Example:

Encoder Side:

Bridging Off

```
# Static Routes: Network Next Hop Cost Interface DLCI
IP Route 209.23.44.0/24 10.223.10.17 1 s1
```

Decoder Side:

Bridging Off

Interface LAN1

Arp On

Arp Address 224.0.1.2 01:00:5E:00:01:02

NOTE: The MAC Address prefix is always 01:00:5E for multicast. The lower 23 bits of the multicast IP Address are mapped onto the lower 24 bits of the MAC Address.

Chapter 4

Installation of the IP•Express Router

This chapter provides details on the physical connections required to form WAN networks using Engage IP•Express routers. Also covered is the initial communication with the router. References are made to the configuration and operation of the routers as well as to the Command Line Interface, (CLI). These topics are covered in detail in their respective chapters.

Installation Requirements

The use of Engage IP•Express routers/bridges to enable functionality on a wide area network requires one router at each side of a synchronous connection. Any Engage router can be connected to any other Engage router. Engage routers, with support for the Point-to-Point Protocol (PPP), and Frame Relay interoperability standards, can also connect to any other manufacturer's routers that support these WAN protocols.

A standard IP•Express Router package includes:

- One Engage IP•Express router
- One or more installed WAN interfaces, (T1/E1 DSU/CSU, RS530, RS232, V.35)
- Console port adapter
- RJ45 or other cables for optionally installed WAN interfaces
- An appropriate power converter, (110 or 220 VAC input)
- Engage documentation disk
- Owner registration card

Router Installation Steps

The process of installing an IP•Express router on the network involves the following steps:

- Planning for network configuration and security
- Installing the router hardware
- Configuring the router for the local area network
- Connecting and configuring any external data comm equipment
- Connecting and verifying the WAN connection

Planning for Network Configuration & Security

To avoid conflicts with network addressing as well as unauthorized access to sensitive areas of the private network, it is advisable to have complete network address information available to verify that the new network addresses are unique. Determine in advance which networks/subnetworks need to be filtered and determine which networks/subnetworks should be blocked from access by remote network users.

For more information on network security, please see Chapter 6: *Network Security*.

Installing the Hardware

Locating the Engage router

Site consideration is important for proper operation of the IP•Express router. The user should install the router in an environment providing:

- A well-ventilated indoor location
- Access within six feet of a power outlet
- Two feet additional clearance around the unit to permit easy cabling connection

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

Powering the IP•Express

Engage IP•Express routers utilize an external 110/220 power adapter with 15-24 VDC output. (Other configurations for alternative sources of power are available. Contact Engage Communications for details.)

Ensure the power adapter is not connected to power Plug the AC adapter into the rear panel POWER connector

Power On

Connect the power adapter to an appropriate AC power outlet and 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.

Ethernet Interface

The IP•Express DLT1, DLE1, GT1 and GE1 and E2 models provide specific information, with TD and RD indicators providing status on packet transmission and receipt, respectively, on the Ethernet interface. In addition, FDX and LNK indicators provide status on Duplex and connectivity, respectively, on the Ethernet interface:

- When connected to an Ethernet Network, LNK will show a steady GREEN
- When in Full Duplex mode, FDX will show a steady GREEN. No light indicates Half Duplex
- The RD and TD will flash Green on transmission or reception of packets through the router's Ethernet interface

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 on 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 Connections.

Initial Communication with the Router in a TCP/IP environment

The recommended approach for safely configuring the IP address of an “unknown” router for use on an IP network relies on 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. When the connection is made and **Return** is entered, a **Login** prompt will appear. Enter the username **Root** to open the session. No password is set initially. Use the command **PASSWD** to set a new password.

Once an IP address and an address for the Default Router has been assigned, you can **Telnet** into the router from anywhere on the Local Area Network and continue configuration of the unit or complete the configuration via the console port.

Connecting and Configuring WAN Interfaces

Engage IP•Express models are available with a variety of WAN and Serial interfaces. Some models integrate digital telecommunication interfaces into the router, such as units with T1 or E1, fracT1/E1 DSU/CSU's. Other models provide synchronous serial interfaces for use with external Data Communication Equipment, (DCE).

Serial Interface Connections

For those IP•Express models providing alternative serial interfaces, such as RS-530, RS-232 or V.35, the connection to external equipment is made using standard synchronous, male-to-male, one-to-one cables:

- 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
- Male-to-male refers to the connectors at each end of the cable
- 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

WAN Interface Connections

The WAN connection of an IP•Express with integrated DSU/CSU is made utilizing a straight-thru RJ45 cable. The cable terminates in the SmartJack or other interface installed by the telecommunication service provider. For bench testing, a connection between two IP•Express units can be made using a crossover cable. See the *Appendices* for DSU/CSU cabling pinouts and crossover cables.

Note: Connection of an unconfigured router to a T1 line can overload the router with framing errors, making communication with the router over the LAN difficult. Always configure the router's T1 interface prior to connection to the live T1 line. To reduce the risk of fire, use only No. 26 AWG or larger, listed telecommunication line cord.

Verifying the WAN Connection

The Engage router's connection to a remote router can be verified by the active port interface LED's. Although the port LEDs are specific to the Engage router model used, they do share common characteristics:

- When the IP•Express negotiates a layer two protocol with the remote router, the port LNK LED turns GREEN, and remains GREEN as long as communication with the remote router continues
- The FDX LED, when GREEN, is an indication of a Full Duplex connection. No light indicates Half Duplex
- When the Engage router detects transmission or reception of packets, the TD and RD LEDs will blink GREEN

Chapter 5

Command Line Interface

Configuration of IP•Express routers is accomplished using the Engage Command Line Interface, (CLI). Command Line access to the router can be made through the Ethernet port across a LAN connection or via the Console port.

For communication through the Ethernet port, **Telnet** is used. Telnet is part of the TCP/IP Protocol Suite, and 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 IP connectivity between the User Host and the router.

For communication through the Console port, standard serial communication software is used. The console port can be used to communicate with the router locally through a terminal.

