# MAX 1800
# ISP & Telecommuting
# Configuration Guide

*Ascend Communications*

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- The software and hardware options
- The software version
- Whether you are routing or bridging with your Ascend product
- The type of computer you are using
- A description of the problem

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# Introduction

# 1

This chapter covers these topics:

# Using the MAX as an ISP or telecommuting hub

The MAX is a high-performance WAN router that can be used to concentrate many incoming switched connections to a corporate backbone or to another network, such as the Internet or a frame relay network.

A switched connection is a temporary link between devices, established only for the duration of a call. When you use bandwidth-on-demand, the MAX adds and subtracts bandwidth as necessary, keeping connection costs as low as possible. Of course, the MAX also supports leased connections for those users whose connection times justify a permanent virtual connection to the backbone network.

The most common uses of the MAX are as an ISP (Internet Service Provider) hub, to manage many switched IP connections to the Internet, and as a telecommuting hub, to provide high-speed connections between a corporate backbone and remote locations. Its configuration options provide the flexibility you need to optimize your installation. Management features include a comprehensive set of control and monitoring functions and easy upgrades.

## Using the MAX as an ISP hub

Individuals subscribe to an Internet Service Provider to get a TCP/IP connection to the Internet. Subscribers dial in to a local Point-of-Presence (POP), typically using an analog modem, an ISDN V.120 terminal adapter (such as a BitSurfer), or an ISDN router such as an Ascend Pipeline. When it is used as an ISP hub, the MAX is configured as an IP router that establishes the dial-in WAN connection with subscribers and routes their data stream to other Internet routers.

Figure 1-1 shows a typical ISP configuration with three POPs. Each POP has at least one MAX on an Ethernet, with another Internet router (such as a Cisco router) on that LAN.

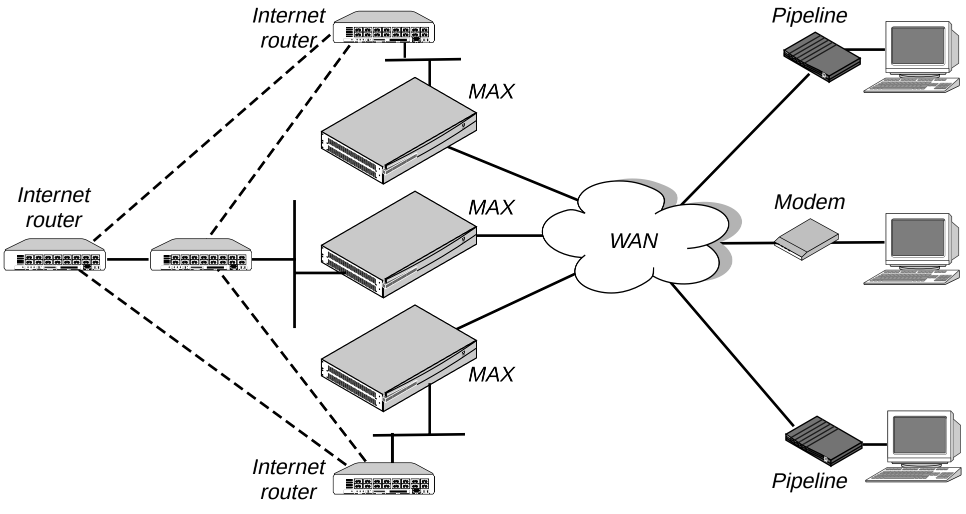


*Figure 1-1. Using the MAX as an ISP hub*

The MAX has BRI lines using ISDN signaling to connect to the WAN and handle the incoming switched connections. To connect to Internet routers, the MAX most often uses the local Ethernet, but it could also use serial WAN or frame relay.

The connections between Internet routers can be any high bandwidth connection ,such as frame relay, nailed T1, nailed E1, HSSI, FDDI, or Sonet. Large ISPs often support redundant MAX units and Internet routers on each Ethernet segment.

## Using the MAX as a telecommuting hub

Telecommuters are typically users at branch offices, at home, at customer sites, at vendor sites, and on the road. The MAX enables these remote users to access the corporate backbone just as though they were connected locally. The backbone may be a NetWare LAN, an IP network, or a multi-protocol network. Figure 1-2 shows an example where home users, remote offices, and customer sites access the backbone network.

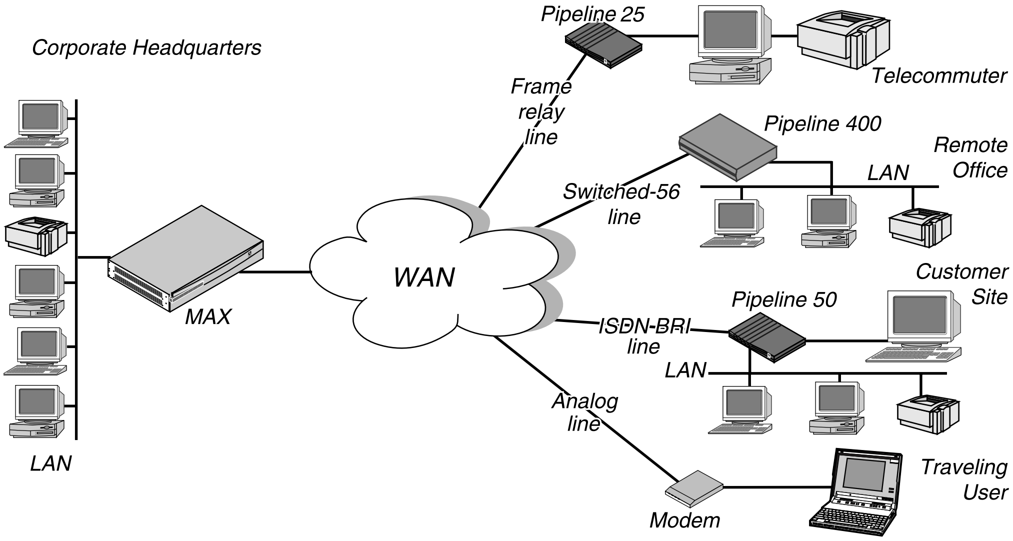


*Figure 1-2. Using the MAX as a telecommuting hub*

In this example network, a telecommuter in a home office logs into the corporate LAN using a Pipeline 25 and frame relay. Users on a remote office LAN access the backbone via a Pipeline 400 with a switched-56 connection. A customer can access selected corporate network resources using a Pipeline 50 with an ISDN BRI connection. A mobile user with an analog modem can dial into the backbone, provided that the MAX has a digital modem card installed.

Notice that each user can access the MAX through a different type of line. One user may access the MAX by using the switched services on an ISDN BRI or Switched-56 line, while another user might require a nailed 56K frame relay circuit.

# Overview of MAX configuration

This section provides an overview of how to configure the MAX. It covers these topics:

- Configuring the lines, channels, and ports, and how calls are routed between them
- Configuring wide area network connections and security
- Configuring the MAX as a frame relay or X.25 concentrator
- Configuring routing and bridging across the WAN
- Configuring Internet services, such as multicast, OSPF, and virtual private networks

## Creating a network diagram

Ascend strongly recommends that, after you have read this introductory material, you diagram your network and refer to the diagram while configuring the MAX.

Creating a comprehensive network diagram helps prevent problems during installation and configuration, and can help you troubleshoot problems later.

## Configuring lines, slots, and ports for WAN access

The MAX comes with eight built-in BRI lines and a V.35 serial port (8 Mbps). Each BRI line has a variety of configuration options, including telco options and channel-specific parameters. The way you configure each line affects how much bandwidth will be available and whether you can direct outbound calls to use specific channels. The way you configure channels depends on your connectivity needs.

The serial WAN port is typically used for a leased high-speed connection to a frame relay switch or to another WAN router. The port itself requires little configuration. Most of the required information is specified in a Frame Relay or Connection profile.

You can add expansion modules to support serial host ports modules to support videoconferencing, digital modems to support analog modem connections over digital lines, and V.110 modems to support V.110 connections. The lines and ports on the modules (cards) have their own configuration requirements, including the assignment of phone numbers and information about routing calls.

Once you have enabled the lines, slots, and ports for WAN access, you need to configure the manner in which calls will be routed to them (for dial-out access to the WAN) and routed from them to other destinations (such as the local network).

## Configuring WAN connections and security

When the MAX receives packets that require establishment of a particular WAN connection, it automatically dials the connection. Software at the both ends of the connection encapsulates each packet before sending it out over the phone lines. Each type of encapsulation supports its own set of options, which can be configured on a per-connection basis to enable the MAX to interact with a wide range of software and devices.

After a connection’s link encapsulation method has been negotiated, the MAX typically uses a password to authenticate the call. Authentication and authorization are both described fully in the *MAX Security Supplement*. Following are some of the connection security features supported in the MAX:

- Authentication protocols

  For PPP connections, the MAX supports both PAP (Password Authentication Protocol) and CHAP (Challenge-Handshake Authentication Protocol). CHAP is more secure than PAP, and is preferred if both sides of the connection support it.
- Callback security

  You can specify that the MAX call back any user dialing into it, which ensures that the connection is made with a known location.

- Caller-ID and called-number authentication

  You can restrict who can access the MAX by verifying the caller-ID before answering the call. You can also use the called number to authenticate and direct the call.
- Authentication servers

  You can offload the authentication responsibility to a RADIUS or TACACS server on the local network.
- Security-card authentication

  The MAX supports hand-held personal security cards, such as those provided by Enigma Logic and Security Dynamics. These cards provide users with a password that changes frequently, usually many times a day. Support for dynamic passwords requires the use of a RADIUS server that has access to an authentication server, such as an Enigma Logic Safe-Word AS or Security Dynamics ACE authentication server.
- Terminal server security

  After a dial-in user has passed the initial connection security, another password can be required for access to the MAX terminal services. Within the terminal server, you can restrict which commands are accessible to users, or prevent them from executing any command other than Telnet.
- Filters and firewalls

  Filters and firewalls provide a packet-level security mechanism that can provide a very high level of network security.

## Concentrating frame relay connections

The MAX provides extensive support for frame relay. Using a serial WAN port for a nailed connection to a switch, it can function as an NNI (network-to-network interface) switch, a DCE (data communications equipment) unit responding to users, or as a DTE (data terminal equipment) requesting services from a switch.

## Enabling X.25 terminal connections

X.25 is a precursor to frame relay and is generally considered less efficient. However, many sites use it to transmit information between users across the WAN. It accommodates both high-volume data transfers and interactive use of host machines. The MAX may have one physical connection to an X.25 DCE using a BRI line. To support interactive use, the connection must be nailed.

## Configuring routing and bridging across the WAN

Routing and bridging configurations enable the MAX to forward packets between the local network and the WAN and also between WAN connections.

### Enabling protocol-independent packet bridging

The MAX can operate as a link-level bridge, forwarding packets from Ethernet to a WAN connection (and vice versa) on the basis of the destination hardware address in each packet. Unlike a router, a bridge does not examine packets at the network layer. It simply forwards packets to another network segment if the address does not reside on the local segment.

### Using IPX routing (NetWare 3.11 or newer)

The MAX can operate as an IPX router, linking remote NetWare LANs with the local NetWare LAN on Ethernet. IPX routing has its own set of concerns related to the client-server model and user logins. For example, uses should remain logged in for some period even if the connection has been brought down to save connection costs.

### IP routing

IP routing is the most widespread use of the MAX, and it has a wide variety of configurable options. IP routing is the required basis for Internet-related services such as IP multicast support, OSPF, and cross-Internet tunneling for virtual private networks. Most sites create static IP routes to enable the MAX to reliably bring up a connection to certain destinations or to change global metrics or preferences settings.

## Configuring Internet services

All Internet services and routing methods require that the MAX function as an IP router, so an IP routing configuration is a necessary precondition.

### OSPF routing

OSPF (Open Shortest Path First) is the next generation Internet routing protocol. The MAX can be configured to communicate with other OSPF routers within an autonomous system (AS). To enable this routing function, you must configure the OSPF options on the Ethernet interface and for each WAN connection that supports remote OSPF routers.

OSPF can import routes from RIP as well. You can control how these imported external routes are handled by adjusting system-wide routing options such as route preferences and ASE type metrics.

### Virtual private networks

Many sites use the Internet to connect corporate sites or to enable mobile nodes to log into a corporate backbone. Such virtual private networks use cross-Internet tunneling to maintain security or to enable the Internet to transport protocols that it would otherwise drop, such as IPX. To implement virtual private networks, the MAX supports both ATMP, an Ascend-proprietary tunneling mechanism, and PPTP (Point-to-Point Tunneling Protocol).

ATMP enables the MAX to create and tear down a tunnel to another Ascend unit. In effect, the tunnel collapses the Internet cloud and provides what looks like direct access to a home network. Packets received through the tunnel must be routed, so ATMP applies only to IP or IPX networks at this time.

A PPTP session occurs between the MAX and a Windows NT server over a special TCP control channel. Either end may initiate a PPTP session and open the TCP control channel. Note that opening a PPTP session does not mean that a call is active, it simply means that a call can now be placed and received.

# Overview of management features

This section describes management functions that use features built into the MAX, including:

- Using the terminal server command line
- Using status windows to track WAN or Ethernet activity
- Managing the MAX using SNMP
- Using remote management to configure far end Ascend units
- Updating software in the MAX unit's flash RAM
- Using Call Detail Reporting

The MAX provides up to nine security levels to control which management and configuration functions are accessible to users. These security profiles are described in detail in the *MAX Security Supplement*.

## Using the terminal server command line

To invoke the terminal server command-line interface, you must have administrative privileges. Once you have activated a Security profile that enables these privileges, you can invoke the command line by selecting Term Serv in the Sys Diag menu. To close the command-line, use the Quit command at the command-line prompt. The command-line interface closes and the cursor is returned to the vt100 menus.

## Using status windows to track WAN or Ethernet activity

Eight status windows are displayed on the right side of the screen in the MAX configuration menus. The windows provide a great deal of read-only information about what is currently happening in the MAX. If you want to focus on the activity of a particular slot card, you can change the default contents of the windows to show what is currently going on in that slot.

## Managing the MAX using SNMP

Many sites use Simple Network Management Protocol (SNMP) applications to obtain information about the MAX and make use of it to enhance security, set alarms for certain conditions, and perform simple configuration tasks.

The MAX supports the Ascend Enterprise MIB, MIB II, and some ancillary SNMP features. The MAX can send management information to an SNMP manager without being polled. SNMP security uses a community name sent with each request. The MAX supports two community names, one with read-only access, and the other with read/write access to the MIB.

## Using remote management to configure far-end Ascend units

When you have an MP+ or AIM connection to another Ascend unit, you can use the management subchannel established by those protocols to control, configure, and obtain statistical and diagnostic information about that Ascend unit. Multi-level password security ensures that unauthorized personnel do not have access to remote management functions.

## Flash RAM and software updates

Flash RAM technology enables you to perform software upgrades in the field without opening the unit or changing memory chips. You can upgrade the MAX through its serial port by accessing it either locally or through a dial-in modem. You cannot perform remote software upgrades over the WAN interface because of a conflict between running the WAN and reprogramming the software.

## Call Detail Reporting (CDR)

Call Detail Reporting (CDR) is a feature that provides a database of information about each call, including date, time, duration, called number, calling number, call direction, service type, associated inverse multiplexing session, and port. Because the network carrier bills for bandwidth on an as-used basis, and bills each connection in an inverse multiplexed call separately, you may want to use CDR to understand and manage bandwidth usage and the cost of each inverse multiplexed session.

You can arrange the information to create a wide variety of reports, which can be based on individual call costs, inverse multiplexed WAN session costs, costs on an application-by-application basis, bandwidth usage patterns over specified time periods, and so on. With the resulting better understanding of your bandwidth usage patterns, you can make any necessary adjustments to the ratio of switched to nailed bandwidth between network sites.

# Where to go next

When you have planned your network, you are ready to configure the MAX. The flexibility of the MAX and its ever-increasing number of configurations means there is no set order for configuration. You can perform configuration tasks in any order you want. Table 1-1 shows you where to look for the information you need.

*Table 1-1. Where to go next*

| To do this: | Go to this chapter or document: |
|---|---|
| Configure slots, lines, and ports | Chapter 2, “Configuring the MAX for WAN Access.” |
| Configure WAN connections | Chapter 3, “Configuring WAN Links.” |
| Set up frame relay | Chapter 4, “Configuring Frame Relay.” |
| Set up X.25 | Chapter 5, “Configuring X.25.” |
| Set up packet bridging | Chapter 7, “Configuring Packet Bridging.” |
| Set up IPX routing | Chapter 8, “Configuring IPX Routing.” |
| Set up IP routing | Chapter 9, “Configuring IP Routing.” |
| Set up OSPF routing | Chapter 10, “Configuring OSPF Routing.” |
| Set up multicast forwarding | Chapter 11, “Setting Up IP Multicast Forwarding.” |
| Set up virtual private networks | Chapter 12, “Setting Up Virtual Private Networks.” |
| Set up SNMP access and traps | Chapter 13, “MAX System Administration.” |

*Table 1-1. Where to go next*

| **To do this:** | **Go to this chapter or document:** |
|---|---|
| Manage the system | Chapter 13, “MAX System Administration.” |
| Work with status windows | *MAX Reference Guide* |
| Write configuration scripts | *MAX MIF Supplement* |
| Set up security | *MAX Security Supplement* |
| Set up RADIUS | *MAX RADIUS Configuration Guide* |

# Configuring the MAX for WAN Access

# 2

This chapter covers these topics:

# Introduction to WAN configuration

The MAX comes with eight built-in BRI lines and a V.35 serial port for WAN access. It also has two expansion slots, which can support V.110 modules, AIM ports modules to support videoconferencing, or digital modems to support analog modem connections over digital lines.

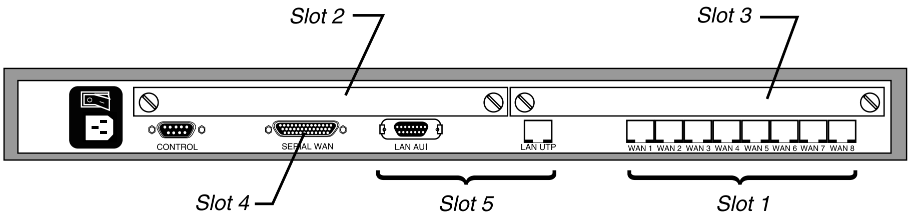


*Figure 2-1. Slot and port numbering in the MAX 1800*

## How the vt100 menus relate to slots and ports

The numbers in the vt100 menus relate to slot numbers in the MAX unit, which may be an actual expansion slot or a “virtual” slot on the unit’s motherboard.