Communication with the console port should be set as:

9600 baud, 1 stop bit, no parity, 8 bit fixed, flow control none

The RJ45 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. For connection to other DTE, such as a terminal, a Null Modem adapter is required. An appropriate cable and adapter are provided with the IP•Express for use with standard 9 pin COM ports.

Console Port

On first establishing the connection the user should login as **root**.

No password is configured initially.

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 is **root**.

Engage routers are shipped with no password set. Passwords are set or modified with the **passwd** command, detailed below.

Overview of the Engage CLI

A full description of the Engage Command Line Interface follows. 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 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:

- `routename#` the single “#” indicates standard Telnet mode
- `routename##` double “#” indicates Configuration mode
- `routename(TEL1)##` router is in Interface Config mode, TEL Port 1

To move up one level, from Interface Config mode to Config mode, enter the **Interface** command with no argument. To change between interfaces when in Interface Config mode, specify the new interface. For example:

```
routename(TEL1)## Interface TEL2
```

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 apply an complete configuration. Using a cut and paste operation, configurations may be edited off-line and stored and/or pasted back into the interface.

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.

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 {LAN1 | LAN2 | TEL1 | TEL2 | TEL3 | TEL4 | ALL}

Clears the port statistics on the selected port, Ethernet or Serial Ports.

TERM NN

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

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

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} [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 by configuring a TFTP server with the appropriate upgrade file and connecting to that server over the network.

Please see Table - Engage Flash Upgrade Instructions

Example:

UPGRADE 192.168.1.1 26_72_82_upgrade.upg

Ensure IP connectivity between the IP•Express and the TFTP server by pinging from one to the other. Then issue the upgrade command.

Note: An IP•Tube which is running an upgrade must go through a reset. This may cause a Telnet connection to drop. If this does occur, simply re-establish the Telnet connection.

SHOW Commands

SHOW [INTERFACE [LAN1 | LAN2 | TEL1 | TEL2 | TEL3 | TEL4]] {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 routes 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 methodology for storing a router configuration into a local text file. The full configuration can be edited offline.

SHOW CONFIG INTERFACE {LAN1 | LAN2 | TEL1 | TEL2 | TEL3 | TEL4}

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

Provides overall router configuration information including hardware configuration, ethernet MAC address, uptime, etc.

SHOW SSHD INFO

Use the Show Info or Show SSHD Info to determine the state of the SSHD Server.

SSHD Information**SSHD: Off**

The SSHD server is configured off. No connections are accepted. If configured On, on unit start up the SSHD server will be in this state for a very short time until the SSHD server is started.

SSHD: No Host Key, Run SSHD HostKey Enter

A connection was attempted, but the SSHD server does not have a valid host key. Use the SSHD HostKey Enter command to configure a valid host key. Do not enter a pass phrase.

SSHD: Stopped

A brief transient state when SSHD is stopped during a configuration save operation.

SSHD: Running - No active session

The SSHD Server is running and ready to accept incoming connections, but no session is currently active.

SSHD: Running - Session active

An SSH session is currently active.

CONFIGURATION Commands

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 changes.

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, to the default gateway. Typically set to 1.

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

Static Routes are entered using the **IP Route** command. 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:

<u>IP Address Range</u>	<u>Subnet Mask</u>	<u>addr/mask value</u>
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 LAN1, LAN2, TEL1, TEL2, TEL3 and TEL4
- 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 LAN1 19
- ip route 204.99.13.64/26 204.99.13.65 1 LAN1 103
- ip route 207.22.88.8/29 207.22.88.9 1 LAN1

Note: All Static Routes require an explicit IP Network Address. User should configure a route to the IP network on which the Default Router resides, if not on a directly connected network.

A route to 0.0.0.0 is not permitted, instead the default router's IP address is specified.

IP DELETE addr

Delete a static route.

CONFIG INTERFACE Commands

INTERFACE [LAN1 | LAN2 | TEL1 | TEL2 | TEL3 | TEL4]

Places router in the Interface Configuration mode for a specific **Interface**, or Port.

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. IP•Express routers support RIP v1.

OFF

RIP not enabled

ON

NOTE: The current **RIP** version doesn't communicate subnet information, therefore it may be necessary to add a static route depending upon the IP scheme.

LISTEN

Router will process incoming **RIP** packets, but will not Transmit **RIP**.

SEND

Router will transmit **RIP** information but ignore received RIP packets.

Note: RIP v1 has limitations relating to subnetting and variable length subnet masks. Because subnet mask information is not included in RIP v1 updates, it will not route properly to networks which have been subnetted. Therefore it is only useful when using full, "classful" IP networks. The following table defines IP address classes A, B and C, and the subnet mask that must be applied for RIP v1 to work properly.

Class	Lower Addr	Upper Addr	Required Subnet Mask
A	1.0.0.0	126.255.255.255	/8 (255.0.0.0)
B	128.0.0.0	191.255.255.255	/16 (255.255.0.0)
C	192.0.0.0	223.255.255.255	/24 (255.255.255.0)

Table 1 - 10/100BaseT Port Specification

For example, the Class C network 192.168.1.0 must utilize a 255.255.255.0 subnet mask in order for RIP v1 to route properly, while the Class A network 10.1.1.0 must utilize a 255.0.0.0 subnet mask.

TYPE {T1 | E1 | RS530 | RS232 | V.35}

Sets the port type. Port types T1 and E1 are only available with models which have the internal DSU/CSU installed.

PROTOCOL {ENGAGE | PPP | FRAME-RELAY}

Selects the Engage proprietary WAN protocol, or one of two standards-based WAN protocols.

POLL-CD {ON | OFF}

Applicable only to serial interfaces including RS-530 and RS-232. This defines whether the carrier detect, (CD), signal must be active to bring the WAN connection up.

WAIT-CD {ON | OFF}

Applicable only to serial interfaces. Set **On** to specify that the serial interface will operate in synchronous mode only when CD is asserted, otherwise it is in asynchronous mode.

DTR {ON | OFF}

Applicable only to serial interfaces and used for dialup connections, such as ISDN. This asserts the **DTR** control signal for the external DCE.

TIMEOUT NN

Used for dialup connections, such as ISDN. This permits setting a timeout after which the connection will be brought down in the absence of data.

Ethernet Interface

AUTONEGOTIATION {ON | OFF}

Enable or disable IEEE 802.3 **Autonegotiation** on the Ethernet interface.

DUPLEX {HALF | FULL}

Sets the duplex mode for the Ethernet interface. This command only takes effect when **Autonegotiation** is configured to **Off**.

Note: If the device connected to LAN1 or LAN2 uses **Autonegotiation** and LAN1 or LAN2 is configured to

use full duplex without **Autonegotiation**, the other device may operate in half duplex mode by default and successful operation cannot be guaranteed.

SPEED {10 | 100}

Sets the line rate in Mbps for the Ethernet interface. This command only takes effect when **Autonegotiation** is configured to **Off**.

IP ADDRESS address[/mask]

The interface IP address and subnet mask are required for configuration with telnet or connectivity tests with ping. The subnet mask can be entered in long or short form.

Examples:

- IP ADDRESS 192.168.1.1/255.255.255.0
- IP ADDRESS 192.168.1.1/24

IP BROADCAST [ONES | ZEROS | DIRECTED]

Assigns IP broadcast address for the Ethernet port. **ONES** assigns a broadcast address of 255.255.255.255, which is the default on most networks. **ZEROS** assigns a broadcast address of 0.0.0.0. **DIRECTED** assigns a broadcast address which is a multicast of the network address for the Ethernet port. For example, if the network address is 10.x.x.x, a directed broadcast address would be 10.255.255.255. Example:

IP BROADCAST ONES

The interface IP address and subnet mask are the only parameters required for the Ethernet interface. The subnet mask can be entered in long or short form.

Examples:

- IP ADDRESS 192.168.1.1/255.255.255.0
- IP ADDRESS 192.168.1.1/24

BROADCASTRCV {OFF | ON}

The Ethernet interface can be configured to disable the reception of Broadcast and Multicast packets. The IP protocol uses broadcast packets to resolve the Ethernet MAC Address of the destination IP.

BROADCASTRCV OFF requires that the Destination IP•Express or the Default Router and any local device that wants to communicate with the IP•Express needs to be configured with the MAC address of the unit in its ARP table. Due to the complexity involved in setting up the IP Address to Ethernet MAC addresses manually it is recommended that **BroadcastRCV** is set to **On** unless broadcast storms are expected on the network where the IP•Express' reside.

Typically if **BroadcastRCV** is set to **Off** the Tube Ether ARP and Tube Ethernet Address need to be configured with the MAC address of the IP•Express packet's Ethernet destination, refer to **Interface TEL1**. Since the destination for the IP•Express packet will have its broadcast receive turned **Off** also.

SSHD Configuration Commands

SSHD {On | Off}

Enables or disables the SSH Server.

SSHD Port <port number>

Specifies the TCP port number for incoming SSH sessions.

SSHD HostKey Enter <OpenSSH DSA Key>

Configures the SSH Server host key. The SSH Server must have a host key for an SSH Client to accept a connection from the Server. The <OpenSSH DSA Key> must be in OpenSSH format.

Units shipped with this base firmware or later versions have an SSH Server host key already configured. Use this command to change the host key.

Units running base firmware that did not previously support SSH will need to run this command after an upgrade to a version that supports SSH.

Most SSH Client software have the facility to generate an OpenSSH host key. The text of a key generated by client software can be used as the <OpenSSH DSA Key> in the SSHD HostKey Enter command.

Note: When creating a key do not enter a pass phrase.

Note: There will be two keys generated when creating a key, use the file without the '.pub' extension.

Example:

OpenSSH provides the sys-keygen program. Run:
ssh-keygen -b 1024 -t dsa -f <filename>

ssy-keygen creates a private key in filename and a public key in filename.pub. Enter the text of the private key as the <OpenSSH DSA Key> in the SSHD HostKey Enter command.

SecureCRT can create an OpenSSH format private key. In the tools menu, select Create Public Key. Execute the Key Generation wizard to create a client key (the client key can be used as a host key). Choose type DSA and 1024 bits. Select OpenSSH format when it saves the private key in a file. Used the saved file as the input to the SSHD HostKey Enter command.

Changing a host key can have repercussions amongst clients. The next time they connect to the server, they may prompt the user if they want to continue even though the Server key has changed or refuse the connection entirely.

Troubleshooting SSHD

If an SSH client cannot make a connection to the IP•Express, check the following items.

Make sure the SSHD is configured on.

Check the SSHD Port number is the same as the Client attempting the connection.

Look at the "Show SSHD Info" status. Check if SSHD is On, or there is already a session active (only one allowed), or the host key is not valid.

Use the Client logging facilities to gather information about the failed connection attempt. For the OpenSSH client, use the -vvv option.

For the SecureCRT client, select the Raw Log Options from the File menu.

T1 Port Configuration Commands

T1 DATA {NORMAL | INVERTED}

Can be set for **Normal** or **Inverted** and must match the setting of the DSU/CSU on the other end.

T1 CLOCKING {NETWORK | INTERNAL}

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.

When set to **Internal**, the DSU/CSU transmits data at a rate set by an internal clock. This mode is used when testing on the bench.

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

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.

T1 FRAMING {ESF | D4}

Selects whether **Extended Super Frame, (ESF)**, or **D4** framing is to be used. Typically the T1 service pro-

vider specifies .

T1 CODING {B8ZS | AMI}

Selects whether **B8ZS** or **Alternate Mark Inversion, (AMI)**, line coding is used.

T1 SPACING {ALTERNATE | CONTIGUOUS}

Associated only with fractional T1, this parameter specifies whether the channels are **Alternating**, (every other channel), or **Contiguous**, (adjacent).

T1 CHANNELS {FULL | FRACTIONAL {NN XX}}

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

NN indicates the first channel to be included and **XX** is the number of channels used. Enter the location of the start channel, or DS0, of the fractional service. Minimum entry is "1".

Then enter the total number of channels used, seperated by a space.