- The system itself is assigned slot number 0 (menu 00-000).

  The System menu contains these profiles and submenus, which are all related to system-wide configuration and maintenance:

  ```
  00-000 System
     00-100 Sys Config
     00-200 Sys Diag
     00-300 Security
     00-400 Destinations
     00-500 Dial Plan
  ```

- The built-in BRI lines are assigned slot 1 (menu 10-000).

  Each of these slots contains two T1 or E1 lines. The menus for configuring and testing the lines are organized like this:

  ```
  10-000 Net/BRI
     10-100 Line Config
     10-200 Line Diag
  ```

- The two expansion slots are slots 2 and 3 (menus 20-000 and 30-000), with the numbering shown in Figure 2-1.
- The serial WAN port is slot 4 (menu 40-000).
- The Ethernet is slot 5 (menu 50-000). The Ethernet menu contains submenus and profiles related to the local network, routing and bridging, and WAN connections.

## Phone number assignments

The MAX receives calls on phone numbers that have been assigned to its BRI channels. This section describes important issues related to assigning those phone numbers.

In the MAX configuration, phone numbers are limited to 24 characters, which can include the following characters:

```
1234567890()[]!z-*#|
```

## Add-on numbers

A multi-channel call begins as a single-channel connection to one phone number. The calling unit then requests additional phone numbers it can dial to connect those channels, and stores the add-on numbers it receives from the answering unit. The calling unit must integrate the add-on numbers with the phone number it dialed initially to add channels to the call.

**Note:** The most common reason multi-channel calls fail to connect beyond the initial connection is that the answering unit sends the calling unit add-on numbers it cannot use to dial the other channels. The first rule to follow to avoid this problem is to make sure that the add-on numbers you assign have the same number of digits. If the calling unit receives an add-on number that is the same length as the phone number that established the base channel of the call, the entire add-on number is used. (For example, if 6532 is the add-on number, and 6588 is the initially dialed number, the derived phone number is 6532.)

If the calling unit receives an add-on number that is longer than the number it initially dialed, it discards extra digits it receives for add-on numbers starting with the leftmost digit. It the add-on number is shorter than the dialed number, the calling unit adds on the rightmost digits of the initially dialed number. (For example, if 6532 is the add-on number, and 9-555-6588 is the initially dialed number, the derived phone number is 9-555-6532.)

For example, if each channel of eight BRI lines is assigned a different phone number, you have 16 phone number assignments. Typically, those numbers have leading digits in common, for example:

- 212-555-8760
- 212-555-8761
- 212-555-8762
- 212-555-8780
- 212-555-8781

... (and so forth)

All these phone numbers have the digits “(212) 555-87” in common. Only the two rightmost digits are needed to distinguish one phone number from another. Those are the digits you should specify when assigning phone numbers in the line’s channel configuration.

## Hunt groups

A group of channels that has the same phone number is called a hunt group. When a call comes in on that number, the MAX uses the first available channel to which the number was assigned. Because channels in a hunt group share a common phone number, the add-on numbers in the profile are the same.

**Note:** If all of a line’s channels are assigned the same add-on number, you can leave the phone number assignment blank.

### SPIDS

The SPIDs assigned to a BRI line operating in multipoint mode are numbers used at the central switch to identify services provisioned for your ISDN line. A SPID is derived from a telephone number and should be supplied by your carrier.

**Note:** Not all telephone companies include a suffix on their SPIDs. When receiving SPIDs from your telephone company, ask them to verify whether or not suffixes are included. The SPID formats described in the next sections have been agreed upon by most telephone companies.

For example, for an AT&T switch in multipoint mode, SPIDs have one of these formats:

`01`*`nnnnnnn`*`0`

`01`*`nnnnnnn`*`00`

In the AT&T SPID formats, *nnnnnn* is the 7-digit phone number (not including the area code). For example, if the phone number is 555-1212, the SPID will be 0155512120 or 01555121200. For a Northern Telecom switch, SPIDs have one of these formats:

*`aaannnnnnnSS`*

*`aaannnnnnnSS`*`00`

In the Northern Telecom SPID formats, *aaannnnnn* is the 10-digit phone number (including the area code). SS is an optional suffix—if specified it is a one or two-digit number differentiating the channels. For example, if the phone numbers are 212-555-1212 and 212-555-1213, the SPIDs may be:

```
21255512121
21255512132
```

or:

```
212555121201
212555121302
```

or one of the above formats followed by 00 (for example, 21255512130200).

## How inbound and outbound calls are routed

When the MAX receives a call on one of its phone numbers, it routes that call internally to one of its slots or ports. When a digital modem, AIM port, or a host on the local Ethernet port originates a dial-out connection, the MAX routes that call internally to an available WAN channel to place the call. The channel configuration of a WAN line determines how the channel routes inbound calls and places outbound calls. For details, see “Call routing” on page 2-21

# Configuring ISDN BRI lines

The built-in ISDN BRI (Basic Rate Interface) network interface has eight BRI lines. These lines provide lower-cost connections to some sites that do not require or have access to the higher-bandwidth T1 or E1 lines. These are the relevant BRI network configuration parameters.

```
Net/BRI
   Line Config
      Name=bri-net
      Switch Type=AT&T
      Line N...
         Enabled=Yes
         Link Type=P_T_P
         B1 Usage=Switched
         B1 Slot=3
         B2 Prt/Grp=1
         B1 Trnk Grp=5
         B2 Usage=Switched
         B2 Slot=3
         B2 Prt/Grp=2
         B2 Trnk Grp=5
         Pri Num=555-1212
         Pri SPID=01555121200
         Sec Num=555-1213
         Sec SPID=01555121300
```

For details on these parameters, see the *MAX Reference Guide.*

**Note:** After you have configured the line, you may need to configure the card for outbound calls. See "Configuring the Net BRI line for outbound calls" on page 2-7.

## Understanding the Net BRI parameters

This section provides some background information on the Net BRI parameters.

- Assigning a profile name

  You can configure several profiles and activate a profile when it is needed. The name should indicate usage.

- Carrier switch type and how it operates

  The Switch Type is the central network switch that provides ISDN service to the MAX. For details on supported switch types, see the *MAX Reference Guide*.

  The Link Type specifies whether the switch operates in point-to-point or multi-point mode. In point-to-point mode, MAX requires one phone number and no SPIDs (Service profile Identifiers). In multi-point mode, the MAX requires two phone numbers and two SPIDs. All international switch types except DBP Telecom and all domestic (U.S.A.) switch types except AT&T 5ESS operate in multipoint mode.

- Using the BRI line for switched or nailed connections

  Each BRI line has two B channels for user data and one D channel for signaling . The B1 and B2 Usage parameters specify how the B channels are used: Switched (the default), Nailed, or Unused (not available for use).

- Associating the channel with a slot/port in the MAX

  In the B N Slot and B N Prt/Grp parameters, you can assign a switched channel to a slot or slot/port combination for a digital modem, AIM port, or Ethernet. This configuration affects both inbound call routing and placing calls. In effect, it reserves the channel for calls to and from the specified slot or port. For details, see "Call routing" on page 2-21.

  **Note:** You cannot control whether an incoming call will ring on the first or second B channel, so the B1 Slot and B2 Slot parameters should be set to identical values.

If the channel is nailed, B N Prt/Grp is a Group number, which will be referenced in a Connection or Call profile to make use of this nailed connection.

- Assigning the channel to a trunk group

  Trunk group numbers 4 through 9 can be assigned to channels to make them available for outbound calls. You cannot combine PRI channels with BRI channels in the same trunk group. See "Routing outbound calls" on page 2-24 for details.

- Phone number and SPID (Service Profile Identifier) assignments

  Pri Num is the primary add-on number for the Net BRI line. If the line is configured for point-to-point service, it is the only number associated with the line.

  Sec Num is the secondary add-on number for the Net BRI line. If the line is configured for point-to-point service, it is not applicable.

  Pri SPID and Sec SPID are the SPIDs associated with the Primary and Secondary numbers, respectively. See "SPIDS" on page 2-4.

# Example Net BRI configurations

This section provides some example configurations for Net BRI lines.

## Configuring incoming switched connections

In this example configuration, the BRI lines are configured in multipoint mode with an NI-1 switch. The lines are configured for switched incoming connections.

**1** Open Net/BRI>Line Config.

**2** Assign a name to the profile and specify the carrier's switch type.

```
Net/BRI
   Line Config
      Name=bri-net
      Switch Type=NI-1
```

**3** Open Line 1, enable the line, and specify multipoint mode.

```
      Line 1...
         Enabled=Yes
         Link Type=P_T_P
```

**4** Configure the B channels for switched usage, and for routing to the local network.

```
         B1 Usage=Switched
         B1 Slot=9
         B2 Prt/Grp=0
         B1 Trnk Grp=
         B2 Usage=Switched
         B2 Slot=9
         B2 Prt/Grp=0
         B2 Trnk Grp=
```

**5** Specify the primary and secondary add-on numbers and their associated SPIDs.

```
         Pri Num=555-1212
         Pri SPID=01555121200
         Sec Num=555-1213
         Sec SPID=01555121300
```

**6** Close the Line 1 subprofile and proceed to configure the other 7 lines.

**7** Close the Net BRI profile.

## Configuring the Net BRI line for outbound calls

In this example Net BRI configuration, the MAX has two T1 or E1 lines and has a Net BRI card installed in slot 5. To enable local users to initiate outbound connections using the BRI lines, the MAX must be configured for trunk groups. To enable outbound calls using trunk groups:

**1** Open System>Sys Config and enable trunk groups system-wide.

```
System
   Sys Config
      Use Trunk Grps=Yes
```

**2** Close the System profile.

**3** Open Net/BRI>Line Config>Line 1.

```
Net/BRI
   Line Config
      Name=bri-net
      Switch Type=NI-1
      Line 1...
```

**4** Assign both of the line's channels to trunk group 6 (for example).

```
         B1 Trnk Grp=6
         B2 Trnk Grp=6
```

**5** Repeat this trunk group setting for the remaining BRI lines (Lines 2—8), so that all BRI lines are in trunk group 6.

**6** Close the Net BRI profile.

To specify that outbound calls initiating from the MAX unit's bridge/router use trunk groups:

**7** Open Ethernet>Mod Config>WAN Options and set the Dial Plan parameter to Trunk Grp.

```
Ethernet
   Mod Config
   Wan options...
      Dial Plan=Trunk Grp
```

**8** Close the Ethernet profile.

To specify that a connection uses a BRI line:

**9** Open the Connection profile.

**10** Include the Net BRI trunk group number in the Dial # parameter.

For example:

```
Ethernet
   Connections
      Dial #=6-555-1212
```

When the first digit of the Dial # is a trunk group number, the MAX places the call using the channels in that trunk group.

**11** Close the Connection profile.

**Note:** See "Routing outbound calls" on page 2-24 for a way to use Destination profiles to specify lines as backup channels if all WAN channels are busy. Instead of explicitly entering the dial number in the Connection profile, you can reference a Destination profile, which can specify up to six different dial-out paths to a particular destination.

# Configuring the serial WAN port

The MAX has a built-in V.35 serial WAN DB-44 port. A serial WAN port provides a V.35/RS-449 WAN interface that is typically used to connect to a frame relay switch. The serial WAN data rate is determined by the clock speed received from the link. The maximum acceptable clock is 8 Mbit/s. The clock speed at the serial WAN port has no effect on the bandwidth of other WAN interfaces in the MAX.

These are the serial WAN configuration parameters:

```
Serial WAN
   Mod Config
      Module Name=serial
      Nailed Grp=3
      Activation=Static
```

For complete details, see the *MAX Reference Guide*.

## Understanding the serial WAN parameters

This section provides some background on the serial WAN configuration.

- Assigning a group number to the serial WAN bandwidth

  The Nailed Grp parameter assigns a number that can be referenced as the Group in a Connection profile or the Nailed Grp in a Frame Relay profile. If it is specified in a Connection profile, the MAX will bridge or route packets to another unit across that nailed connection. If it is used in a Frame Relay profile, the MAX will have a nailed connection to a frame relay switch and the DLCI number in each frame will determine which frames are sent over the link.

  The number you assign must be unique in the MAX configuration. Do not use a group number that is already in use for a nailed connection on another interface.

- Signals to control the serial WAN data flow

  The Activation parameter tells the MAX which signals control the data flow through the serial WAN port. The DCE to which the serial WAN port is connected (such as a frame relay switch) determines how to set its value. Flow control is always handled by the CTS (Clear To Send) signal.

## Example serial WAN configuration

To configure the serial WAN interface to connect to a frame relay switch that uses Static data flow:

**1** Open Serial WAN>Mod Config.

**2** Assign a module name and a group number.

**3** Set the Activation parameter to Static.

```
Serial WAN
   Mod Config
      Module Name=wan-serial
      Nailed Grp=3
      Activation=Static
```

**4** Close the Serial WAN profile.

**5** Configure a Frame Relay profile and specify the Nailed Grp number assigned to this port. For example:

```
Frame Relay
   Name=NNI
   Active=Yes
   Call Type=Nailed
   FR Type=NNI
   LinkUp=Yes
   Nailed Grp=3
   ...
```

See Chapter 4, “Configuring Frame Relay.”

# Configuring digital modems

A digital modem is a device that can communicate over a digital line (such as an ISDN line) with a station that uses a modem connected to an analog line. Incoming modem calls and incoming digital calls come over the same digital line to the MAX unit’s integrated digital modem. The MAX can also make an outgoing call over a digital line to a modem on an analog line.

A digital modem accepts an incoming call as a PCM (Pulse Coded Modulation) encoded digital stream, which contains a digitized version of the analog waveform sent by a caller attached to a modem. The digital modem also converts outgoing data to a PCM-encoded digital stream and sends it across the WAN to an analog modem.

These are the digital modem configuration parameters:

```
V.34 Modem (or V.42 Modem)
   Mod Config
      Ans 1#=12
      Ans 2#=13
      Ans 3#=14
      Ans 4#=15
V.34 Modem (or V.42 Modem)
   Modem Diag
      ModemSlot=enable slot
      Modem #1=enable modem
      Modem #2=enable modem
      Modem #3=enable modem
      Modem #4=enable modem
      Modem #5=enable modem
      Modem #6=enable modem
      Modem #7=enable modem
      Modem #8=enable modem
```

(The “V.34” menus may specify “V.42” instead, depending on which modem cards are installed in the MAX.) For details on each parameter, see the *MAX Reference Guide*.

## Understanding the digital modem parameters

Digital modem processing is required to process asynchronous data calls initiated by analog modems, so all incoming analog modem calls must be routed first to a digital modem. The

Answer numbers are add-on numbers assigned to some of the MAX unit's WAN lines. See "Call routing" on page 2-21.

After it has been processed by the digital modems, the call is passed to the MAX unit's terminal server software. If it does not contain PPP encapsulation, it is handled as a login call, which may be routed transparently to a telnet host on the local network. PPP-encapsulated modem calls are passed to the bridge/router as regular PPP connections.

See terminal server information in Chapter 3, "Configuring WAN Links."

**Note:** V.120 terminal adapters such as the BitSurfer (also known as ISDN modems) are asynchronous calls with CCITT V.120 encapsulation. The MAX handles V.120 encapsulation in software, so these calls do not require digital modem processing. See "Configuring V.110 modems" on page 2-10 for information about processing V.110 calls.

## Example configuration

To configure digital modems:

1. Open V.34 Modem>Mod Config (or V.42 Modem>Mod Config).
2. Specify the rightmost unique digits of the phone numbers to be routed to digital modems. For example:

```
V.34 Modem
   Mod Config
      Ans 1#=12
      Ans 2#=13
      Ans 3#=14
      Ans 4#=15
```

3. Close the Modem profile.

## Quiescing digital modems and returning them to service

A digital modem that has been temporarily disabled without disrupting existing connections is "quiesced." Active calls are not torn down. When an active call drops, that modem is added to the disabled modem list and is not available for use. If all modems are on the disabled list, incoming callers receive a busy signal until the modems have been restored for service. When you re-enable the quiesced modem, a delay of up to 20 seconds may occur before the modem becomes available for service.

**Note:** Booting the MAX restores all quiesced lines, slots, and ports to service.

For details, see the *MAX Reference Guide*.

# Configuring V.110 modems

A V.110 card provides eight V.110 modems, each of which enables the MAX to communicate with an asynchronous device over synchronous digital lines. An async device such as an ISDN modem encapsulates its data in V.110.

The V.110 module in the MAX removes the encapsulation and enables an async session (a terminal server session). See terminal server information in Chapter 3, "Configuring WAN Links."

These are the V.110 configuration parameters:

```
V.110
   Mod Config
      Ans 1#=12
      Ans 2#=13
      Ans 3#=14
      Ans 4#=15
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the V.110 modem parameters

V.110 modem processing is required to process asynchronous data calls that use V.110 encapsulation, so incoming calls using V.110 must be routed first to a V.110 modem. The Answer numbers are add-on numbers assigned to some of the MAX unit's WAN lines. See "Call routing" on page 2-21.

After it has been processed by the V.110 modems, the call is passed to the MAX unit's terminal server software. If it does not contain PPP encapsulation, it is handled as a login call, which may be routed transparently to a telnet host on the local network. PPP-encapsulated modem calls are passed to the bridge/router as regular PPP connections.

**Note:** V.110 terminal adapters are asynchronous calls with CCITT V.110 encapsulation. These calls require V.110 modem processing.

## Example V.110 configuration

To configure V.110 modules:

**1** Open V.110>Mod Config.

**2** Specify the dial-in phone numbers to be routed to V.110 as a terminal server call.
For example,

```
V.110
   Mod Config
      Ans 1#=12
      Ans 2#=13
      Ans 3#=14
      Ans 4#=15
```

**3** Close the V.110 profile.

# Configuring Host/6 (Host/Dual) AIM ports

You can connect a videoconferencing codec (coder/decoder) to a MAX AIM port to communicate over a point-to-point link. An AIM port is the V.35, RS-499, or X.21 port on the MAX. Typically, these calls are used in the inverse-multiplex mode between video codecs and other devices that might need high bandwidth serial data over the WAN.

An AIM port uses pins for controlling the data flow through the port. A device sends a signal through a pin and over the line to another device; the signal being sent determines the control-line state. For example, a device can send a signal to another party, indicating that it has data to send; in this case, the control-line state is RTS (Request to Send). The other device can send a signal to indicate that it is ready to receive data; in this case, the control-line state is DTR (Data Transmit Ready). The process of sending these synchronization signals between AIM ports is called handshaking.

**Note:** When you install an AIM port card in the MAX, the AIM ports become the default route for inbound data calls, taking precedence over the bridge/router software. This means you must specify call routing for calls to reach the local Ethernet. See “Call routing” on page 2-21.

An AIM port requires three levels of configuration:

- The Port profile, to configure the AIM port itself
- The Host interface profile, to configure the interface to the codec
- The Call profile, to configure WAN connections on the port

## Configuring the AIM port

The Port profile sets protocol and routing parameters for the port itself. The Port profile contains these parameters:

```
Host/6 (or Host/Dual)
   PortN Menu
      Port Config
         Port Name=Port1
         Dial Plan=Trunk Grp
         Ans 1#=1212
         Ans 2#=1213
         Ans 3#=
         Ans 4#=
         Idle=None
         Dial=Terminal
         Answer=Auto
         Clear=Terminal
         Port Password=Ascend
         Term Timing=No
         RS-366 Esc=N/A
         Early CD=None
         DS0 Min Rst=Off
         Max DS0 Mins=N/A
         Max Call Mins=0
```

For details on each parameter, see the *MAX Reference Guide*.

### Understanding the Port profile parameters

This section provides some background information about the AIM port configuration.

- Specifying the dial plan

  The Dial Plan parameter specifies how calls will be placed from this port, by using trunk groups or the extended dial plan. See “Routing outbound calls” on page 2-24.

- Routing inbound calls to the codec

  Answer numbers specify add-on numbers assigned to a WAN line. This is one way of routing inbound calls received on those numbers to the AIM port. See “Call routing” on page 2-21.
- What happens when you turn on the power

  Idle specifies the action the port takes when you turn on the power, or if no call is active. You can specify None (the port waits for a user to establish a call), or Call (the port dials the call).
- How the codec dials out

  Dial specifies how the codec dials an outbound call:
  - Terminal (dial manually by using DO DIAL).
  - DTR Active (dial only if DTR is asserted at the port, indicating that the codec is ready to send data).
  - RS-366 ext1 (dial through an RS-366 dialing service).
  - RS-366 ext2 (same as RS-366 but using different message protocols).
  - V.25bis (dial direct according to V.25 bis hardware handshaking).
  - V.25bis-C (same as V.25bis, but the CTS signal cannot change state during a call).
  - X.21 ext1 (dial as described in the CCITT Blue Book Rec. X.21).
  - X.21 ext2 (same as X.21 ext1, but using different message protocols).
  - X.21 ext1-P (same as X.21 ext1, but used for a PictureTel X.21 dialer).
- How the codec answers calls

  Answer specifies how the codec answers a call:
  - Terminal (answer manually by using DO ANSWER).
  - DTR Active (answer only if DTR is asserted at the port, indicating that the codec is ready to receive data).
  - DTR+Ring (answer after one ring if DTR is asserted at the port, for codecs configured to answer manually).
  - P-Tel Man (same as DTR+Ring, but used for a Picture Tel codec configured to answer calls manually).
  - V.25bis (answer according to V.25 bis hardware handshaking).
  - V.25bis-C (same as V.25bis, but the CTS signal cannot change state during a call).
  - X.21 (answer according to X.21 hardware handshaking).
  - Auto (answer every call automatically, regardless of the control-line state).
  - None (use the port for outgoing calls only).
- Clearing calls on this port

  Clear specifies whether the control-line state determines when the MAX clears a call.
- Host session authentication

  The Port Password is used by the receiving unit to compare with the Call Password sent by the caller upon initial connection of the first channel of an AIM or BONDING call. If the password matches the Port Password, the session is established normally for the remainder of the call. If it doesn’t match, the authenticating unit sends a message back to the originator and drops the session. The port status screen will indicate that the call failed authentication. If the Port profile doesn’t specify a Port Password, the units connect without authentication, even though the originating unit may have sent a password.

Note that the MAX only authenticates AIM and BONDING calls; dual-port calls are not authenticated. See “Understanding the Call profile parameters” on page 2-17.

- Clocking data from the codec

  Terminal Timing is a clock signal that compensates for the phase difference between Send Data and Send Timing. If the codec uses this signal, set the Term Timing parameter to yes; otherwise, it uses the Send Timing signal from the codec.

- Setting an escape character for RS-366 dialing

  When Dial specifies RS-366 ext2, the default escape character is #. You can use RS-366 Esc to set a different escape character if you wish.

- Preventing timeouts while waiting for a carrier detect signal

  By default, the MAX raises Carrier Detect (CD) after the completion of handshaking and an additional short delay. If the local or remote codec times out waiting for CD, you can set Early CD to raise CD without waiting for handshaking.

- Controlling port usage

  A DS0 minute is the online usage of a single 56-kbps or 64-kbps switched channel for one minute. When the usage exceeds the maximum (Max DS0 Mins), the MAX cannot place any more calls, and takes any existing calls offline. The DS0 Min Rst parameter resets accumulated DS0 minutes to zero after a specified time, or disables the timer.

## Example Port profile configuration

To configure the port for RS-366 dialing:

**1** Open Host/6>Port 1 Menu>Port Config.

**2** Assign the profile a name, and configure call routing; for example,

```
Host/6
   Port 1 Menu
      Port Config
         Port Name=Port1
         Dial Plan=Trunk Grp
         Ans 1#=1212
         Ans 2#=1213
         Ans 3#=1214
         Ans 4#=1215
```

**3** Set the dial, answer, and clear parameters appropriately for the codec; for example:

```
         Dial=RS-366 ext1.
         Answer=Auto
         Clear=Terminal
```

**4** Leave the default values for the remaining parameters, or modify them as needed.

**5** Close the Port profile.

## Performing port diagnostics

After configuring the port, you can perform a loopback test to verify the configuration. The port diagnostics menu contains only the loopback command:

```
Host/6
   Port N Menu
      Port Diag
         Local LB
```

For details, see the *MAX Reference Guide*. In a local loopback test, data originating at the local site is looped back to its originating port without going out over the WAN. It is as though a “data mirror” were held up to the data at the WAN interface, and the data were reflected back to the originator. The WAN interface is the port on the MAX that is connected to a WAN line. The AIM port on the MAX must be idle when you run the local loopback test; it can have no calls online.

## Configuring the host interface

A Host interface profile defines how the port or pair of ports will interface with the codec. These are the related host interface parameters:

```
Host/6
   Mod Config
      Module Name=dualport
      Port 1/2 Dual=Yes
      Port 3/4 Dual=Yes
      Port 5/6 Dual=No
      Palmtop=Full
      Palmtop Port #=N/A
      Palmtop Menus=Standard
Host/Dual
   Mod Config
      Module Name=nodual
      Dual Ports=No Dual
      Palmtop=Full
      Palmtop Port #=N/A
      Palmtop Menus=Standard
```

For details on each parameter, see the *MAX Reference Guide*.

### Understanding the host interface parameters

This section provides some background information about configuring the interface to the codec.

- Pairing ports for dual-port calls

  If you are configuring the interface to an older model codec that does not support AIM, you can use the pair two AIM ports to provide double the bandwidth for the videoconferencing call. A dual-port call requires that the codec has a dual-port interface.

  In a dual-port call, the codec performs its own inverse multiplexing on two channels so that a call can achieve twice the bandwidth of a single channel. A pair of AIM ports on the MAX connects to the codec. The pair includes a primary and secondary port. Because the MAX places the two calls in tandem and clears the calls in tandem, it considers them a single call.

  Creating a dual-port configuration does not prevent you from dialing any other type of call from the primary host port of the pair, or from using either port for receiving any call type. Pairing ports does not disable RS-366 dialing at the secondary port.

- Restricting access to the AIM port from the Palmtop Controller

  You can prevent Palmtop operators from accessing the port, or restrict their level of access.

### Enabling dual-port calls

This configuration pairs the first two AIM ports in a Host 6 card:

1. Open Host/6>Mod Config.
2. Assign a name (optional).
3. Use the Dual Port parameter to pair two ports. For example:

   ```
   Host/6
      Mod Config
         Module Name=pair-one
         Port 1/2 Dual=Yes
         Port 3/4 Dual=No
         Port 5/6 Dual=No
   ```

4. Close the Host interface profile.

See “Configuring a two-channel dual-port call” on page 2-20.

## Configuring WAN connections between serial hosts

A Call profile defines a WAN connection on the AIM port. These are the Call profile parameters:

```
Host/6 (or Host/Dual)
   PortN Menu
      Directory
         Name=bonding
         Dial #=212-555-1212
         Call Type=BONDING
         Call Mgm=Mode 1
         Data Svc=56K
         Force 56=No
         Base Ch Count=3
         Inc Ch Count=2
         Dec Ch Count=1
         Bill #=212-555-1213
         Auto-BERT=120
         Bit Inversion=No
         Fail Action=Disc
         PRI # Type=Intl
         Transit #=222
         Group=N/A
         FT1 Caller=N/A
         B&O Restore=N/A
         Flag Idle=Yes
         Dyn Alg=N/A
         Sec History=N/A
         Add Pers=N/A
         Sub Pers=N/A
         Call Password=Ascend
         Time Period N...
            Activ=N/A
            Beg Time=N/A
            Min Ch Cnt=2
            Max Ch Cnt=12
            Target Util=N/A
```

For details on each of these parameters, see the *MAX Reference Guide*.

## Understanding the Call profile parameters

This section provides some background information on Call profile parameters.

- Dialing out to the remote codec

  The dial number specifies the far-end number and can specify the method of placing the call. It can include up to 24 characters. On a 2-Chnl call, it can contain up to 49 characters, or two phone numbers containing up to 24 characters each and separated by an exclamation point. See "Routing outbound calls" on page 2-24 for details about specifying the method of placing the call.

  **Note:** The V.25bis protocol implementation in the MAX includes extensions that enable specification of a phone number using the V.25bis CRS command. You can specify a BONDING or other profile in the CRS command, followed by a phone number, which is stored in this parameter. For this usage, the phone number is limited to 20 characters.

- Defining the type of connection and how bandwidth is managed

  Call type specifies the type of connection between the local and remote codecs.

  - 1 Chnl (single channel call)
  - 2 Chnl (dual-port call)
  - FT1-B&O (provides automatic backup and overflow protection of nailed-up circuits).
  - FT1 (fractional T1 nailed channels)
  - AIM (uses Ascend Inverse Multiplexing to combine channels).
  - FT1-AIM (combines nailed and switched channels using the AIM protocol).
  - BONDING (uses the Bandwidth On Demand Interoperability Group September 1992 1.0 specification).

  When an AIM or BONDING call type is selected, you must also specify a management method (Call Mgm). See the *MAX Reference Guide* for details.

- Bandwidth issues

  The Base Ch Count parameter specifies the base number of channels to use when setting up the call. The Inc Ch Count and Dec Ch Count specify the number of channels it can add and subtract at one time, respectively.

  Data Service affects how much bandwidth is available for a particular connection, and how channels may be allocated to the call. For example, if the data service is 384K, then the channel count parameters such as Dec Ch Count should be divisible by 6 (namely, 6, 12, 18, or 24), since 384 kbps is 6x64 kbps. Operational problems can result if you do not specify a multiple of 6. The Inc Ch Count parameter should equal the number of B channels in the service or a integer multiple of that service's B channels.

  Similarly, if the data service is MultiRate or GloBanD (a multiple of 64 kbps), then be sure to make Inc Ch Count and Dec Ch Count divisible by the same multiple. Again, the Inc Ch Count parameter should equal the number of B channels in the service or a integer multiple of that service's B channels.

- What the MAX does when it cannot establish a base channels of a connection

  Fail Action specifies whether the MAX disconnects, reduces the bandwidth request, or establishes a lower bandwidth call and retries for the additional bandwidth when it cannot establish a call with the number of channels specified by the Base Ch Count parameter.

- Telco options

You can configure a set of Telco options for the call, including a billing number, automatic byte-error test (Auto-BERT), PRI # Type, Transit #, a trunk group or nailed group number, and FT1 caller (whether the local codec originates the call).

- Supporting configuration for certain call types or management methods

  When the call type is FT1-B&O, B&O Restore specifies the number of seconds to wait before restoring a nailed channel that has been dropped due to quality problems.

  When the call management type is Dynamic, Flag Idle specifies whether the port looks for a flag pattern (01111110) or a mark pattern (11111111) as the idle indicator.

- Dynamic bandwidth allocation issues

  For calls that have AIM or BONDING-compatible equipment on both ends, the MAX can use its proprietary dynamic bandwidth allocation algorithms.

  The MAX connects to the remote end over a single channel and then dials multiple channels to the same destination based on the total amount of bandwidth requested. When adding bandwidth, the MAX adds the number of channels specified in the Inc Ch Count parameter. When subtracting bandwidth, it subtracts the number of channels specified in the Dec Ch Count parameter.

  – Dyn Alg specifies which algorithm to use for calculating ALU during the time period specified by the Sec History parameter.

  – Sec History specifies a number of seconds to be used as the basis for calculating average line utilization (ALU), which is compared to a target percentage threshold (Target Util). When the ALU exceeds the threshold for a specified time period, the MAX attempts to add channels. When ALU falls below the threshold for a specified time period, the MAX attempts to remove channels.

  – Add Pers specifies the number of seconds the ALU must exceed the Target Util before the MAX adds bandwidth.

  – Sub Pers specifies the number of seconds the ALU must fall below the Target Util before the MAX subtracts bandwidth.

  – Time periods

    You can divide an AIM call that specifies Dynamic call management into time periods, each characterized by separate Activ, Beg Time, Max Ch Cnt, Min Ch Cnt, and Target Util parameters.

- Host session authentication

  The Call Password is sent by the calling unit when the base channel of the call is connected. The receiving unit compares the value to its Port Password. If the password received matches the stored password, the session is established normally for the remainder of the call. If there is no match, the authenticating unit sends a message back to the originator and drops the session.The port status screen will indicate that the call failed authentication with the message “Password Mismatch.”

  See “Understanding the Port profile parameters” on page 2-12.

## Example AIM call configuration

To configure an AIM call that uses dynamic bandwidth allocation algorithms to manage the call dynamically:

1 Open Host/6>Port 1 Menu>Directory.

2 Specify the dial number to reach the remote device and set the call type to AIM.

```
Host/6
   Port 1 Menu
      Directory
         Name=aim
         Dial #=6-212-555-1212
         Call Type=AIM
```

**3** Specify Dynamic call management.

```
         Call Mgm=Dynamic
```

**4** Set the base channels and the number of channels to be added or subtracted when bandwidth requirements change.

```
         Base Ch Count=3
         Inc Ch Count=2
         Dec Ch Count=1
```

**5** Specify the DBA parameters.

```
         Dyn Alg=Quadratic
         Sec History=60
         Add Pers=20
         Sub Pers=20
         Time Period 1...
            Activ=Enabled
            Beg Time=00:00:00
            Min Ch Cnt=1
            Max Ch Cnt=12
            Target Util=70
```

**6** Close the Call profile.

## Example FT1-B&O call configuration

FT1 calls contain nailed channels, while FT1-AIM and FT1-B&O calls can combine switched channels with nailed channels. For FT1-B&O calls, you must also specify B&O Restore.

**Note:** For FT1-AIM or FT1-B&O, you must set the Idle and Dial parameters in the Port profile at both the local and remote ends of the call. For the MAX to connect the switched channels when you switch it on, choose Idle=Call and Dial=Terminal. For the MAX to connect the switched channels when the host equipment at both ends sets DTR active, set Idle=None and Dial=DTR.In this latter configuration, the hosts at both ends of the connection must establish DTR active to make the MAX connect the switched channels.

To configure an FT1-B&O call:

**1** Open Host/6>Port 1 Menu>Directory.

**2** Set the call type to FT1-B&O.

```
Host/6
   Port 1 Menu
      Directory
         Name=ft1-bo
         Call Type=FT1-B&O
```

**3** Set call management to Dynamic. This is required in the device that initiates the FT1-B&O call.

```
         Call Mgm=Dynamic
```

**4** Specify the Group number for the nailed channels.

```
         Group=3
```

5 Specify that the MAX initiates the call.

```
         FT1 Caller=Yes
```

If the other end of the link initiates the call, set this parameter to No. Only one side of the link can initiate the call for FT1-AIM or FT1-B&O calls.

6 Close the Call profile.

7 Open Host/6>Port 1 Menu>Port Config.

8 Specify how the switched channels will be connected. For example:

```
Host/6
   Port 1 Menu
      Port Config
         Idle=None
         Dial=DTR
```

This setting must be the same in the devices at both ends of the link. The setting shown above connects the switched channels when the host equipment at both ends sets DTR active. As an alternative, the following settings connect the channels at power-up:

```
Host/6
   Port 2 Menu
      Port Config
         Idle=Call
         Dial=Terminal
```

9 Close the Port profile.

## Configuring a single-channel call

This example configures a connection between two terminal adaptors connected to two AIM ports in the MAX. A call between AIM ports on the same MAX remains entirely local; the MAX does not use any WAN channels. To configure a single-channel port-to-port call:

1 Open Host/6>Port 3 Menu>Directory.

2 Set the Dial # parameter using a special 3-digit format

```
Host/6
   Port 3 Menu
      Directory
         Name=terminal-adaptors
         Dial #=241
```

See “Routing outbound calls” on page 2-24.

3 Specify a single-channel call type.