E1 Port Configuration Commands

E1 DATA {NORMAL | INVERTED}

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

E1 CLOCKING {NETWORK | INTERNAL}

Determines the source of Transmit Clock (TxCk). When set to **Network**, the DSU/CSU derives its transmit timing from the received data, (RxD). When set to **Internal**, the DSU/CSU transmits data at a rate set by an internal clock. This mode is often used when testing E1 connections on the bench.

E1 FRAMING {CRC4 | FAS}

Selects whether **CRC4** Framing is enabled.

E1 CODING {HDB3 | AMI}

Selects whether **HDB3** or **Alternate Mark Inversion, (AMI)**, line coding is used.

E1 CHANNELS {FULL | FRACTIONAL {NN XX}}

Select **Full** or **Fractional** E1 and configure for **Fractional**, where **NN** is the first E1 channel, (1 - 31), **XX** is the number of channels to be used.

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 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 [LAN1 | LAN2 | TEL1 | TEL2 | TEL3 | TEL4]]

DELETE ALL**Config Inverse Multiplexor Commands**

Inverse Multiplexing provides commands to enable/disable and to query the status. If the Inverse Multiplexor option is not enabled on the IP•Express router, these commands will result in an "invalid command" response.

INVERSE MUX [ON | OFF]

Used to enable the Inverse Multiplexing mode.

SHOW INVERSE

Provides the status of the Inverse Multiplexing operation on each of the two ports.

Inverse-Mux On:

- Serial Port 1 Inverse Mux Status: **ACTIVE**
- Serial Port 2 Inverse Mux Status: **ACTIVE**

Note: **ACTIVE** occurs when both ports have successfully Inverse Multiplexed. Inverse Multiplexing requires the connection of Port 1 to Port 1 and Port 2 to Port 2 on the connected IP•Express routers.

Config Drop and Insert Shift Commands**ClockingMaster {TEL1 | TEL2 | TEL3 | TEL4} {Internal | Network}**

This is configured at the system level. This sets the Master Clock of the circuit. None of the Serial Interfaces will have an T1/E1 Clocking parameter.

TEL1StartDS0 [NN]

TEL1StartDS0 specifies how this port's DS0s are mapped onto TEL1. The position of this port's first specified channel is moved into the TEL1 DS0 position specified by TEL1StartDS0.

For example, if this port is using channels 5-8 and TEL1StartDS0 is 9, then this port's channels 5-8 are mapped onto TEL1 channels 9-12. If the TEL1StartDS0 is 1, then this port's channels 5-8 are mapped onto TEL1 channels 1-4.

Care must be taken to select each port's Channels and TEL1StartDS0 parameters so that they do not overlap on the TEL1 Channels. A warning message is displayed when there is a conflict and behavior is unspecified.

Channels None

Effectively turns off Serial Interface so no data will be sent to TEL1. Channels None is an addition to the existing Channels syntax which would make it:

T1/E1 Channels {Full | None | {Fractional {NN XX | {{NN | Y-Z}[,MM | ,Y-Z]}}}}

Example: If the TEL1 (WAN) channels are 1-5, the TEL2 channels are 1-16, and the TEL3 channels are 1-4, and you want TEL2 channels on 6-21 of TEL1, and TEL3 channels on 22-25 of TEL1, and turn off TEL4 data, it would look like this:

```
Interface S1
E1 Channels 1-5

Interface S2
E1 Channels 1-16
E1 TEL1StartDS0 6

Interface S3
E1 Channels 1-4
E1 TEL1StartDS0 22

Interface S4
```

E1 Channels None

Config NAT Commands

Network Address Translation provides commands to enable and disable the feature as well as for querying status. An "invalid" response will be returned if the **NAT** option is not installed.

NAT [ON | OFF]

Used to enable **NAT**

NAT GLOBAL ADDRESS addr

Used to enter the **Global Address** to which the IP•Express router is to respond.

SHOW NAT

Responds with the **NAT** enable/disable status and the configured **NAT** global address.

BERT Pattern Generation and Detection

NOTE: The BERT Patteren Generation and Detection was available on Legacy Equipment. This feature is not available in the current IP•Express DL and IP•Express G product

The built-in Bit Error Rate Tester, (BERT), allows the user to generate a variety of standard BERT test patterns on the T1 or E1 transmit path. Once a test pattern is configured for transmission out the interface, the **STATUS** of the receive path signal can be queried for the quality of the received test pattern.

The **BERT** function is assigned on a per-channel basis for both the transmitter and receiver. This allows configuration of **BERT** tests on a single DS0 or across multiple contiguous DS0s, up to and including the full T1 or E1.

Note: **BERT** Test patterns are Framed.

BERT tests are configured on a per-interface basis. The user must first specify the interface on which the **BERT** test is to be configured:

INTERFACE [TEL1 | TEL2]

There are nine **BERT** test arguments:

BERT [OFF | ON | DIRECTION | CHANNEL | PATTERN | RESYNC | ERROR | STATUS | CLEAR]

BERT OFF

Returns selected interface back to it's configured state.

BERT ON

Turns **On BERT** for selected serial interface.

Note: Any **BERT** test is turned **Off** after an IP•Express **RESET** or power cycle.

BERT DIRECTION [IN | OUT]

Configured for **OUT**, the **BERT** test pattern is transmitted out the selected Serial interface. This is the typical test mode. The **IN** configuration sends the **BERT** pattern into the system and is only valid for serial interface 2 (TEL2), in Drop and Insert configurations on the Engage MLDI model.

BERT CHANNELS [NN XX]

Configure the DS0(s) across which the **BERT** test pattern is transmitted and monitored. **NN** is the first channel to put the **BERT** Pattern into and **XX** is the number of channels to be used. T1 interfaces have DS0s numbered 1-24, while available DS0s for an E1 interface are 1-31.

BERT PATTERN [2E07 | 2E11 | 2E15 | QRSS]

Select the desired pseudorandom test patterns. **QRSS** is the most common.

- 2E07: 2^7-1
- 2E11: $2^{11}-1$
- 2E15: $2^{15}-1$
- QRSS: A $2^{20}-1$ pattern with 14 consecutive zeros

Note: **BERT** parameter changes take effect immediately upon entering them. **BERT** configurations must be saved if they are to be retained after a **RESET** or power cycle.