```
         Call Type=1 Chnl
```

4 Close the Call profile.

## Configuring a two-channel dual-port call

In a dual-port call, two AIM ports on the MAX connect a dual-port call to the serial host; these ports are the primary port and the secondary port. Because the MAX places the two calls in tandem and clears the calls in tandem, it considers them a single call. These restrictions apply for dual-port connections:

- The selected data service must be available end-to-end.
- The dialing method cannot be V.25 bis.

- The Answer number must be the same for both ports.
- If trunk groups are in use, both channels of the call must be in the same trunk group.

In this example, the Host interface profile must enable port pairing for dual-port calls. See “Enabling dual-port calls” on page 2-16. In addition, a T1 or E1 line has two of its channels configured with the phone number 1212 (a hunt group). To route the call answered on the 1212 hunt group to the paired ports for a dual-port call:

**1** Open Host/Dual>Port 1 Menu>Port Config.
This is the Port profile for the primary port (Port 1).

**2** Specify the hunt group answer number. For example:

```
Host/Dual
   Port 1 Menu
      Port Config
         Port Name=Port1
         Ans 1#=1212
```

**Note:** Do not set the Ans # parameter for the secondary host port (Port 2).

**3** Close the Port profile.

To configure the dual-port call:

**1** Open Host/Dual>Port 1 Menu>Directory.

**2** This is the Call profile for the primary port (Port 1).

**3** Specify the dial number of the remote codec. For example:

```
Host/Dual
   Port 1 Menu
      Directory
         Name=hunt-groups
         Dial #=6-201-555-7878
```

If the dual-port call requires two dial numbers, specify both numbers separated by an exclamation mark. For example

```
         Dial #=6-201-555-7878!6-201-555-7879
```

**4** Set Call Type to 2 Chnl

```
         Call Type=2 Chnl
```

**5** Close the Call profile.

# Call routing

This section describes how you configure the MAX to configure call routing. For flow charts that detail how the MAX routes its calls, see Appendix A, “Troubleshooting.”

## Routing inbound calls

When the MAX receives a call on a WAN line, it performs CLID or DNIS authentication (if appropriate), answers the call, and determines which slot should receive the call. It then find’s the caller’s profile, authenticates the call, builds a session, and passes the data stream to the appropriate module or host. When a call is routed to the Ethernet port, the bridge/router software forwards it to a host or hosts according to packet addresses.

These are the topics related to routing inbound switched calls:

- Setting up ISDN subaddressing

  The MAX first checks for an ISDN subaddress in the dialed number. If it finds one, it uses that to route the call; if not, it goes on to the next comparison.
- Specifying answer numbers for destination host ports

  The MAX then checks for answer number specifications. If it finds a matching answer number, it uses that to route the call; if not, it goes on to the next comparsion.
- Specifying host ports' slot and port numbers in WAN channel configurations

  The MAX then checks for slot and port number specifications. If it finds a matching slot number, it uses that to route the call. (If it also finds a port number, if routes to that specific port on the slot number.) If not, it goes on to the next comparison.
- Exclusive port routing

  Unless you turn on exclusive port routing, if the call comes in on an ISDN line, the MAX can route the call using bearer service information if it finds no explicit call-routing information.

## Setting up ISDN subaddressing

These are the parameters for setting up ISDN subaddressing:

```
System
   Sys Config
      Sub-Adr=Routing
      Serial=1
      LAN=2
      DM=3
      V.110=4
```

A single-digit number is assigned to the AIM ports (Serial), Ethernet (LAN), digital modems (DM), and V.110 slots. When ISDN subadressing is used in routing mode, incoming calls include a subaddress number as part of the phone number. For example, with the configuration shown above, the caller would dial 510-555-1212,3 to reach the digital modems. The subaddress “3” follows the dialed number and is separated from it by a comma.

## Specifying answer numbers for destination host ports

Each host port can specify one or more answer numbers. In effect, these settings say “route all calls received on this number to me.” When the MAX receives an inbound call and no subaddress is in use, it matches the called number to these answer numbers and routes the call to the port with the matching number. These are the related parameters:

```
V.34 Modem (or V.42 Modem)
   Mod Config
      Ans 1#=1213
      Ans 2#=1214
      Ans 3#=1215
      Ans 4#=1216
```

```
V.110
   Mod Config
      Ans 1#=1217
      Ans 2#=1218
      Ans 3#=1219
      Ans 4#=1220
```

```
Ethernet
   Mod Config
      WAN options...
         Ans 1#=1236
         Ans 2#=1237
         Ans 3#=1238
         Ans 4#=1239
```

**Note:** When a MAX has more than one digital modem slot card installed, the cards and modems form a pool, and any modem can answer a call routed to any digital modem slot.

## Slot and port specifications

In the configuration of WAN lines, you can assign one or more channels to a slot card. In the case of AIM slot card, you can assign channels to a port on the card. This channel configuration affects both inbound call routing and placing calls. In effect, it reserves the channel for calls to and from the specified slot or port.

Configure slot and port routing only when answer number and ISDN subaddress routing are not specified. These are the related parameters:

```
Net/BRI
   Line Config
      Line N...
         BN Usage=Switched
         BN Slot=3
         BN Prt/Grp=1
```

When the MAX receives an inbound call and no subaddress is in use or matching answer number is found, it evaluates the slot and port specifications and routes the call to the specified destination. In the MAX 1800 model, these are the valid slot specifications:

- 0 (Zero, the default). Zero means this parameter is not used to route incoming calls.
- 1 is an invalid setting, because it represents the built-in slot containing the BRI lines.
- 2 and 3 represent expansion slots. When looking at the back panel of the MAX unit, slot 2 is the left-most slot.
- 5 represents the LAN. Calls are routed to the bridge/router module.

**Note:** When a MAX has more than one digital modem slot card installed, the cards and modems form a pool, and any modem can answer a call routed to any digital modem slot.

## Exclusive port routing

If Excl Routing is set to No (which it is by default), the MAX routes the call based on bearer service. Voice calls are routed to a digital modem, V.110 calls are routed to a V.110 module, and data calls are routed to an AIM port, or if no AIM ports are available, to the bridge/router. If it is set to Yes and none of the previous call-routing comparisons were successful, the MAX drops the call. This is the parameter for turning on exclusive port routing:

```
System
   Sys Config
   Excl Routing=No
```

Exclusive port routing prevents the MAX from accepting calls for which it has no explicit routing destination.

## Routing outbound calls

When the MAX dials out, it routes the outbound call from the originating slot to a WAN channel to place the call. It first looks for channels associated with the trunk group specified in the Dial # (if any) and the port that originated the call, based on the channel configuration parameters. If no trunks have available channels, the call is not placed.

**Note:** An available channel within the trunk group is one that is not assigned to any port (its slot/port numbers are zero) or is assigned to the port that originated the call. Channels assigned to another port are not available.

These are the topics related to routing outbound calls:

- Enabling trunk groups

  If trunk groups are enabled, dial-out numbers must include a trunk group number as a dialing prefix, and all switched channels must be assigned to a trunk group to be available for outbound calls.
- Dialing using trunk group 2 (local port-to-port calls)

  Trunk group 2 is used for port-to-port calls within the MAX system. Trunk group 2 is the first digit in a 3-digit dialing prefix in which the next 2 digits are interpreted as the slot and port number of the called port.
- Dialing using trunk group 3 (Destination profiles)

  Trunk group 3 is the first digit in a 3-digit dialing prefix in which the next 2 digits are interpreted as the number of a Destination profile.
- Dialing using trunk groups 4 through 9

  Trunk groups 4 through 9 reference specific groups of WAN channels to use for placing the call. If that group has no available channels, the call is not placed.
- Dialing using the extended dial plan

  When the extended dial plan is specified for a particular port, the trunk group number is the first digit in a 3-digit dialing prefix in which the next 2 digits are interpreted as the number of a Dial Plan profile.
- Matching slot and port specifications (reserved channels)

  Whether or not trunk groups are enabled, the MAX relies on slot/port specifications to place outbound calls, if any slot/port numbers are specified. When a channel configuration specifies a slot or slot/port combination, it effectively reserves the channel for calls to and from the specified slot or port. Calls originating from a different slot or port will not find the channel available.

### Enabling trunk groups

A trunk group is a group of channels that has been assigned a number. Once you have enabled trunk groups, all switched channels must be assigned a trunk group number to be available for outbound calls. This is the related parameter:

```
System
   Sys Config
      Use Trunk Grps=Yes
```

**Note:** Trunk group numbers 2 and 3 have special meaning, as described in the next two sections. Only trunk groups 4 through 9 are available for assignment to channels.

## Dialing using trunk group 2 (local port-to-port calls)

When 2 is the first digit in a three-digit dial number, the MAX places a call to the slot and port specified in the next two digits. These are the related parameters:

```
Host/6 (or Host/Dual)
   PortN Menu
      Directory
         Name=bonding
         Dial #=241
```

Wit the dial number 241, the MAX places a call to the first port of a Host 6 or Host Dual card in slot 4. The second digit can be 0 (zero) or any number between 3 and 8. If it is zero, the call will go to any available AIM port (the third digit is ignored in this case). If it is between 3 and 8, it represents an expansion slot number and the third digit is the host port on that card.

## Dialing using trunk group 3 (Destination profiles)

When 3 is the first digit in a three-digit dialing prefix, the MAX interprets the next two digits as the number of a Destination profile. These are the related parameters:

```
Destinations
   Name=outdial-1
   Option=1st Avail
   Dial 1#=4-212-555-1212
Dial Plan
   Call-by-Call 1=1
   Dial 2#=5-212-555-1212
   PRI # Type=National
   Transit #=
   Bill #=

Host/6 (or Host/Dual)
   Port N Menu
      Directory
         Dial #=312

Ethernet
   Connections
      Dial #=312
```

With the dial number 312, the MAX reads Destination profile 12. Destination profiles let you instruct the MAX to use the first available channels to place the call, or to try one trunk group first, followed by another if the first in unavailable. For example, if the Destination profile sets Option=1st Avail, the MAX takes the first available channels for the call. If the dial numbers specify different trunk groups, the MAX can use bandwidth from one switch as backup for another; for example, trunk group 4 may contain channels serviced by Spring and trunk group 5 may be serviced by AT&T.

## Dialing using trunk groups 4 through 9

Trunk group numbers 4 through 9 can be assigned to WAN channels to group those channels. Trunk group assignments limit the number of channels available to multichannel calls, because only channels within the same trunk group can be aggregated. Trunk group assignments are also used to group the channels from different types of lines; for example, when the MAX lines are serviced by more than one carrier, you might assign trunk group 4 to a line serviced by one carrier and trunk group 5 to a line serviced by another.

**Note:** A trunk group cannot include both BRI and PRI channels.

These are the related parameters:

```
Net/BRI
   Line Config
      Line N...
         BN Usage=Switched
         BN TrnkGrp=5
Ethernet
   Mod Config
      WAN options...
         Dial Plan=Trnk Grp
Ethernet
   Connections
      Dial #=5-555-1212
Host/6 (or Host/Dual)
   Port N Menu
      Directory
         Dial Plan=Trunk Grp
         Dial #=4-555-1217
```

If Dial Plan=Trunk Grp and a single-digit dialing prefix between 4 and 9, the MAX places the call using channels in that trunk group.

## Slot and port specifications (reserved channels)

Specifying a slot and port number in a channel configuration reserves the channel for calls to and from the specified slot or port. These are the related parameters:

```
Net/BRI
   Line Config
      Line N...
         BN Usage=Switched
         BN Slot=3
         BN Prt/Grp=1
```

If the outbound call originates from a host on Ethernet, the destination address in the packets brings up a Connection profile or RADIUS user profile that dials the call. If the call does not go out through a digital modem, it originates from slot 5.

If the outbound call originates from a device connected to an AIM port, the Call profile associated with that port dials the call. This type of call originates from the slot and port of the AIM card.

If the outbound call originates from a terminal-server user dialing out through a digital modem, the digital modem slot is the source of the call. ( No matter where the call originates, if it goes out through a digital modem, the digital modem slot is the source of the call.)

When the MAX receives an outbound call, it evaluates the slot and port specifications as part of determining which channels are available for placing the call.

- If the slot and port specifications for a channel are set to zero (the default), the channel is available for all outbound calls that specify the right trunk group.
- If the slot is non-zero and the port is zero, the channel is available to outbound calls originating on that slot.

- If both the slot and port numbers are non-zero, the channel is available only to outbound calls originating on that port.

# Configuring WAN Links

# 3

This chapter covers these topics:

# Introduction to WAN links

This chapter describes how to configure various types of links across the WAN. It focuses on the encapsulation issues for these types of connections:

- PPP (Point-to-Point Protocol)

  PPP and its multilink variants (MP and MP+) enable dial-in connections from modems or ISDN devices, using one or more channels. The remote devices must have PPP software.
- Combinet

  Combinet bridges two network segments at the link level using one or two channels. The remote device is another Combinet bridge.
- EU-UI and EU-RAW

  Two types of EU encapsulation are provided: EU-UI, which is used by the MAX when the equipment on the other side of the connection requires the DCE and DTE address fields in the EU header, and EU-RAW, which is used when these address fields are absent. EU connections can be dial-in or dial-out.

  EU encapsulation does not support an authentication protocol. CLID authentication is used to match incoming calls to the proper Connection profile when, for example, special filters are applied to certain callers, or some callers route IP and others bridge.
- ARA (AppleTalk Remote Access)

  ARA enables a Macintosh user to access AppleTalk devices or IP hosts via modem. The remote Mac must have ARA client software and (if applicable) TCP/IP software.
- Terminal server connections

  Asynchronous calls from modems, ISDN modems (V.120 terminal adapters), or raw TCP are processed by the MAX terminal server. Those calls may be logged into the terminal server interface or, if they contain PPP, passed to the router.

**Note:** Frame relay, X.25, IP or IPX routing, and bridging all require both connection-specific and more general system configuration. Those topics are handled in their own chapters later in this guide.

This chapter does not describe RADIUS user profiles, which serve the same function as resident Connection profiles. If you are using a RADIUS authentication server, see the *MAX RADIUS Configuration Guide*. For details about WAN connection security, see the *MAX Security Supplement*.

## The Answer profile

The Answer profile determines whether an incoming call is answered or dropped. If the call doesn’t comply with the Answer profile, the MAX drops the call before answering it.

Most administrators set up the Answer profile to reject calls for which no configured profile is found. When a call has a configured profile, the related encapsulation and session options in the Answer profile are not used—the MAX relies on the connection-specific settings instead. However, if the configured profile is a Name-password profile, the MAX may use the settings in the Answer profile to build the session. The Answer profile contains these parameters:

```
Ethernet
   Answer
      Use Answer as Default=No
      Force 56=No
```

```
Profile Reqd=Yes
Id Auth=None
Assign Adrs=No
Encaps...
   MPP=Yes
   MP=Yes
   PPP=Yes
   COMB=Yes
   FR=Yes
   X25/PAD=Yes
   EU-RAW=Yes
   EU-UI=Yes
   V.120=Yes
   X.75=Yes
   TCP-CLEAR=Yes
   ARA=Yes
IP options...
   Metric=7
PPP options...
   Route IP=Yes
   Route IPX=Yes
   Bridge=Yes
   Recv Auth=Either
   MRU=1524
   LQM=No
   LQM Min=600
   LQM Max=600
   Link Comp=Stac
   VJ Comp=Yes
   BACP=No
   Dyn Alg=Quadratic
   Sec History=15
   Add Pers=5
   Sub Pers=10
   Min Ch Count=1
   Max Ch Count=1
   Target Util=70
   Idle Pct=0
   Disc on Auth Timeout=Yes
COMB options...
   Password Reqd=Yes
   Interval=10
   Compression=Yes
V.120 options...
   Frame Length=260
X.75 options...
   K Window Size=7
   N2 Retran Count=10
   T1 Retran Timer=1000
   Frame Length=2048
Session options...
   RIP=Off
   Data Filter=5
   Call Filter=3
   Filter Persistence=No
   Idle=120
   TS Idle Mode=N/A
   TS Idle=N/A
   IPX SAP Filter=1
   Max Call Duration=0
   Preempt=N/A
DHCP options...
   Reply Enabled=No
   Pool Number=N/A
   Max Leases=N/A
```

## Understanding the Answer profile parameters

This section provides some background information on the Answer profile. For details on each parameter, see the *MAX Reference Guide*.

- Use Answer profile settings as the defaults for externally authenticated calls

  Use Answer as Default indicates whether the Answer Profile should override the factory defauls when the MAX validates an incoming call using RADIUS or TACACS.

- Forcing 56k data service

  Force 56 tells the MAX to use only the 56-kbps portion of a channel, even when all 64 kbps appear to be available. It is useful for answering calls from European or Pacific Rim countries from within North America, when the complete path cannot distinguish between the Switched-56 and Switched-64 data services. It is not needed for calls within North America.

- Requiring a configured profile to answer a call

  If you don't require a configured profile for all callers, the MAX builds a temporary profile for unknown callers. Many sites consider this a security breach. Note that setting Profile Reqd to Yes disables Guest access for ARA connections.

- Called number and caller-ID authentication

  The called number (typically the number dialed by the far end) and CLID (the far-end device's number) may be presented by the phone company as part of the call information and used in a first-level authentication process that occurs before a call is answered. See "Understanding Connection profile parameters" on page 3-7 for details. See the *MAX Security Supplement* for background information about authentication.

- Enabling types of encapsulation

  The Encaps subprofile contains settings for each type of link encapsulation that may be supported. If an encapsulation type is set to No in this menu, the MAX will not accept calls of that type.

- IP options

  In the Answer Profile, the Metric parameter determines the virtual hop count of the IP link when the MAX validates an incoming call using RADIUS or TACACS and Use Answer as Default is enabled.

- Setting encapsulation-specific options

  See the sections on configuring connections later in this chapter for details on the PPP, Combinet, and other encapsulation options. They are used in the Answer profile only when corresponding options are not set in the caller's configured profile.

- X.75 options

  The X.75 options enable dial-in access to the terminal server using the X.75 protocol. Full technical specifications for X.75 can be found in the CCITT Blue Book Recommendation X series 1988.
- Session options

  In the Answer profile, session options set default filters and timers to build connections that use RADIUS (if Use Answer as Defaults is enabled) or Names/Passwords profiles.
- DHCP options

  In the Answer profile, DHCP options enable the MAX to act as a DHCP server for a local Pipeline unit for connections that use RADIUS (if Use Answer as Defaults is enabled) or Names/Passwords profiles.

## Example Answer profile configuration

To set up a basic Answer profile:

**1** Open the Answer profile and set Profile Reqd to Yes.

**2** Set up CLID (Calling Line ID) or Called Number authentication, if required.

**3** Enable dynamic assignment of IP addresses to callers, if appropriate.

```
Ethernet
   Answer
      Profile Reqd=Yes
      Id Auth=None
      Assign Adrs=No
```

**4** Make sure that the encapsulation types you intend to support are enabled. For example:

```
      Encaps...
         MPP=Yes
         MP=Yes
         PPP=Yes
         COMB=Yes
         FR=Yes
         X25/PAD=Yes
         EU-RAW=Yes
         EU-UI=Yes
         V.120=Yes
         X.75=Yes
         TCP-CLEAR=Yes
         ARA=Yes
```

**5** Enable routing and bridging and specify authentication requirements, as appropriate. For example:

```
      PPP options...
         Route IP=Yes
         Route IPX=Yes
         Bridge=Yes
         Recv Auth=Either
```

**6**

```
      COMB options...
         Password Reqd=Yes
```

**7** Close the Answer profile.

## Connection profiles

Connection profiles define individual connections. For a given encapsulation type, the Connection profile contains many of the same options as the Answer profile.

**Note:** Settings in a Connecton profile always override similar settings in the Answer profile.

Connection profiles contain these parameters:

```
Ethernet
   Connections
      Station=device-name
      Active=Yes
      Encaps=encapsulation-protocol
      Dial #=555-1212
      Calling #=555-2323
      Called #=555-1212
      Route IP=Yes
      Route IPX=No
      Bridge=No
      Dial brdcast=N/A
      Encaps options...
         depends on selected encapsulation-protocol
      IP options...
         LAN Adrs=0.0.0.0/0
         WAN Alias=0.0.0.0/0
         IF Adrs=0.0.0.0/0
         Preference=100
         Metric=7
         Private=No
         RIP=Off
         Pool=0
         Client Pri DNS=0.0.0.0
         Client Sec DNS=0.0.0.0
         Client Assign DNS=Yes
         Client Gateway=0.0.0.0
      IPX options...
         Peer=Router
         IPX RIP=None
         IPX SAP=Send
         Dial Query=No
         IPX Net#=cfff0003
         IPX Alias#=00000000
         Handle IPX=None
         Netware t/o=30
      Session options...
         Data Filter=5
         Call Filter=3
         Filter Persistence=No
         Idle=120
         TS Idle Mode=N/A
         TS Idle=N/A
         Preempt=N/A
         IPX SAP Filter=0
         BackUp=
         IP Direct=0.0.0.0
         ATMP Gateway=No
         FR Direct=No
         FR Prof=N/A
         FR DLCI=N/A
      OSPF options…
         RunOSPF=Yes
         Area=0.0.0.0
         AreaType=Normal
         StubAreaDefaultCost=N/A
         HelloInterval=40
         DeadInterval=120
         Priority=5
         AuthType=Simple
         AuthKey=ascend0
         Cost=10
         ASE-type=N/A
         ASE-tag=N/A
         TransitDelay=5
         RetransmitInterval=20
      Telco options...
         AnsOrig=Both
         Callback=Yes
         Exp Callback=No
         Call Type=Switched
         Group=N/A
         FT1 Caller=N/A
         Data Svc=56KR
         Force 56=N/A
         Bill #=555-1212
         Dialout OK=No
      Accounting...
         Acct Type=None
         Acct Host=N/A
         Acct Port=N/A
         Acct Timeout=N/A
         Acct Key=N/A
         Acct-ID Base=N/A
      DHCP options...
         Reply Enabled=No
         Pool Number=N/A
         Max Leases=N/A
```

**Note:** After you have selected an encapsulation method in the Encaps option, the Encaps Options subprofile contains settings related to the selected type.

For information on IP, IPX, bridging, and OSPF configuration, see the appropriate chapter in this guide. For details on each parameter, see the *MAX Reference Guide*.

## Understanding Connection profile parameters

This section provides some background information on Connection profile parameters.

- The remote device’s station name

The station name is the name of the remote device. Make sure the name matches the remote device name exactly, including case changes.

- The dial number

  Dial # is the phone number used to dial out this connection. It can contain up to 24 characters, which may include a dialing prefix that directs the connection to use a trunk group or dial plan; for example: 6-1-212-555-1212. For more details, see Chapter 2, “Configuring the MAX for WAN Access.”

- The called number

  Called # (typically the number dialed by the far end) is presented in an ISDN message as part of the call when DNIS (Dial Number Information Service) is in use. In some cases, the phone company may present a modified called number for DNIS. This number is used for authentication and to direct inbound calls to a particular device from a central rotary switch or PBX. See the *MAX Security Supplement* for details.

- The calling number

  Many carriers include the calling number (the far-end device's number) in each call. Calling # is the caller ID number displayed on some phones and used by the MAX for CLID (Calling Line ID) authentication.

  CLID authentication prevents the MAX from answering a connection unless it originates at the specified phone number.  The number you specify may also be used for callback security if you configure callback in the per-connection telco options.

- Encaps and encaps options

  An encapsulation protocol must be specified for each connection, and its accompanying options configured in the Encaps Options subprofile. These are described in separate sections in this chapter.

- Routing configurations

  Each connection may be configured for IP routing, IPX routing, or OSPF routing (which requires IP routing). Each of these routing setups has a separate subprofile within a Connection profile. See the appropriate chapters later in this guide.

- Bridging

  Link-level bridging forwards packets to and from remote networks based on the hardware-level address, not a logical network address. Bridge and Dial Brdcast are related parameters. See the chapter on packet bridging later in this guide.

## Connection profile session options

These are the Session Options parameters in a Connection profile:

```
Ethernet
   Connections
      Session options...
         Data Filter=5
         Call Filter=3
         Filter Persistence=No
         Idle=120
         TS Idle Mode=N/A
         TS Idle=N/A
         Max Call Duration=0
         Preempt=N/A
         IPX SAP Filter=0
         BackUp=
         IP Direct=0.0.0.0
```

```
            FR Direct=No
            FR Prof=N/A
            FR DLCI=N/A
```

This section provides a brief overview. For details, see the later chapters in this guide and the *MAX Reference Guide*.

- Applying data or call filters to a session

  Ascend filters define packet conditions. Data filters drop specific packets, and are often used for security purposes. Call filters monitor inactive sessions and bring them down to avoid unnecessary connection costs. When a filter is in use, the MAX examines every packet in the packet stream and takes action if the defined filter conditions are present. The action the MAX takes depends both on the conditions specified within the filter and how the filter is applied. See Chapter 6, "Creating and Applying Packet Filters."
- Timing inactive sessions

  The Idle timer specifies how long the connection may remain idle before the MAX drops it. TS Idle Mode parameter specifies whether the MAX uses the terminal server idle timer and, if so, whether it monitors traffic in one or both directions to determine when the session is idle. TS Idle specifies how long the terminal server session can remain idle before the MAX logs out the user and terminates the connection.
- Setting a maximum call duration

  This parameter sets the maximum duration of an incoming call (1-1440 minutes). The default zero turns off this function. The connection is checked once a minute, so the actual time of the call may be slightly longer than the number of minutes you set.
- Allowing bandwidth to be preempted

  Preempt specifies the number of idle seconds the MAX waits before it can use one of the channels of an idle link for a new call.
- Specifying a backup connection when a nailed connection fails

  Backup specifies the name of a Connection profile to use when a nailed connection goes down. For example, if a nailed connection to corporate net #1 is out of service, a backup switched connection to corporate net #2 may be used. This parameter cannot be used to provide alternative lines to a single destination.
- IP direct connections

  An IP direct connection channels all inbound packets to a specified local host. See Chapter 9, "Configuring IP Routing."
- Frame relay redirect connections

  A frame relay redirect connection channels all inbound packets out to a frame relay switch. See Chapter 4, "Configuring Frame Relay."

## Connection profile telco options

These are the Telco Options parameters in a Connection profile:

```
Ethernet
   Connections
      Telco options...
         AnsOrig=Both
         Callback=Yes
         Exp Callback=No
         Call Type=Switched
         Group=N/A
```

```
FT1 Caller=N/A
Data Svc=56KR
Force 56=N/A
Bill #=555-1212
Dialout OK=No
```

For details on each parameter, see the *MAX Reference Guide*. This section provides a brief overview.

- Enabling both dial-in and dial-out on this connection

  The AnsOrig parameter specifies whether the unit can answer incoming calls, dial out, or both. The FT1 Caller parameter specifies whether this unit (the MAX) can initiate calls on fractional T1 to add switched channels to a nailed MPP connection (only one side of the connection should have this parameter set to Yes).

- Setting callback security

  When Callback is set to Yes, the MAX hangs up on the caller and dials back immediately using the dial number in this profile. When Expect Callback is set to Yes, the MAX expects the far end to hang up and dial back (recommended when CLID is required on the far end unit and PING or TELNET are in use).

- Nailed, switched, and other call types

  The Call Type is switched by default. The other options are nailed, nailed-MPP, and permanent switched connections.

  A nailed connection is a permanent link that is always up as long as the physical connection persists. For a nailed connection, you must specify the group number of the nailed channels. You can even combine groups of nailed channels to create a single high-speed nailed connection. For example:

  ```
  Call Type=Nailed
  Group=3, 4
  ```

  A nailed/MPP connection combines nailed and switched channels. When you choose this Call Type, you need to specify which side of the link can add switched channels by using the FT1 Caller parameter. See “Example MP connection without BACP” on page 3-19 for details about the Nailed/Mpp call type.

  A permanent switched connection is an outbound switched call that attempts to remain up at all times. If the unit or central switch resets or if the link is terminated, the permanent switched connection attempts to restore the link at 10-second intervals, which is similar to the way a nailed connection is maintained. A permanent switch connection conserves connection attempts but causes a long connection time, which may be cost effective for some customers. See the *MAX Reference Guide* for details.

- Data service

  Data Svc specifies the type of data service the link uses, such as 56K or modem.

- Billing numbers

  Bill # can specify a billing number for charges incurred on the line. If appropriate, your carrier can provide a billing number that can be used to sort your bill. For example, each department may require its own billing number. The billing number can contain up to 24 characters.

- Dialout OK

  This specifies whether the Connection profile may be used for dialing out on one of the MAX unit’s digital modems. Only if Dialout OK is set to Yes will the local user be allowed access to the immediate modem feature.

## Connection profile accounting options

These are the accounting parameters in a Connection profile:

```
Ethernet
   Connections
      Accounting...
         Acct Type=None
         Acct Host=N/A
         Acct Port=N/A
         Acct Timeout=N/A
         Acct Key=N/A
         Acct-ID Base=N/A
```

For details on each parameter, see the *MAX Reference Guide*. This section provides a brief overview.

- Accounting type

  You can specify whether this connection uses the default accounting setup (specified in the Ethernet profile), no accounting at all, or the user-specific setup specified here. The MAX supports both RADIUS and TACACS+ accounting.

- Accounting host and port

  These specify the IP address of a connection-specific accounting server to use for information related to this link, and the UDP port number to use in accounting requests.

- Accounting timeout and key

  The accounting key is a shared secret (a password shared with the accounting server). The Acct Timeout parameter specifies how long to wait for a response to a RADIUS accounting request. TACACS+ has its own timeout method.

- Accounting ID base

  This specifies the numeric base (base 10 or base 16) for the session ID.

## Connection profile DHCP options

These are the DHCP parameters in a Connection profile:

```
Ethernet
   Connections
      DHCP options...
         Reply Enabled=No
         Pool Number=N/A
         Max Leases=N/A
```

For details on each parameter, see the *MAX Reference Guide*. This section provides a brief overview.

- Reply Enabled

  This specifies whether the MAX processes DHCP packets and acts as a DHCP server on this connection. If it is set to Yes and the connection is bridged, the MAX responds to all DHCP requests. If it is set to Yes and the connection uses routing, it responds only to Network Address Translation (NAT) DHCP packets from a Pipeline unit. If it is set to No, the MAX does not respond to DHCP requests.

- Pool Number

  This specifies the IP address pool to use to assign addresses to NAT clients. It is not applicable if Reply Enabled is set to No.

- Max Leases

  This parameter restricts the number of dynamic IP addresses to be given out through this connection, thus limiting the number of clients on the remote LAN who can access the Internet. It is not applicable if Reply Enabled is set to No.

## Name-Password profiles

Name-password profiles provide simple name/password authentication for incoming calls. They are used only if authentication is required in the Answer profile (Recv Auth). The MAX prompts dial-in users for a name and password, matches the input to a Name-password profile, accepts the call, and uses the settings in the Answer profile or a specified Connection profile to build the connection.

**Note:** If Recv Auth is set to None in the Answer profile, Name-password profiles are not used.

Name-password profiles contain these parameters:

```
Ethernet
   Names / Passwords
      Name=Brian
      Active=Yes
      Recv PW=brianpw
      Template Connection #=0
```

### Understanding the Name-password profile parameters

This section provides some background information on Name-password profiles.

- Name

  The name must exactly match the name specified by a dial-in user, including case changes. We recommend that you do not specify a name that is already in use in a Connection profile. The name can be up to 31 characters.

- Active

  To enable a Name-password profile for use, set Active to Yes. If you are using a “template” Connection profile to build the session, that profile must also be active.

- Password

  The password must exactly match the password specified by a dial-in user, including case changes. The password can be up to 20 characters.

- Template connection

  To use a “template” Connection profile rather than the Answer profile settings to build the session for this Name-password profile, specify the unique portion of the profile’s number here. The default zero instructs the MAX to use the Answer profile settings. Any other number denotes a Connection profile. The specified Connection profile must be active.

  Template connections may be used to enable or disable group logins. For example, you can specify a Connection profile for the Sales group to use when dialing in, then configure a Name-password profile for each individual salesperson. You can prevent a single salesperson from dialing in by setting Active to No in the Name-password profile, or you can prevent the entire group from logging in by setting Active to No in the Connection profile.

### Example Name-Password profile configuration

To configure a Name-Password profile that uses the Answer profile settings:

1. Open a Name-Password profile.
2. Specify the user's name and password, and then activate the profile.

```
Ethernet
   Names / Passwords
      Name=Brian
      Active=Yes
      Recv PW=brianpw
      Template Connection #=0
```

3. Leave the Template Connection # set to 0 to use Answer profile settings.
4. Close the profile.

# Configuring PPP connections

This section describes how to configure PPP-encapsulated connections. A PPP connection may be one of the following types:

- PPP—a single-channel connection to any remote device running PPP software.
- MP (Multilink PPP)—a multilink connection to an MP-compliant device from any vendor.
- MP with BACP (MP with Bandwidth Allocation Control Protocol)—an MP call that uses BACP to increase or decrease bandwidth on demand.
- MP+ (Multilink PPP with Ascend extensions)—a multilink connection to another Ascend unit, which uses Ascend dynamic bandwidth allocation to increase or decrease bandwidth on demand.

A multilink connection begins by authenticating a base channel. If the connection allows additional bandwidth, the local or remote unit dials another link. For example, if a dial-in Pipeline unit has a single-channel session at 56 Kbps or 64 Kbps and multilink PPP is configured, a second call can combine the first B channel with the second for a transmission rate of 112 Kbps or 128 Kbps.

MAX units can be “stacked” to distribute the bandwidth required for connections across multiple units. See “Configuring a Combinet connection” on page 3-24.

**Note:** If a connection configured for multilink PPP fails to establish multiple channels, it falls back to a single-channel PPP session. In each case, the PPP parameters are used as part of the connection negotiation. MP, BACP, and MP+ settings are used *in addition to* the single-channel PPP settings.

## Configuring single-channel PPP connections

This section describes how to the parameter used for PPP negotiation to establish a single-channel PPP call and to establish the base channel of multilink PPP calls. These are the related parameters:

```
Ethernet
   Answer
```

```
      Encaps...
         PPP=Yes
      PPP options...
         Route IP=Yes
         Route IPX=Yes
         Bridge=Yes
         Recv Auth=Either
         MRU=1524
         LQM=No
         LQM Min=600
         LQM Max=600
         Link Comp=Stac
         VJ Comp=Yes
Ethernet
   Connections
      Encaps=PPP
      Encaps options...
         Send Auth=None
         Send PW=N/A
         Recv PW=
         MRU=1524
         LQM=No
         LQM Min=600
         LQM Max=600
         Link Comp=Stac
         VJ Comp=Yes
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the PPP parameters

This section provides some background information about the PPP parameters.

- Enabling routing and bridging in the Answer profile

  You must enable routing or bridging in the Answer profile for the MAX to pass the data stream from an answered call to its internal bridge/router software. See the appropriate chapter on routing or bridging later in this guide for more information.

- Authentication method used for passwords received from the far end

  The Recv Auth parameter specifies which protocol to use for authenticating the password sent by the far end during PPP negotiation. You can specify None, PAP (Password Authentication Protocol), CHAP (Challenge Handshake Authentication Protocol), or Either, which includes PAP, CHAP and MS-CHAP (Microsoft Challenge Handshake Authentication Protocol format supported by Windows NT systems). The far end must also support the specified protocol.

- Authentication method used for passwords sent to the far end

  The Send Auth parameter specifies which protocol to use for the password sent to the far end during PPP negotiation.

- Passwords to send to and receive from the far end

  The Send PW is the password sent to the remote device. It must match the password expected from the MAX. The Recv PW is the password sent to the MAX from the remote device. It is used to match up the caller to a profile when IP routing is not in use.

- Maximum receive units (MRU)

  MRU specifies the maximum number of bytes the MAX can receive in a single packet on a PPP link. Usually the default 1524 is the right setting, unless the far end device requires a lower number.

- Link quality monitoring (LQM)

  The LQM parameters specify whether the MAX monitors the quality of the link. If LQM is set to Yes, you can specify the minimum and maximum duration between reports, measured in tenths of a second.

  LQM counts the number of packets sent across the link and periodically asks the remote end how many packets it has received. Discrepancies are evidence of packet loss and indicate link quality problems.

- Link and header compression

  For data compression to take effect, both sides of a connection must support it. The MAX supports Stac and MS-Stac compression for PPP-encapsulated calls.

  Stac compression refers to the Stacker LZS compression algorithm, developed by STAC Electronics, Inc., which modifies the standard LZS compression algorithm to optimize for speed (as opposed to optimizing for compression). Stac compression is one of the parameters negotiated when setting up a PPP connection.

  MS-Stac refers to Microsoft LZS Coherency compression for Windows 95. This is a proprietary compression scheme for Windows 95 only (not for Windows NT).

  **Note:** If the caller requests MS-Stac and the matching profile does not specify MS-Stac compression, the connection seems to come up correctly but no data is routed. If the profile is configured with MS-Stac and the caller does not acknowledge that compression scheme, the MAX attempts to use standard Stac compression, and if that doesn't work, it uses no compression.