BERT RESYNC

Forces the receive **BERT** synchronizer to resynchronize to the incoming data stream. This command should be issued as needed to acquire synchronization on a new pattern.

BERT ERROR

Injects a single bit error in the pattern. Useful for confirming pattern detect.

BERT CLEAR

Clears Bits Transmitted and Bit Error counters for the selected port.

BERT STATUS

Queries the IP•Express for information on **BERT** configuration and test results. The **BERT STATUS** will report Sync when the incoming pattern matches for 32 consecutive bit positions. The **BERT STATUS** will lose Sync after receiving six errored bits out of 64 bits. Once synchronization is achieved, this bit will remain set until read.

An example of the results displayed with the **BERT STATUS** command:

- Bert TEL1 Status
- | Start End
- | Turned: On Direction: Out Channels: 1 12
- | Pattern: QRSS Pattern Synch: Yes Pattern Synch Lost: No
- |
- | Receive All Ones: No Receive All Zeros: No
- | Bits Transmitted: 3735398 Bit Errors: 0

In the above example note that:

- A BERT test is enabled on interface Serial 1, (TEL1)
- The BERT pattern is applied in the outbound direction of TEL1
- The BERT pattern is applied only on DS0s 1 through 12, not the entire T1
- QRSS is the BERT pattern in use
- The Receive circuitry has Synced, (locked), on to the incoming BERT pattern
- The Receive circuitry has no Lost Sync since BERT statistics were last cleared
- 3,735,398 bits transmitted since BERT statistics last cleared
- There have been 0 Errors received since BERT statistics were last cleared

Chapter 6

Configuration and Operation

Engage IP•Express routers are available with a variety of WAN and LAN interface options. This chapter describes the specific interfaces and features, and outlines their configuration and operation.

Numerous examples include Command Line Interface, (CLI), commands. Consult the *Command Line Interface* chapter for a complete listing of available configuration and query commands.

Interfaces and Features

The IP•Express family of WAN routers and bridges provide a wide variety of configurations to suit specific user requirements. Models range from the IP•Express DL, with dual Ethernet interfaces and a two WAN interfaces, to the IP•Express MLDI-Hub with Drop and Insert Multiplexing, 4 Ethernet hub ports and two serial interfaces.

Engage routers are fully interoperable with other vendors' routers through the use of the Point-to-Point (PPP), and Frame Relay WAN protocols.

Contact Engage Communication Sales for specific model numbers and configuration options.

Console Port

IP•Express routers provide a Console port for configuring the router. The Console port may be used to communicate with the router locally through a terminal.

IP•Express router models utilize an RJ45 jack for the Console port. The Console port is configured as a DTE (data terminal equipment), port. This allows for direct connection to a DCE (data communication equipment), device. An RJ45 to DB9 adapter is provided with each router.

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

Terminal communication to the console port should be set as:

9600 baud, 1 stop bit, no parity, 8 bit fixed, flow control none

When a connection is made to the router the **Login** prompt will appear. Enter the default username, **root**, to open the CLI session.

LAN Interfaces

IP•Express routers provide 10/100BaseT Ethernet LAN connections. Basic IP•Express models include 10/100BaseT ports while IP•Express-Hub versions have an integrated four port Ethernet hub.

All the IP•Express models include dual 10/100BaseT Ethernet LAN connections. The 10/100BaseT interfaces introduce new configuration parameters for interface LAN1:

- **Autonegotiate** On - Interface determines speed and duplex mode
- **Autonegotiate** Off - Speed and duplex are set manually
- **Speed** 10 or 100 - 10Mbps or 100Mbps
- **Duplex** - half or full

The 10/100BaseT interface connects via an Ethernet patch cable to an external Ethernet switch or hub. Configuration of the port involves setting the IP address and subnet mask, as well as broadcast address and other

parameters.

The integrated four port hub model eliminates the need for an external Ethernet switch or hub in a basic installation. Up to four workstations or other network devices can be connected to the hub.

The Ethernet physical, (MAC), address can be obtained by issuing the command **Show Router**.

Serial Port Interfaces

Engage IP•Express routers may be configured with up to four ports for Wide Area Network (WAN), connections.

T1/fractional T1 DSU/CSU Option

The internal T1/fracT1 DSU/CSU permits direct connection to a T1/fracT1 interface provided by the telecommunications service provider. This connection uses an RJ45 jack. 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 configuration items, including Line Coding, Framing and TxData timing, are configurable using the Command Line Interface.

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.

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/fractional E1 DSU/CSU Option

The internal E1/fractional E1 DSU/CSU permits direct connection to a E1/fracE1 interface as provided by the telecommunications service provider. This connection uses an RJ45 jack. E1/fracE1 circuits use pins 1&2 for RxData and 4&5 for TxData. An RJ45 to 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 and Framing, are configurable using the Command Line Interface.

Inverse Multiplexor Option

The Inverse Multiplexor Option is available on dual port DLT1, DLE1 and GT1/GE1 IP•Express models. A proprietary inverse multiplexing technology provides a highly efficient utilization of two T1 or E1 connections, yielding an aggregate bandwidth of 3 Mbps for T1, 4 Mbps for E1.

Connection between the two IP•Express routers must ensure that Port 1 on one unit connects to Port 1 on the other and Port 2 connects to Port 2.

The Inverse Multiplexor Option must be enabled with the CLI command

INVERSE-MUX [ON | OFF]

See Chapter 6: *Command Line Interface* for details on the configuration and status query for Inverse Multiplexing.

Drop and Insert Mux Option

Engage IP•Express MLDI models provide a Drop and Insert Mux capability to permit the utilization of a single T1 or E1 line for both IP data traffic and PBX voice traffic.

The customer data network, (LAN), connects to any of the Ethernet ports and data traffic is routed between

the IP•Express Ethernet interface, (designated interface LAN1 in the CLI), and the TELCO interface, (designated interface TEL1).

The customer voice network, typically a connection to a PBX, connects to the DS1 port. In most cases a Crossover T1 cable is required for this interconnection. See *Appendices* for Crossover T1 specifications. PBX voice traffic is carried between the DS1 interface and the TELCO interface.

Configuration of the Drop and Insert Mux option requires defining the T1 or E1 bandwidth division between data and voice traffic, with selected TELCO channels utilized for data and the remainder of the channels utilized for voice.

Note the following configuration highlights:

- Bandwidth configuration is required for interface TEL1 only. The remaining bandwidth is automatically assigned to interface TEL2. If interface TEL2 is allocated partial bandwidth, idle characters are transmitted out the unallocated channels, disrupting the IP data routing path
- In contrast, the PBX which connects to the DS1 interface must be configured for just the channels of the E1 interface which it will utilize
- The T1 or E1 clock source must be synchronous between the TELCO interface and the DS1 interface. This is accomplished by setting the T1 Clocking to Network for interfaces TEL1 and TEL2
- One potential issue for T1 applications involves the use by some PBX systems of the 24th channel for "D" signalling. This can result in the PBX mistakenly interpreting IP data on that channel as voice calls. The PBX should be configured so as to not designate this 24th channel as signalling.

Drop and Insert Shift Option

Similar to the Drop and Insert Mux Option (See Above), the Shift Option will allow utilization of a single T1 or E1 line for both IP data and PBX voice traffic.

With this added feature, it will be possible to add separate blocks of PBX voice traffic from up to three different sources. Once the bandwidth configuration for TEL1 is set for data traffic, the remaining bandwidth of the circuit is available to transmit blocks of voice traffic. This is accomplished by allowing a SHIFT of the block of DS0s being added to TEL1. This gives flexibility to stack the blocks of traffic to use the available channels on TEL1.

Configuration highlights:

- Ability to fill the remaining bandwidth of TEL1 with DS0 blocks from TEL2, TEL3 and TEL4.
- Care must be taken to ensure that there is no overlapping of DS0 channels on TEL1. When overlapping occurs the data on TEL1 is unspecified for the overlapped channels. A WARNING message appears if there are overlapping DS0s.

BERT Test

NOTE: The BERT Pattern Generation and Detection was available on Legacy Equipment. This feature is not available in the current IP•Express DL and IP•Express G product

IP•Express models provide a powerful E1 and T1 troubleshooting feature. This is a built-in Bit Error Rate Tester (BERT). This test feature enables the user to verify the functionality of the IP•Express and to pinpoint external problems with their E1 or T1 services.

BERT Pattern Generation/Detection

The built-in Bit Error Rate Tester (BERT), allows the user to generate a variety of standard BERT test patterns on the T1 or E1 transmit path, and to monitor and measure errors on those patterns in the receive path. The BERT patterns can be transmitted on a single DS0 or across multiple contiguous DS0s, including the full T1 or E1.

Chapter 7

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 inadvertently 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 TEL1 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

- Filter rules are applied in the order in which they were entered by the user.
- A packet will be checked against the rules until a match, either a permit or deny, is encountered. No further rules are checked.
- 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

- Generally the user will place Permit filters before Deny filters
- 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 [LAN1|LAN2|TEL1|TEL2|TEL3|TEL4]

The next prompt indicates selected interface:

RouterName (TEL2)##

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 (TEL2)##<

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{LAN1 | TEL1 | TEL2 | TEL3 | TEL4}}] [In | Out][src-addr[dest-addr]] [type] [options]

Permit or deny designates what action should be performed on the packet.

[Interface{LAN1 | TEL1 | TEL2 | TEL3}] 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 upon. 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.

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)
• nickname	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:

• nickname	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{LAN1 | LAN2 | TEL1 | TEL2 | TEL3 | TEL4}] [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: TEL1

Direction: In

	Source	Destination	Protocol	Protocol
Action	Address	Address	Type	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
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 test 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. If you have a Class C IP network 156.22.235.0/24, apply the following filter:

```
interface TEL1
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 LAN1
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:

- One host to FTP Out: 157.22.234.114
- Only FTP server 157.22.234.115 is accessible from the Internet
- All users on subnet 157.22.234.112/28 can Telnet Out, but no outside user may Telnet In

interface S1 or TEL1 for QT1/QE1 Models