  VJ Comp applies only to packets in TCP applications, such as Telnet. When you turn it on, the MAX applies TCP/IP header compression for both ends of the link.

## Example PPP connection

Figure 3-1 shows the MAX with a PPP connection with a remote user who is running Windows 95 with the TCP/IP stack and PPP dialup software. The dial-in user has a modem, so the call is asynchronous and uses only one channel.

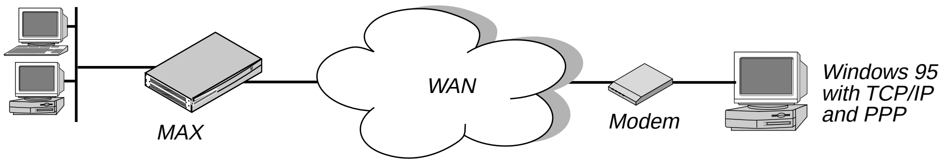


*Figure 3-1. A PPP connection*

To configure this PPP connection:

1 Make sure the Answer profile enables PPP encapsulation and sets the appropriate routing, bridging, and authentication values. For example:

```
Ethernet
   Answer
      Encaps...
         PPP=Yes
      PPP options...
         Route IP=Yes
         Route IPX=Yes
         Bridge=Yes
         Recv Auth=Either
```

2 Close the Answer profile.

3 Open a Connection profile.

4 Specify the name of the remote device and activate the profile. For example:

```
Ethernet
   Connections
      Station=tommy
      Active=Yes
```

**Note:** Make sure that you specify the Station name exactly, including case changes.

5 Select PPP encapsulation and set the appropriate PPP options. For example:

```
      Encaps=PPP
      Encaps options...
         Send Auth=CHAP
         Send PW=remotepw/A
         Recv PW=localpw
```

The Send Auth parameter should be set to CHAP or PAP. .Both sides of the connection must support the selected authentication protocol and the selected compression methods.

6 Close the Connection profile.

## Enabling PPP outdial for v.110 modems

The MAX can make outgoing calls to a client on the other side of a v.110 terminal adapter using the PPP protocol. This feature also supports the callback feature via v.110 for the MAX Link Client software product.

See “Configuring dialout options” on page 3-43 for information about enabling dialout using the MAX unit’s digital modems.

To enable PPP outdial for v.110 modems:

1 Open a Connection profile configured for async PPP.

2 Open the Telco Options subprofile and specify the following data service:

```
Ethernet
   Connections
      Telco options...
         Data Svc=v110 19.2 56K
```

3 Close the Connection profile.

The Data Svc settings that begin with “v110” enable for V.110 outdial. These settings include the v110 indicator (which tells the MAX to communicate with a V.110 terminal adapter), the bit rate for the connection, and the data service to use. For example:

```
v110 19.2 56k
```

uses a bit rate of 19.2 (“19 .2”) over a line using the Switched-56 data service. If the MAX cannot sync up with the remote TA using the specified bit rate, it attempts to use one of the other bit rates. See the *MAX Reference Guide* for more details on this Data Svc setting.

## Configuring MP and BACP connections

Multilink PPP (MP) uses the encapsulation defined in RFC 1990. MP enables the MAX to interact with MP-compliant equipment from other vendors to use multiple channels for a call. Both sides of the connection must support MP. In addition to the PPP parameters described in “Understanding the PPP parameters” on page 3-14, these are the parameters related to MP connections without BACP:

```
Ethernet
   Answer
      Encaps...
         MP=Yes
         PPP=Yes

      PPP options...
         Min Ch Count=1
         Max Ch Count=1

Ethernet
   Connections
      Encaps=MP
      Encaps options...
         Base Ch Count=1
```

If the Bandwidth Allocation Control Protocol (BACP) is enabled, MP connections use that protocol to manage dynamic bandwidth on demand. Both sides of the connection must support BACP. In addition to the PPP parameters, these are the parameters for MP connections with BACP:

```
Ethernet
   Answer
      Encaps...
         MP=Yes
         PPP=Yes

      PPP options...
         BACP=Yes
         Dyn Alg=Quadratic
         Sec History=15
         Add Pers=5
         Sub Pers=10
         Min Ch Count=1
         Max Ch Count=1
         Target Util=70

Ethernet
   Connections
      Encaps=MP
      Encaps options...
         BACP=Yes
         Base Ch Count=1
         Min Ch Count=1
         Max Ch Count=2
         Inc Ch Count=1
         Dec Ch Count=1
         Dyn Alg=Quadratic
         Sec History=15
         Add Pers=5
         Sub Pers=10
         Target Util=70
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the MP and BACP parameters

This section provides some background information on MP and BACP configuration.

- MP without BACP

  For MP connections without BACP, you can specify the base channel count, which must be greater than or equal to the minimum count and less than or equal to the maximum count specified in the Answer profile. The base channel count specifies the number of channels to use to establish the connection, and this number of channels remains fixed for the whole session.

- Enabling BACP for MP connections

  You can enable BACP to use that protocol to increase or decrease bandwidth on demand for MP connections. Both sides of the connection must support BACP.

- Specifying channel counts

  The base channel count specifies the number of channels to use to establish the call. After the base channel or channels have been established, another link must be dialed to add channels. Inc Ch Count and Dec Ch Count specify the number of channels it can add and subtract at one time, respectively. You can also specify a maximum and minimum number of channels that can be allocated to the call. See also Parallel Dial in the System profile.

- Dynamic algorithm for calculating bandwidth requirements

  Dyn Alg specifies an algorithm for calculating average line utilization (ALU) over a certain number of seconds (Sec History). Figure 3-2 shows how the algorithms weight usage samples.

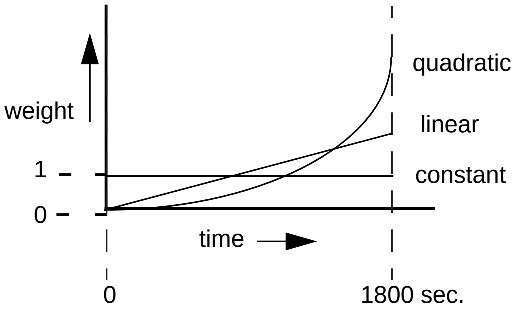


*Figure 3-2. Algorithms for weighing bandwidth usage samples*

  - Quadratic (the default) gives more weight to recent samples of bandwidth usage than to older samples taken over the specified number of seconds. The weighting grows at a quadratic rate.
  - Linear gives more weight to recent samples of bandwidth usage than to older samples taken over the specified number of seconds. The weighting grows at a linear rate.
  - Constant gives equal weight to all samples taken over the specified number of seconds.

- Time period for calculating average line utilization

  Sec History specifies a number of seconds to use as the basis for calculating average line utilization (ALU).

- Comparing the average utilization to a target utilization

  Target Util specifies a percentage of line utilization (default 70%) to use as a threshold when determining when to add or subtract bandwidth.

- How long the condition should persist before adding or dropping links

  Add Pers specifies a number of seconds for which the ALU must persist beyond the Target Util threshold before the MAX adds bandwidth. Sub Pers specifies a number of seconds for which the ALU must persist below the Target Util threshold before the MAX subtracts bandwidth. When adding bandwidth, the MAX adds the number of channels specified in the Inc Ch Count parameter. When subtracting bandwidth, it subtracts the number of channels specified in the Dec Ch Count parameter, dropping the newest channels first.

## Guidelines for configuring bandwidth criteria

When configuring dynamic bandwidth allocation, keep these guidelines in mind:

- The values for the Sec History, Add Pers, and Sub Pers parameters should smooth out spikes in bandwidth utilization that last for a shorter time than it takes to add capacity. Over T1 lines, the MAX can add bandwidth in less than ten seconds; over ISDN lines, the MAX can add bandwidth in less than five seconds.
- Once the MAX adds bandwidth, there is typically a minimum usage charge; thereafter, billing is time sensitive. The Sub Pers value should be at least equal to the minimum duration charge plus one or two billing time increments. Typically, billing is done to the next multiple of six seconds, with a minimum charge for the first thirty seconds. Your carrier representative can help you understand the billing structure of their switched tariffs.
- You can add channels one at a time or in multiples (see the Parallel Dial parameter).
- Avoid adding or subtracting channels too quickly (less than 10-20 seconds apart).

  Adding or subtracting channels very quickly leads to many short duration calls, each of which incur the carrier's minimum charge. In addition, adding or subtracting channels too quickly can affect link efficiency, since the devices on either end have to retransmit data when the link speed changes.

## Example MP connection without BACP

To configure an MP connection without BACP:

**1** Open the Answer profile.

**2** Enable PPP and MP encapsulation and specify the appropriate routing, bridging, and authentication values. For example:

```
Ethernet
   Answer
      Encaps...
         PPP=Yes
         MP=Yes

      PPP options...
         Route IP=Yes
         Route IPX=Yes
         Bridge=Yes
         Recv Auth=Either
```

**3** Close the Answer profile.

**4** Open a Connection profile, specify the name of the remote device, and activate the profile. For example:

```
Ethernet
   Connections
      Station=ted
      Active=Yes
```

5 Select MP encapsulation and open the Encaps Options subprofile.

6 Configure PPP authentication.

```
      Encaps=MP
      Encaps options...
         Send Auth=PAP
         Send PW=remotepw
         Aux Send PW=N/A
         Recv PW=localpw
```

7 Set the base channel count. For example, to use two channels for this call:

```
         Base Ch Count=2
```

**Note:** Both sides of the connection should specify the same number of channels.

8 Close the Connection profile.

## Example MP connection with BACP

To configure an MP connection using BACP:

1 Open the Answer profile.

2 Enable PPP and MP encapsulation and specify the appropriate routing, bridging, and authentication values. For example:

```
Ethernet
   Answer
      Encaps...
         MP=Yes
         PPP=Yes

      PPP options...
         Route IP=Yes
         Route IPX=Yes
         Bridge=Yes
         Recv Auth=Either
```

3 Enable BACP to monitor bandwidth requirements based on received packets.

```
         BACP=Yes
```

4 Close the Answer profile.

5 Open a Connection profile, specify the name of the remote device, and activate the profile. For example:

```
Ethernet
   Connections
      Station=clara
      Active=Yes
```

6 Select MP encapsulation and set the MP authentication options. For example:

```
      Encaps=MP
      Encaps options...
         Send Auth=PAP
         Send PW=remotepw
         Aux Send PW=N/A
         Recv PW=localpw
```

7 Enable BACP to monitor bandwidth requirements on packets transmitted on this connection, and configure the Ascend criteria for bandwidth management.

```
BACP=Yes
Base Ch Count=1
Min Ch Count=1
Max Ch Count=2
Inc Ch Count=1
Dec Ch Count=1
Dyn Alg=Quadratic
Sec History=15
Add Pers=5
Sub Pers=10
Target Util=70
```

**Note:** For optimum performance, both sides of a connection must set the channel count parameters to the same values.

8 Close the Connection profile.

## Configuring Ascend MP+ connections

MP+ (Multilink PPP Plus) uses PPP encapsulation with Ascend extensions. MP+ enables the MAX to connect to another Ascend unit using multiple channels. BACP is not required, because the Ascend criteria for adding or dropping a link are part of the MP+ extensions. In addition to the PPP and MP parameters described earlier, these are the parameters for MP+ connections:

```
Ethernet
   Answer
      Encaps...
         PPP=Yes
         MP=Yes
         MPP=Yes

      PPP options...
         Dyn Alg=Quadratic
         Sec History=15
         Add Pers=5
         Sub Pers=10
         Min Ch Count=1
         Max Ch Count=1
         Target Util=70
         Idle Pct=0

Ethernet
   Connections
      Encaps=MPP
      Encaps options...
         Aux Send PW=aux-passwd
         DBA Monitor=Transmit
         Base Ch Count=1
         Min Ch Count=1
         Max Ch Count=2
         Inc Ch Count=1
         Dec Ch Count=1
         Dyn Alg=Quadratic
         Sec History=15
         Add Pers=5
```

```
Sub Pers=10
Target Util=70
Idle Pct=0
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the MP+ parameters

This section provides some background information on MP+ connections.

- Channel counts and bandwidth allocation parameters

  BACP and MP+ use the same criteria for increasing or decreasing bandwidth for a connection. For details on the bandwidth allocation parameters, see “Understanding the MP and BACP parameters” on page 3-18 and “Guidelines for configuring bandwidth criteria” on page 3-19.

- Sending an auxiliary password for added channels

  The Aux Send PW parameter can specify another password for authenticating subsequent links as they are dialed. See the *MAX Security Supplement* for details.

- Monitoring traffic in one or both directions

  DBA Monitor specifies whether bandwidth criteria for adding or dropping links are applied to traffic received across the link, transmitted across the link, or both. If both sides of the link have DBA Monitor set to None, bandwidth on demand is disabled.

- Idle percent

  Idle Pct specifies a percentage of utilization below which all channels including the base channel are dropped. Bandwidth utilization must fall below this percentage on *both sides* of the connection before the link is dropped. If the device at the remote end of the link enters an Idle Pct setting lower than the value you specify, the MAX does not clear the call until bandwidth utilization falls below the lower percentage. The default value for Idle Pct is 0, which causes the MAX to ignore bandwidth utilization when determining whether to clear a call and use the Idle timer instead.

## Example MP+ configuration

Figure 3-1 shows the MAX connected to a remote Pipeline unit with an MP+ connection.

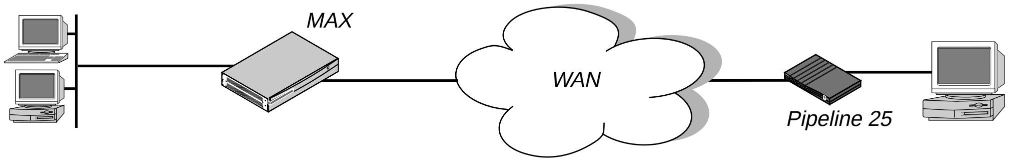


*Figure 3-3. An MP+ connection*

To configure an MP+ connection with a remote Ascend unit:

**1** Open the Answer profile.

**2** Make PPP and MP+ encapsulation are enabled and the appropriate routing, bridging, and authentication values are specified. For example:

```
Ethernet
   Answer
      Encaps...
      MPP=Yes
      PPP=Yes
   PPP options...
      Route IP=Yes
      Route IPX=Yes
      Bridge=Yes
      Recv Auth=Either
```

**3** Close the Answer profile.

**4** Open a Connection profile, specify the name of the remote device, and activate the profile. For example:

```
Ethernet
   Connections
      Station=richard
      Active=Yes
```

**5** Select MPP encapsulation and set the MP+ authentication options. For example:

```
      Encaps=MPP
      Encaps options...
         Send Auth=PAP
         Send PW=remotepw
         Aux Send PW=secondpw
         Recv PW=localpw
```

**6** Configure the DBA Monitor and the Ascend criteria for bandwidth management. For example:

```
      Encaps options...
         DBA Monitor=Transmit-Recv
         Base Ch Count=1
         Min Ch Count=1
         Max Ch Count=5
         Inc Ch Count=1
         Dec Ch Count=1
         Dyn Alg=Quadratic
         Sec History=15
         Add Pers=5
         Sub Pers=10
         Target Util=70
         Idle Pct=0
```

**Note:** For optimum performance, both sides of a connection must set the Base Ch Count, Min Ch Count, and Max Ch Count parameters to the same values.

**7** Close the Connection profile.

## Configuring a nailed MP+ connection

A Nailed/MPP connection is a nailed connection that can add switched channels for increased bandwidth. A Nailed/MPP connection is established when its nailed OR switched channels are connected end-to-end. The switched channels are dialed when the MAX receives an outbound packet for the far end and cannot forward it across the nailed connection, either because those channels are down or because they are being fully utilized.

If both the nailed and switched channels in a Nailed/MPP connection are down, the connection does not reestablish itself until the nailed channels are brought back up or the switched channels are dialed.

The maximum number of channels for the Nailed/MPP connection is either the Max Ch Count or the number of nailed channels in the specified group, whichever is greater. If a nailed channel fails, MAX replaces that channel with a switched channel, even if the call is online with more than the minimum number of channels.

**Note:** If you modify a Nailed/MPP Connection profile, most changes become active only after the call is brought down and then back up. However, if you add a group number (for example, changing Group=1,2 to Group=1,2,5) and save the modified profile, the additional channels are added to the connection without having to bring it down and back up.

To configure a Nailed/MPP connection:

1. Configure an MP+ connection, as described in the preceding section.
2. Open the Telco Options subprofile of the Connection profile.
3. Specify that the MAX is the designated caller for the switched part of the connection.

   ```
   Ethernet
      Connections
         Telco options...
            AnsOrig=Call Only
            FT1 Caller=Yes
   ```

   **Note:** On the far end of the connection, set the AnsOrig and FT1 Caller parameters for answering only. Note that the DO HANGUP command only works from the caller end of the connection.
4. Specify the Nailed/Mpp call type, and the group number(s) of its nailed channels. For example:

   ```
            Call Type=Nailed/MPP
            Group=1,2
   ```
5. Close the Connection profile.

# Configuring a Combinet connection

The MAX supports Combinet bridging to link two LANs as if they were one segment. For a Combinet connection to work, bridging must be enabled at the system level. See Chapter 7, “Configuring Packet Bridging.” Figure 3-4 shows a Combinet connection.