```
# 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: Since there are no filters on serial port Out, all packets in that direction are allowed.

```
interface TEL1
```

```
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 8

Troubleshooting

Wide Area Network systems 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 or the Engage IP•Express 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 the Console Port, Telnet, 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 10/100BaseT hub to confirm a good connection. If necessary, create a stand-alone LAN with just a workstation and the router.

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.

Cause: Can not connect to a hub at 100 Mbps with Autonegotiate turned On. Connection drops to 10 Mbps at half duplex.

Solution: Change interface to match what the hub is configured for.

Can't Communicate with Router - TCP/IP

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 IP•Express 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 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, flow control none.

Cause: Transmit and Receive Data swapped.

Solution: The console port is configured as a DTE port. For connection to other DTE, such as a terminal, a Null Modem adapter is required.

High Ethernet Error Count

Cause: Bad cabling.

Solution: Check all cabling. Swap ports on 10/100BaseT hub to troubleshoot.

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

Unable to Communicate with the Remote Site

No Serial Port Transmit Data

Check whether the Serial Port Transmit Packet count is increasing by repeatedly issuing the command:

SHOW INTERFACE {TEL1 | TEL2 | TEL3 | TEL4} STATISTICS

Solution: Router is configured to transmit data only when the Carrier Detect signal is active. Ensure that the DCE does supply CD, (or DCD), or turn off the Engage router's sensitivity to Carrier Detect.

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.

No Serial Port Receive Data

Check whether the Serial Port Receive Packet count is increasing by selecting the Serial Port and monitoring "Packets Received" or by repeatedly issuing the command:

SHOW INTERFACE {TEL1|TEL2|TEL3|TEL4} 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.

Inverse Mux Connection Down

Cause: The two WAN interfaces, T1 or E1, are not connected one-for-one with the remote site.

Solution: Swap the WAN interfaces on one side to ensure Port 1 connects to Port 1 and Port 2 to Port 2.

Drop & Insert Mux Path not passing PBX data

Cause: PBX not configured to utilize only the T1 or E1 channels designated for the DS1 path.

Solution: PBX must be configured to utilize only the T1 or E1 channels which are not being utilized by the IP•Express for IP data. For example, if MLDI interface TEL1 is configured to utilize T1 channels 1-8, the PBX must be configured to use only the remaining channels 9-24.

Cause: IP•Express MLDI serial port TEL2, (DS1 port for PBX connection), is configured for fractional T1 or E1.

Solution: Interface TEL2 (the DS1 serial interface), should be configured for CHANNELS: FULL in all cases. It is automatically assigned the channels not assigned to TEL1.

Cause: Improper connection between PBX and IP•Express MLDI. A crossover T1 cable is typically required to connect the PBX to the IP•Express MLDI. See *Appendices* for crossover T1 cable specifications.

Test Suggestion: Local DTE Loop

If using the IP•Express with external DCE, 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. 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. DCE must supply TxC and RxC during Local Loop for the test to pass.

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 v1, which automates the exchange of routing information between routers and is suitable for simple IP network configurations. RIP v1 is not suitable for subnetted IP networks, in which case Static Routes must be used. Further information is available in the description of RIP provided in Chapter 6: *Command Line Interface*.

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 tel1 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.

SSHD Not Working

If an SSH client cannot make a connection to the IP•Express, check the following items.

Do not enter a pass phrase to create the host key.

Be sure to use the host key without the '.pub' extension.

Make sure the SSHD is configured ON.

Check that the SSHD Port number is the same as the Client attempting the connection.

Look at the "Show SSHD Info" status. Check if SSHD is On, or there is already a session active (only one allowed), or the host key is not valid.

Use the Client logging facilities to gather information about the failed connection attempt. For the OpenSSH client, use the -vvv option. For the SecureCRT client, select the Raw Log Options from the File menu.

Appendices

IP•Express Router Specifications

Ethernet Port

- 10/100 Mbps fixed transmission speed

LAN Protocol

- TCP/IP

WAN Protocols

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

Available WAN Interfaces

- RS-530/RS-232/V.35: DB-25 female
- Internal T1/fracT1 DSU/CSU
- Internal E1/fracE1 DSU/CSU

Power Supply

- Non-Hub Models - External 24 Volts AC, 1Amp, with standard AC plug. International power supplies available
- Hub Models - External 15-26 Volts DC, 1Amp terminal block connection. International power supplies available

Physical

- Standard 19 inch rack mount kit available
- Hub model dimensions: 9.45 x 7.2 x 1.63 inches
- Non-Hub model dimensions: 8.75 x 5.50 x 1.63 inches
- Weight: approximately 2 lbs., excluding external power adapter

IP•Express Router Specifications

Ethernet Port

- 10/100 BaseT Full/Half Duplex Ethernet
- Autonegotiation or configurable Speed and Duplex

Quality of Service Support

- Interoperability with RFC 1717

LAN Protocol

- TCP/IP

WAN Protocols

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

T1/Fractional T1 Specifications

- One to Four Port Models
- Connects directly to T1 Line or to a DS1 interface with a Crossover Cable
- Framing - ESF or D4
- Coding - B8ZS or AMI
- Supports DS0 assignments from 1 to 24

Up to four Available WAN Interfaces

- RS-530/RS-232/V.35: DB-25 female
- Internal T1/fracT1 DSU/CSU
- Internal E1/fracE1 DSU/CSU

Power Supply