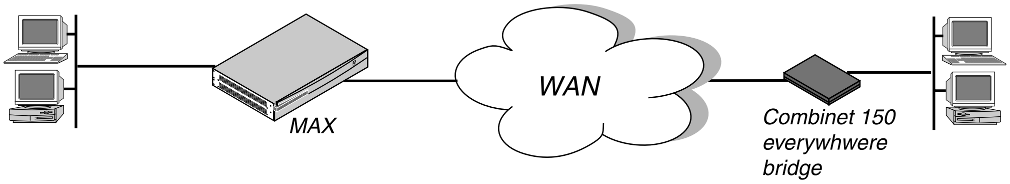


*Figure 3-4. A Combinet connection*

These are the parameters related to Combinet configuration:

```
Ethernet
   Mod Config
      Bridging=Yes
```

```
Ethernet
   Answer
```

```
      Encaps...
         COMB=Yes

      COMB options...
         Password Reqd=Yes
         Interval=10
         Compression=Yes
Ethernet
   Connections
      Station=000145CFCF01
      Encaps=COMB
      Bridge=Yes
      Encaps options...
         Password Reqd=Yes
         Send PW=remotepw
         Recv PW=localpw
         Interval=10
         Base Ch Count=2
         Compression=Yes
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding Combinet bridging parameters

This section provides some background information on a Combinet configuration.

- Specifying the hardware address of the remote Combinet bridge

  The Station parameter must specify the MAC (Media Access Control) address of the remote Combinet bridging device.

- Enabling bridging

  A Combinet connection is always a bridging connection, so the Bridge parameter in the Connection profile must be set to Yes. If the Bridge parameter is N/A, bridging has not been enabled in the Ethernet profile. See Chapter 7, “Configuring Packet Bridging.”

- Requiring a password from the remote bridge

  You can specify that an individual Combinet connection does not require a password exchange, even if the Answer profile specifies that Combinet passwords are required.

- Specifying passwords to exchange with the remote bridge

  The Send PW is the password sent to the remote device. It must match the password expected from the MAX. The Recv PW is the password sent to the MAX from the remote device.

- Configuring line-integrity monitoring

  Interval specifies the number of seconds between transmissions of Combinet line-integrity packets. You can specify a number between 5 and 50. If the MAX does not receive a Combinet line-integrity packet within the specified interval, it disconnects the call.

- Base channel count

  The Base Ch Count parameter specifies the base number of channels to use when setting up the call. It can be set to 1 (64 kbps) or 2 (128 kbps).

- Compression

  This parameter enables or disables STACKER LZS compression/decompression. Both sides of the link must enable compression or it is not used.

## Example Combinet configuration

To configure a Combinet connection:

1 Open a Connection profile.

2 Specify the MAC address of the remote device and activate the profile.

```
Ethernet
   Connections
      Station=000145CFCF01
      Active=Yes
```

3 Configuring bridging options.

```
      Bridge=Yes
      Dial Brdcast=Yes
```

4 Select Combinet encapsulation and then configure COMB options for this connection. (Leave the default values for Compression and Interval.)

```
   Encaps=COMB
      Encaps options...
         Password Reqd=Yes
         Send PW=*SECURE*
         Recv PW=*SECURE*
         Interval=10
         Base Ch Count=2
         Compression=Yes
```

5 Close the Connection profile.

# Configuring EU connections

EU encapsulation is a type of X.75 HDLC encapsulation commonly used in European countries. Like PPP, EU runs over synchronous lines. It has no asynchronous mode for connecting to modems. EU encapsulation differs from a PPP or MP+ connection in that it does not support password authentication, IP/IPX address pools, or dynamic bandwidth allocation (DBA). It does support routing and bridging connections.

EU-RAW and EU-UI do not provide password-authentication of incoming calls, so another mode of authentication is typically used to verify the caller when the call is end-to-end ISDN. For details, see the *MAX Security Supplement*.

These are the parameters related to EU configuration:

```
Ethernet
   Answer
      Id Auth=Called Reqd
      Encaps...
         EU-UI=Yes
         EU-RAW=Yes
```

```
Ethernet
   Connections
      Calling #=555-7878
      Called #=555-1212
      Encaps=EU-RAW
      Encaps options...
         MRU=1524
```

```
Ethernet
   Connections
      Calling #=555-7878
      Called #=555-1212
      Encaps=EU-UI
      Encaps options...
         MRU=1524
         DCE Addr=1
         DTE Addr=3
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the EU parameters

This section provides some background information on EU parameters.

- EU-RAW and EU-UI

  EU-RAW is a type of X.75 encapsulation, in which IP packets are HDLC encapsulated together with a CRC field. EU-UI uses the same encapsulation, but contains a smaller header that can contain one value for packets from the caller and another value for packets from the called unit. Most EU connections use EU-RAW.
- MRU (Maximum Receive Units)

  The MRU parameter specifies the maximum number of bytes the MAX can receive in a single packet on an EU link. Usually the default 1524 is the right setting, unless the far end device requires a lower number. If the administrator of the remote network specifies that you must change this value, enter a number lower than 1524.
- DCE (data communications equipment) address

  The DCE Addr parameter specifies a value for the calling unit in the EU-UI header. The caller needs to obtain the number you specify and configure their unit accordingly.
- DTE (data terminal equipment) address

  This parameter specifies a value for the called unit in the EU-UI header. The caller must use the same value for the called unit.

## Example EU configurations

Figure 3-5 shows three Connection profiles using EU encapsulation with ID authentication.

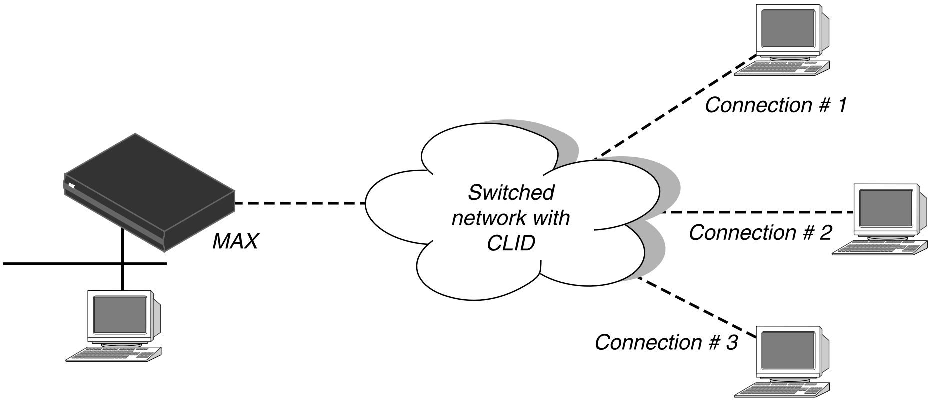


*Figure 3-5. EU connection*

To configure a connection that uses EU-RAW framing:

**1** Open the Answer profile and make sure that EU-RAW encapsulation is enabled.

**2** Set Id Auth to Calling Reqd (CLID authentication).

```
Ethernet
   Answer
      Id Auth=Calling Reqd
      Encaps...
         EU-RAW=Yes
```

**3** Close the Answer profile.

**4** Open a Connection profile and specify the name of the remote device.

**5** Activate the profile.

```
Ethernet
   Connections
      Station=remote-device
      Active=Yes
```

**6** Specify the calling line number.

```
      Calling #=555-1212
```

**7** Select the EU-RAW encapsulation type and, if necessary, configure the MRU in the Encaps Options subprofile.

```
      Encaps=EU-RAW
      Encaps options...
         MRU=1524
```

**8** Close the Connection profile.

## An example EU-UI connection

To configure a connection using EU-UI framing:

**1** Open the Answer profile and make sure that EU-UI encapsulation is enabled.

**2** Set Id Auth to Calling Reqd (CLID authentication).

```
Ethernet
   Answer
      Id Auth=Calling Reqd
      Encaps...
         EU-UI=Yes
```

**3** Close the Answer profile.

**4** Open a Connection profile, specify the name of the remote device, and activate the profile.

```
Ethernet
   Connections
      Station=remote-device
      Active=Yes
```

**5** Specify the calling line number.

```
      Calling #=555-1212
```

**6** Select the EU-UI encapsulation type.

```
      Encaps=EU-UI
```

**7** In the Encaps Options subprofile, set the DCE and DTE addresses.

```
      Encaps options...
         MRU=1524
         DCE Addr=1
         DTE Addr=3
```

8 Close the Connection profile.

# Configuring an ARA connection

ARA (AppleTalk Remote Access) uses V42 Alternate Procedure as its data link, so it can be used only over asynchronous modem connections.

These are the parameters related to ARA connections:

```
Ethernet
   Mod Config
      Appletalk=Yes
      AppleTalk...
         Zone Name=*
Ethernet
   Answer
      Profile Reqd=Yes
      Encaps...
         ARA=Yes
Ethernet
   Connections
      Encaps=ARA
      Encaps options...
         Password=*SECURE*
         Max. Time (min)=0
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the ARA parameters

This section provides some background information on ARA parameters.

- AppleTalk and zone name

  The AppleTalk parameter in the Ethernet profile enables the AppleTalk stack in the MAX. If the local Ethernet supports an AppleTalk router with configured zones, the Zone Name parameter should specify the zone in which the MAX unit resides.

- Turning off ARA Guest access

  When Profile Reqd=Yes in the Answer profile, ARA Guest access is disabled.

- A password required from ARA clients

  The Password parameter specifies the password sent to the MAX from the ARA client.

- Setting the maximum number of minutes for an ARA session

  Max Time specifies the maximum number of minutes an ARA session can remain connected. If it is set to zero (the default), the timer is disabled. The maximum connect time for an ARA connection has nothing to do with the MAX Idle Timer. If a connection is configured with maximum connect time, the MAX initiates an ARA disconnect when that time is up. The ARA link goes down cleanly, but remote users are not notified. Users will find out the ARA link is gone only when they try to access a device.

## Example ARA configuration that allows IP access

This section shows an example ARA configuration that enables a Macintosh with an internal modem dialing into the MAX using the ARA Client software to communicate with an IP host on the Ethernet. A connection that does not require IP access would be a subset of this example. The sample network looks like this:

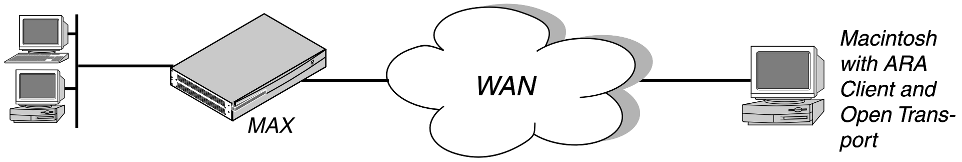


*Figure 3-6. An ARA connection enabling IP access*

**Note:** If IP access is not required, the Connection profile does not need IP routing and the Macintosh client does not need a TCP/IP configuration. For ARA connections that support IP access, the MAX receives IP packets encapsulated in AppleTalk's DDP protocol. It removes the DDP headers and routes the IP packets normally.

The Macintosh ARA Client software must be configured as follows:

- Set the appropriate modem parameters in the ARA Client software to enable the user's async modem to establish a connection with the MAX.
- Specify the right dial-in number in the ARA Client software.

The Macintosh TCP/IP software must be configured as follows:

- Open Transport

  The TCP/IP Control Panel has an option to connect by using MacIP. MacIP is required for DDP-IP encapsulation. This Control Panel also has an option to configure its IP address manually, via BOOTP, via DHCP, or via RARP. If the Macintosh will be assigned a permanent IP address, choose Manually. If the MAX will assign an address to the Macintosh from a pool of allocated addresses, choose BOOTP.
- MacTCP

  The MacTCP Control Panel should have an icon for ARA. That icon must be selected for DDP-IP encapsulation. This Control Panel also has an option to configure its IP address manually or from a Server. If the Macintosh will be assigned a permanent IP address, choose Manually. If the MAX will assign an address to the Macintosh from a pool of allocated addresses, choose Server. *Do not choose "Dynamically" in the MacTCP Control Panel.* That option is not supported in the MAX.

**Note:** The MAX must be configured as an IP router. At a minimum, the MAX unit's Ethernet interface should be configured with an IP address and a DNS server address. If the ARA client will obtain an IP address from the server, you must also configure the MAX for dynamic IP address assignment. See Chapter 9, "Configuring IP Routing."

If the MAX is configured for IP routing (Ethernet profile) you can configure an ARA connection that enabled IP access as follows:

**1** Open the Ethernet profile and set AppleTalk to Yes.

**2** If applicable, specify the AppleTalk zone in which the MAX resides.

```
Ethernet
   Mod Config
      Appletalk=Yes
      AppleTalk...
         Zone Name=Engineering
```

**3** Close the Ethernet profile.

**4** Open a Connection profile, specify the dial-in user's name, and activate the profile.

```
Ethernet
   Connections
      Station=mac
      Active=Yes
```

**5** Select ARA encapsulation and configure the ARA options.

```
      Encaps=ARA
      Encaps options...
         Password=localpw
         Max. Time (min)=0
```

**6** Configure the connection for IP routing.

For example, if the Macintosh software has a hard-coded IP address (Manual):

```
      Route IP=Yes
      IP options...
         LAN Adrs=10.2.3.4/24
```

Or, if the Macintosh software expects a dynamic IP address assignment:

```
      Route IP=Yes
      IP options...
         LAN Adrs=0.0.0.0/0
         Pool=1
```

**7** Close the Connection profile.

# Configuring terminal server connections

Terminal server connections are host-to-host connections that use an analog modem, ISDN modem (such as a V.120 terminal adapter), or raw TCP. If a call is initiated by one of these methods but contains PPP encapsulation, the terminal server forwards the call to the MAX router. These are asynchronous PPP calls, and aside from the initial processing, they are handled like regular PPP sessions. (See "Configuring PPP connections" on page 3-13.)

Figure 3-7 shows a user dialing in via analog modem using dial-up software that does not include PPP. This type of call must be routed first to a digital modem, after which it is forwarded automatically to the terminal server.

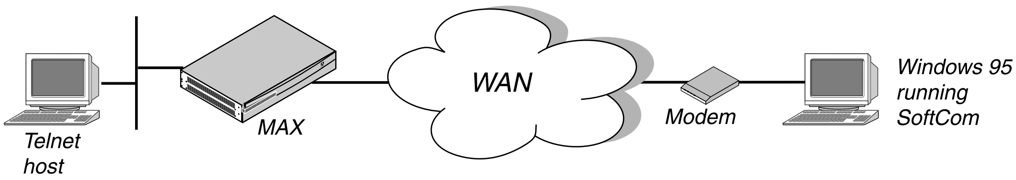


*Figure 3-7. Terminal server connection to a local Telnet host*

Terminal server connections can be authenticated via Connection or Name-password profiles, or through a third-party authentication server such as RADIUS.

**Note:** Like PPP connections, terminal server connections rely on the Answer profile for default settings and enabling of the encapsulation type. See “Introduction to WAN links” on page 3-2 for information about the telco options in a Connection profile, which apply equally to PPP or terminal server calls.

## Connection authentication issues

When a call has been received and forwarded to the terminal server, the terminal server waits briefly to receive a PPP packet. If it times out waiting for PPP, it sends its Login prompt. When it receives a name and password, it authenticates them against the Connection profile.

If the terminal server receives a PPP packet, instead of sending a Login prompt it responds with a PPP packet and LCP negotiation begins, including PAP or CHAP authentication. The connection is then established as a regular PPP session.

These are some recommended settings for callers with modems and terminal adapters:

- Analog modems and async PPP connections

  If the Connection profile specifies PAP or CHAP authentication, the caller’s PPP software should not be configured with any expect-send scripts, because the software must start negotiating PPP when the modems have connected.

  If the Connection profile does not specify PAP or CHAP authentication, the caller’s PPP software should be configured with an expect-send script (expect >"Login:" send <$username> expect "Password:" send <$password:>). When the connection has been authenticated, the software starts sending PPP packets.

- V.120 terminal adapters and PPP connections

  If the V.120 terminal adapter is configured to run the PPP protocol, it handles PAP or CHAP authentication and whatever other PPP or MP features the terminal adapter supports. Typically, the Connection profile requires PAP or CHAP.

- V.120 terminal adapters with PPP turned off

  If the V.120 terminal adapter is configured to run without PPP, it does not support PAP or CHAP authentication. If the Connection profile requires PAP or CHAP authentication, the connection will fail.

## Modem connections

This section shows sample Connection profiles for a terminal server connections established via analog modem. For example, this profile uses only the required parameters for authenticating a terminal server modem connection:

```
Ethernet
   Connections
      Station=uttam
      Active=Yes
      Encaps=PPP
      Encaps options...
         Recv PW=localpw
```

For details on these parameters, see “Understanding the PPP parameters” on page 3-14.

The next profile shows optional parameters for bringing down the terminal server connection after a specified amount of idle time:

```
Ethernet
   Connections
      Station=uttam
      Active=Yes
      Encaps=PPP
      Encaps options...
         Recv PW=localpw
      Session options...
         TS Idle Mode=Input/Output
         TS Idle=60
```

See “Connection profile session options” on page 3-8 and “Configuring single-channel PPP connections” on page 3-13.

## V.120 terminal adapter connections

V.120 terminal adapters (also known as ISDN modems) are asynchronous devices that use CCITT V.120 encapsulation. These are the values that appear to work best for V.120 operation:

- Maximum information field size for send and receive packets = 260 bytes
- Maximum number of retransmissions (N200) = 3
- Logical link ID (LLI) = 256
- Idle timer (T203) = 30 seconds
- Maximum number of outstanding frames = 7
- Modulo = 128
- Retransmission timer (T200) = 1.5 seconds
- Types of frames accepted = UI, I. (I-type frames are recommended.)
- Call placement: The MAX can receive V.120 calls, but cannot place them.

**Note:** If the connection uses PAP or CHAP authentication, the ISDN terminal adapter should be configured for async-to-sync conversion. In this case, V.120 encapsulation is not required in the Connection profile. See “Connection authentication issues” on page 3-32.

The V.120 device must be correctly configured to place calls to the MAX. The settings required for compatible operation of a V.120 device and the MAX are listed below. Refer to the manual for the V.120 device for information on how to enter these settings.

- V.120 maximum transmit frame size = 260 bytes
- V.120 maximum receive frame size = 260 bytes
- Logical link ID = 256
- Modulo = 128
- Line channel speed = Select 56K if the MAX accepts calls from the V.120 device on a T1 line, or if you are not sure that you have 64-kbps channel speed end-to-end.

After checking the configuration of the V.120 device, make sure that V.120 calls are enabled in the Answer profile:

```
Ethernet
   Answer
      Encaps...
         V.120=Yes
      V.120 options...
         Frame Length=260
```

To configure a connection that uses a V.120 terminal adapter, create a Connection profile such as this:

```
Ethernet
   Connections
      Station=tommy
      Active=Yes
      Encaps=PPP
      Encaps options...
         Recv PW=localpw
      Session options...
         TS Idle Mode=Input
         TS Idle=60
```

See “Connection profile session options” on page 3-8 and “Configuring single-channel PPP connections” on page 3-13.

## TCP-clear connections

In most cases, TCP-clear is used to transport custom-encapsulated data understood by the host and the caller. For example, you could use TCP-Clear to “tunnel” a proprietary encapsulation method in raw TCP/IP packets.

**Note:** A TCP-clear connection is host-to-host: as soon as the connection is authenticated, a TCP connection is established to the host specified in the Connection profile.

First, make sure that TCP-clear calls are enabled in the Answer profile:

```
Ethernet
   Answer
      Encaps...
         TCP-CLEAR=Yes
```

To configure a TCP-clear connection:

```
Ethernet
   Connections
      Station=richard
      Active=Yes
      Encaps=TCP-CLEAR
      Encaps options...
         Recv PW=localpw
         Login Host=techpubs
         Login Port=23
      Session options...
         TS Idle Mode=Input
         TS Idle=60
```

If DNS is configured, you can enter a hostname for the Login host (such as the “techpubs” example above). Otherwise, specify the host’s IP address. The port number is the TCP port on the host to use for the connection. A port number of zero means “any port.”

See also “Connection profile session options” on page 3-8.

## Enabling terminal server calls and setting security

The terminal server can provide a command-line interface or a menu of Telnet hosts that dial-in users can log into. Or, you can configure an “immediate mode” to automatically present the user with a login prompt to a host, bypassing the terminal server interface altogether.

- Terminal mode

  Users who have access to the command-line can see information about your network by using administrative terminal server commands. You can also allow them to initiate their own Telnet, Rlogin, or TCP connections to hosts.

- Immediate mode

  In immediate mode, the terminal server initiates a Telnet, Rlogin, or TCP connection to one specified host without every giving the dial-in user with a choice. The login and password entered by the user will be those required by the host, not by the terminal server.

- Menu mode

  The menu interface lists up to four local hosts. Users select a hostname to initiate a Telnet session to that host. The menu interface with four hosts looks like this:

```
Up to 16 lines of up to 80 characters each
will be accepted. Long lines will be truncated.
Additional lines will be ignored



         1. host1.abc.com
         2. host2.abc.com
         3. host3.abc.com
         4. host4.abc.com

           Enter Selection (1-4, q)
```

To configure the terminal server mode:

**1** Open Ethernet>Mod Config>TServ Options.

**2** Enable incoming terminal server calls.