- External 24 Volts AC, 1Amp, with standard AC plug. International power supplies are available from Engage.

FTP Online Upgrade Capable (FLASH ROMs)

- IP Express is fully operational during upgrade

Management

- Telnet support with Edit and Paste Template Files
- Console Port for Out of Band Management
- SNMP support (MIB I, MIB II)
- Remote configuration & monitoring

Physical

- Standard 19 inch rack mount kit available
- Dimensions: 9 x 7.3 x 1.63 inches
- Weight: approximately 3 lbs., excluding external power adapter

IP•Express Switch Settings

IP•Express models have a four position DIP switch accessible by removing the router rear panel and sliding out the motherboard.

The default setting for all DIP switches is **Off**.

Switch 1

Powering the router up when DIP Switch 1 is **On** forces the router to revert to certain default settings, including operation from Base Flash, deleting any download upgrades.

Switch 2

DIP Switch 2 should always be **Off**.

Switch 3

When DIP Switch 3 is **Off**, the router uses DIX Ethernet for IP broadcasts. When **On** the router uses IEEE 802.3 Ethernet.

Switch 4

DIP Switch 4 is used to clear IP filters. When the unit is powered on with DIP Switch 4 set **On**, all configured TCP/IP filters will be deleted, a good method for recovering from filter configuration errors. Return the switch to **Off** to ensure subsequent filter configurations are retained.

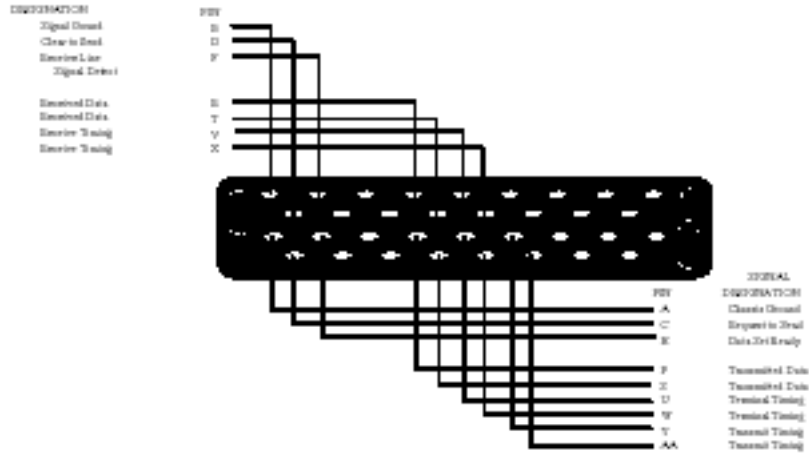
RS-530 Port Specification

The IP•Express RS-530 Interface is a DTE, (Data Terminal Equipment) interface, provided via a DB25 female connector.

DB25 Pin	Signal Name	In/Out
1	Shield	I/O
2	TD-A	O
3	RD-A	I
4	RTS-A	O
5	CTS-A	I
6	DSR-A	I
7	Gnd	I/O
8	CD-A	I
9	RC-B	I
10	CD-B	I
11	ETC-B	O
12	TC-B	I
13	CTS-B	I
14	TD-B	O
15	TC-A	I
16	RD-B	I
17	RC-A	I
18	N/C	
19	RTS-B	O
20	DTR-A	O
21	N/C	
22	DSR-B	I
23	DTR-B	O
24	ETC-A	O
25	N/C	

Table 2 - RS530 DTE Port Specification

V.35 Interface Specifications



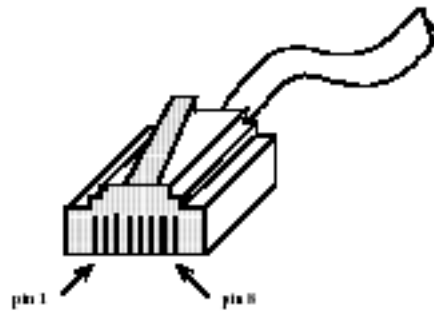
V.35 Cable Specifications

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	

Table 3 - RS530 DTE Port Specification

T1 and E1 Port Specification with Crossover Pinouts



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	Pin 4	(TxRing)
(RxTip)	Pin 2	to	Pin 5	(TxTip)

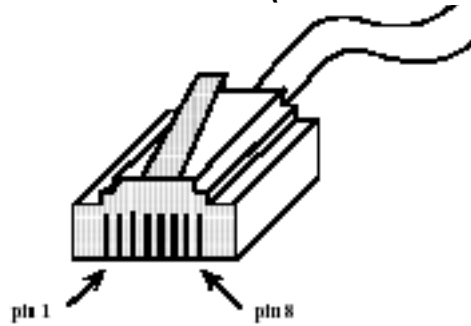
Table 4 - DSU/CSU Port Specification

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

Table 5 - DSU/CSU RJ45 to DB15 Modular Adapter Pinout

10/100BaseT Port Specification (w/ Crossover cable pin out)



100 BaseT 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 Pin 1 (TD+)
- (RD-) Pin 6 to Pin 2 (TD-)

Table 6 - 10/100BaseT Port Specification

Console Port Information

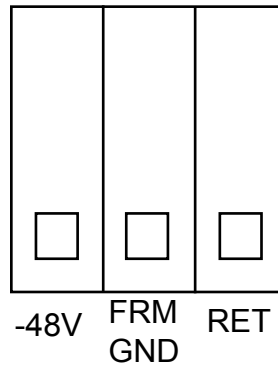
RJ45 Console Port Pinout

RJ45 pin	Signal Name
3	TxDData
6	RxDData
1	RTS
8	CTS
4	Gnd
2	DTR

RJ45/db9F Null Modem Adapter

RJ45 pin	db9pin
3	2
6	3
1	8
4	5
2	6

Table 7 - Console Port Pinout

-48V Interface Specifications

-48V:	-48 Voltage
FRM GND:	Frame Ground
RET:	Return

Table 8 - -48 Power Connector



Upgrade of Engage IP•Tube, IP•Express, BlackBond and BlackDoor Systems

General

This document outlines the procedure for upgrading Engage IP•Tube, IP•Express, BlackBond and BlackDoor system software.

Procedure

1. To determine the current system software and if running from Base or Upgrade Flash, issue the command **show router**
2. If currently running from the Upgrade Flash the unit must be downgraded back to Base Flash before installing a new Upgrade Flash image.
 - a. Issue the command **upgrade 1 1**
 - b. The unit will reboot and revert to Base Flash.
 - c. This will cause a Telnet connection to drop. If this does occur, simply re-establish the Telnet connection
3. The upgrade requires a local TFTP (trivial file transfer protocol) server. Shareware TFTP servers are available online, including <http://www.klever.net/kin/pumpkin/html>
4. Obtain the upgrade file, and unzip password if required, from Engage Communication Technical Support (tel +1-831-688-1021 or support@engageinc.com)
5. Place the .upg file in the appropriate directory on TFTP server.
6. Ensure IP connectivity between the Engage unit and the TFTP server by pinging from one to the other. Firewall software on the TFTP server may need to be disabled to permit TFTP sessions initiated from the Engage unit.
7. Upgrade by issuing the command **upgrade {tftp server addr} {upgrade filename}**
 - a. Example: **upgrade 192.168.1.1 26_72_82_upgrade.upg**
8. Notes:
 - a. When the upgrade is complete, the Engage unit will reboot, causing a Telnet connection to drop. If this does occur, simply re-establish the Telnet connection.
 - b. Upgrades which enable optional features (additional Ports, Compression, Protector, etc.) cause the Engage unit to revert to Base firmware. Any system software upgrades must be re-installed.



Xupgrade of Engage IP•Tube, IP•Express, BlackBond and BlackDoor Systems

General

This document outlines the procedure for xupgrading Engage IP•Tube, IP•Express, BlackBond and BlackDoor system hardware. This is to upgrade the system CPLD, not the system software.

Procedure

1. The xupgrade requires a local TFTP (trivial file transfer protocol) server. Shareware TFTP servers are available online, including <http://www.klever.net/kin/pumpkin/html>
2. Obtain the xupgrade file, and unzip password if required, from Engage Communication Technical Support (tel +1-831-688-1021 or support@engageinc.com)
3. Place the .xsvf file in the appropriate directory on TFTP server.
4. Ensure IP connectivity between the Engage unit and the TFTP server by pinging from one to the other. Firewall software on the TFTP server may need to be disabled to permit TFTP sessions initiated from the Engage Unit.
5. Upgrade by issuing the command ***xupgrade {tftp server addr} {upgrade filename}***
 - a. Example: ***xupgrade 192.168.1.1 IPTubeGX1_BigGlue_Rev3.xsvf***
6. Note that when the xupgrade is complete, the Engage unit will reboot, causing a Telnet connection to drop. If this does occur, simply re-establish the Telnet connection.

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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 by 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.