```
Ethernet
   Mod Config
      TServ options...
         TS Enabled=Yes
```

**3** Password-protect terminal mode.

```
         Passwd=tspassword
         Security=Partial
```

**4** Close the Ethernet profile.

The terminal server security mode can be none, partial, or full. The setting determines whether users are prompted for a login name and password before entering the terminal server. Its meaning is partly dependent on whether users log into menu mode or terminal mode, and whether they are allowed to toggle between these two modes.

- If security mode is set to none, users are not prompted for a login name and password.
- If it is set to partial, they are prompted for a name and password only when entering terminal mode, not for menu mode.

- If set to full, users are prompted for a name and password upon initial login, no matter what interface will be displayed.

## Configuring modem parameters

Calls from analog modems are directed first to the MAX digital modems, where the connection must be negotiated before being directed to by the terminal server software.

To affect how the modem negotiation and data packetizing occurs, you can set the following parameters:

```
Ethernet
   Mod Config
      TServ options...
         V42/MNP=Will
         Max Baud=33600
         MDM Trn Level=-13
         Cell First=No
         Cell Level=-18
         7-Even=No
         Packet Wait Time=2
         Packet characters=0
```

### Understanding the modem parameters

This section provides background information on the modem configuration parameters.

- Digital modem error control

  The digital modems negotiate LAPM/MNP error control with the analog modem at the other end of the connection according to how this parameter is set. It can request LAPM/MNP and accept the call anyway if it is not provided, request it and drop the call if it is not provided, or not use LAPM/MNP error control at all.

- Setting a maximum baud rate

  Typically, the digital modems start with the highest possible baud rate (3360) and negotiate down to the rate accepted by the far end modem. You can adjust the maximum rate to bypass some of the negotiation cycles, provided that no inbound calls will use a baud rate higher than what you specify here.

- Specifying the default modem transmit level

  When a modem calls the MAX, the unit attempts to connect at the transmit attenuate level you specify. This is the amount of attenuation in decibels the MAX should apply to the line, causing the line to lose power when the received signal is too strong. Generally, you do not need to change the transmit level. However, when the carrier is aware of line problems or irregularities, you may need to alter the modem's transmit level.

  Rockwell modem code has been modified to make the transmit level programmable, so users can change the default setting for their specific connection. Transmitting at higher level helps certain modems with near-end-echo problems.

- Attempting cellular connections first

  The MAX supports cellular modem calls. The user can also set the gain level of the modem for cellular communication.

  Cell First determines whether the MAX first attempts cellular modem or conventional modem negotiation when answering incoming calls. If the first negotiation fails, the MAX attempts the other negotiation.

Cell Level determines the gain level of the cellular modem.

- 7-bit even parity

  The MAX does not use 7-bit even parity on outbound data unless you set this parameter to Yes. Most applications do not use 7-bit even parameter.

- Support for specialized applications on modem connections

  Packet Wait time specifies the maximum amount of time in milliseconds that any received data can wait before being passed up the protocol stack for encapsulation.

  Packet Characters specifies the minimum number of bytes of received data that should accumulate before the data is passed up the protocol stack for encapsulation.

  **Note:** Be sure to take into account modem speeds when calculating these values.

### Example modem configuration

To sets the maximum negotiable baud rate for incoming calls from analog modems:

1. Open Ethernet>Mod Config>TServ Options.
2. Set the maximum negotiable baud rate to 26400:

```
Ethernet
   Mod Config
      TServ options...
         Max Baud=26400
```

3. Close the Ethernet profile.

## Configuring terminal mode

When a user communicates with the terminal server itself (rather than a host in immediate mode), a session is established between the remote user's PC and the terminal server. To affect how that session is established and what commands are available to the user, you can set these parameters:

```
Ethernet
   Mod Config
      TServ options...
         Silent=No
         Clr Scrn=Yes
         Passwd=
         Banner=** Ascend Terminal Server **
         Login Prompt=Login:
         Prompt Format=Yes
         Passwd Prompt=Password:
         Prompt = ascend%
         Term Type= vt100
         Login Timeout= 60
         ...
         Telnet=Yes
         Rlogin=No
         Def Telnet=Yes
         Clear Call=No
         Telnet mode=ASCII
         Local Echo=No
         Buffer Chars=Yes
         ...
         3rd Prompt=
         3rd Prompt Seq=N/A
         IP Addr Msg=N/A
```

## Understanding the terminal mode parameters

This section provides background information on the terminal mode configuration parameters.

- Controlling how the screen appears to users while the connection is set up

  Silent determines whether status messages will be displayed or suppressed while the connection is being established. Clr Scrn can be set to clear the screen when a connection has been established.

- Setting the terminal mode password

  Passwd specifies a password up to 15 characters. This is the password terminal server users will be prompted for when establishing a connection to the terminal server itself.

- Setting the login banner and prompts

  When the terminal server session is established, the system displays the banner "**Ascend Terminal Server **" or  a different banner you have configured.

  Login Prompt and Password Prompt specify what the user sees while logging in, by default:

  ```
  Login:
  ```

  ```
  Password:
  ```

  The Login prompt can be up to 80 characters and consist of more than one line if Prompt Format is set to Yes. To specify a multi-line prompt, set Prompt Format to Yes and use "\n" to represent a carriage return/line feed and "\t" to represent a tab.

- Specifying the command-line prompt

  Prompt specifies the command-line prompt, which by default is:

  ```
  ascend%
  ```

  Be sure to include a trailing space if desired.

- Another login prompt for RADIUS-authenticated logins

  The 3rd Prompt is another login prompt, and 3rd Prompt Seq specifies whether the third prompt is displayed before or after the regular terminal server login prompts.

  For RADIUS-authenticated logins, some servers require the third prompt and that is appears last in the login sequence. This is the default setting.

  Some ISPs use a terminal server that follows a login sequence different from that used by Ascend, for example, that includes a menu selection prior to login. Administrators at those sites can configure 3rd prompt to be displayed First to mimic that terminal server and retain compatibility with client software in use by subscribers. See the *MAX Reference Guide* for more details.

- Affecting Telnet and Rlogin session defaults

  You can enable or disable the use of the RLOGIN, and TELNET commands at the terminal server command-line. When they are enabled, you can set parameters to affect session defaults. (Users can modify some of these default values on the command line.)

  Term Type specifies a default terminal type, such as the vt100.

  Clear Call specifies whether when the user terminates a Telnet or Rlogin session, the connection is terminated as well.

  Buffer Chars determines whether the terminal server buffers input characters for 100 milliseconds before forwarding them to the host, or sends the characters as received.

Telnet Mode specifies whether binary, ascii, or transparent mode is the default for Telnet sessions. Def Telnet instructs the terminal server to interpret unknown command strings as the name of a host for a Telnet session. Local Echo sets a global default for echoing characters locally, which can be changed for an individual session within Telnet.

- Displaying a message when informing users of their address

  The terminal server displays “Your IP address is ...” (followed by the assigned address). You can change that default message.

- Specifying a login timeout

  Users will be disconnected if they have not completed logging in when the number of seconds set in the Login Timeout field has elapsed. A user has the total number of seconds indicated in the Login Timeout field to attempt a successful login. This means that the timer begins when the login prompt appears on the terminal server screen, and continues (is not reset) when the user makes unsuccessful login attempts.

### Example terminal mode configuration

This example configures the password and makes the Rlogin option available to dial-in users. Note that the Telnet option is enabled by default.

**1** Open Ethernet>Mod Config>TServ Options.

**2** Specify the terminal server password.

**3** Configure a multi-line login prompt.

```
Ethernet
   Mod Config
      TServ options...
         Login Prompt=Welcome to Ascend Remote Server\nEnter your name:
         Prompt Format=Yes
```

**4** Enable the use of the Rlogin command in terminal mode.

```
         Passwd=tspasswd
         Rlogin=Yes
```

**5** Close the Ethernet profile.

## Configuring immediate mode

When dial-in calls are directed immediately to a host, a session is established between the remote user’s PC and that host via Rlogin, Telnet, or TCP. To affect how that session is established, you can set these parameters:

```
Mod Config
   TServ options...
      Immed Service=None
      Immed Host=N/A
      Immed Port=N/A
      Telnet Host Auth=No
```

### Understanding the immediate mode parameters

This section provides background information on the immediate mode configuration parameters.

- Specifying the type of immediate service

  Immed Service enables a particular type of service for establishing an immediate host connection for dial-in users. You can specify Telnet, Raw-TCP, Rlogin, or X25-PAD. For details on X.25, see Chapter 5, "Configuring X.25."

  For Telnet service, you can set the Telnet Host Auth parameter to bypass the terminal server authentication and go right to a Telnet login prompt.

- The host and the port on which the connection is made

  Specify the hostname or address to which users will be connected in terminal server immediate mode. You can also specify a TCP port number to use for the connections.

### Example immediate mode configuration

This example configures immediate Telnet service that relies on the Telnet host for authentication.

1. Open Ethernet>Mod Config>TServ Options.
2. Set the Immed Service parameter to Telnet.
3. Specify the name or IP address of the Telnet host.
4. If appropriate, specify the TCP port to use on the Telnet host.
5. Set the Telnet Host Auth parameter to Yes.

```
Ethernet
   Mod Config
      TServ options...
         Immed Service=Telnet
         Immed Host=host1.abc.com
         Immed Port=23
         Telnet Host Auth=Yes
```

6. Close the Ethernet profile.

## Configuring menu mode

You can set up the terminal server to display a menu of up to four Telnet hosts  that dial-in users can select for logging in.  You can set up menu mode with these parameters:

```
Ethernet
   Mod Config
      TServ options...
         Initial Scrn=Cmd
         Toggle Scrn=No
         Remote Conf=No
         Host #1 Addr=0.0.0.0
         Host #1 Text=
         Host #2 Addr=0.0.0.0
         Host #2 Text=
         Host #3 Addr=0.0.0.0
         Host #3 Text=
         Host #4 Addr=0.0.0.0
         Host #4 Text=
```

### Understanding the menu mode parameters

This section provides background information on the menu mode configuration parameters.

- Specifying menu mode as the initial interface

  Initial Scrn determines whether the terminal server will bring up a menu interface first for interactive users initiating connections. Depending on the Toggle Scrn setting, users may be able to switch to the command-line interface from menu mode by pressing the zero key. The Security setting determines whether a login and password will be required when entering the menu interface.

- Obtaining the menu from RADIUS

  Remote Conf specifies that the terminal server menu and list of hosts will be obtained from a RADIUS server.

- Specifying the hostnames and addresses of up to four Telnet hosts

  The Host and Text parameters expect an IP address and hostname, respectively, for up to four Telnet hosts.

### Example menu mode configuration

This example specifies that users will be presented with the menu at login, will not be allowed to enter the command-line, and specifies four local hosts.

**1** Open Ethernet>Mod Config>TServ Options.

**2** Specify that dial-in users will be in menu mode initially.

```
Ethernet
   Mod Config
      TServ options...
         Initial Scrn=Menu
```

**3** Specify the IP addresses and hostnames of up to four hosts that will appear in the menu.

```
Ethernet
   Mod Config
      TServ options...
         Host #1 Addr=10.2.3.4
         Host #1 Text=host1.abc.com
         Host #2 Addr=10.2.3.57
         Host #2 Text=host2.abc.com
         Host #3 Addr=10.2.3.121
         Host #3 Text=host3.abc.com
         Host #4 Addr=10.2.3.224
         Host #4 Text=host4.abc.com
```

See “Enabling terminal server calls and setting security” on page 3-35 for an example menu. Dial-in users will be able to Telnet to these hosts by selecting the hostname or IP address.

**4** Close the Ethernet profile.

## Configuring PPP mode

Users who are logged into the terminal server in terminal mode can invoke an async PPP session by using the PPP command, initiating PPP mode.  Or, even if users do  not have access to the command line, they can begin an async PPP session  from an application such as Netscape Navigator or Microsoft Explorer. For example, if a user initiates a session from Windows 95, which has a resident TCP/IP stack, the async PPP session can begin immediately without entering the terminal server interface. These parameters configure PPP mode:

```
Ethernet
   Mod Config
      TServ options...
         PPP=No
         ...
         PPP Delay=5
         PPP Direct=No
         PPP Info=mode
```

### Understanding the PPP mode parameters

This section provides background information on the PPP mode configuration parameters.

- Enabling PPP mode

  You can prevent users from initiating PPP sessions by setting PPP to No.

- PPP delay

  PPP Delay specifies the number of seconds the terminal server waits before transitioning to packet-mode processing.

- PPP direct

  PPP Direct specifies whether to start PPP negotiation immediately after a user enters the PPP command in the terminal server interface, or to wait to receive a PPP packet from an application. (Some applications expect to receive a packet first.)

- The message informing users they are in PPP mode

  You can specify that no message is displayed, or choose between “PPP Mode” and “PPP Session”.

### Example PPP configuration

This example enables PPP direct mode:

**1** Open Ethernet>Mod Config>TServ Options.

**2** Enable the use of the PPP command in terminal mode.

**3** Enable PPP direct negotiation.

```
Ethernet
   Mod Config
      TServ options...
         PPP=Yes
         PPP Direct=Yes
```

**4** Close the Ethernet profile.

## Configuring SLIP mode

If SLIP mode is enabled in the terminal server, users can initiate a SLIP session and then run an application such as FTP in that session. SLIP mode configuration uses these parameters.

```
Ethernet
   Mod Config
      TServ options...
         SLIP=No
         SLIP BOOTP=N/A
```

### Understanding the SLIP mode parameters

This section provides background information on the SLIP mode configuration parameters.

- Enabling SLIP (Serial Line IP) sessions

  You can disable or enable SLIP sessions by using the SLIP parameter.

- Allowing users to obtain an IP address from a BOOTP server

  SLIP BOOTP enables the terminal server to respond to BOOTP within SLIP sessions. If it is enabled, a user who initiates a SLIP session can get an IP address from the designated IP address pool via BOOTP. If it is disabled, the terminal server does not run BOOTP; instead, the user is prompted to accept an IP address at the start of the SLIP session

### Example SLIP configuration

This example enables SLIP sessions and specifies that the terminal server will respond to BOOTP in SLIP sessions:

**1** Open Ethernet>Mod Config>TServ Options.

**2** Enable the use of the SLIP command in terminal mode.

**3** Enable the use BOOTP in SLIP sessions.

```
Ethernet
   Mod Config
      TServ options...
         SLIP=Yes
         SLIP BOOTP=Yes
```

**4** Close the Ethernet profile.

## Configuring dialout options

The terminal server has access to the MAX digital modems, and can be used to enable users on the local network to dialout using those modems. You can enable local dialout using these parameters:

```
Ethernet
   Mod Config
      TServ options...
         Modem dialout=No
         Immediate Modem=N/A
         Imm. Modem port=N/A
         Imm. Modem Pwd=N/A
```

### Understanding the dialout parameters

This section provides background information on the dialout configuration parameters.

- Enabling dialout

  If Modem dialout is enabled, local users can connect to the terminal server via Telnet and then issue AT commands to the modem as if connected locally to the modem’s asynchronous port.

- Enabling direct access dialout

  If Immediate Modem service is enabled, users Telnet to a particular port on the MAX and are provided Immediate Modem dialout service. The port number configured for Immediate Modem dialout tells the MAX that all Telnet sessions initiated with that port number want modem access. Immediate Modem service has its own password (up to 64 characters. If the Imm. Modem Pwd is non-null, users will be prompted for a password before being allowed access to a modem.

## How the modem dialout works

If you enable dialout (not Immediate Modem), users can access a modem as follows:

**1** Telnet to the MAX from a workstation. For example:

```
Telnet max01
```

**2** Invoke the terminal server command-line interface (System>Sys Diag>Term Serv).

Users will see the terminal server prompt, for example:

```
ascend%
```

**3** Enter the terminal server Open command.

```
ascend% open
```

Without an argument, the Open command sets up a virtual connection to the first available digital modem. Alternatively, the user can specify a particular modem by including its slot and item number as an argument to the command; for example:

```
ascend% open 7:1
```

**4** Use the standard Rockwell AT commands to dial out on the modem, just as if using a modem connected directly to a workstation. For example:

```
ATDT 1V1 ^M
```

**5** To suspend a virtual connection to a digital modem and return to the terminal server prompt, press Ctrl-C three times.

```
^C^C^C
```

**6** To resume the suspended virtual connection:

```
ascend% resume
```

**7** To terminate a virtual connection:

```
ascend% close
```

## How immediate modem works

Immediate Modem enables users to access a modem directly by Telneting to the specified port. For example, users can access a modem as follows:

**1** Telnet to the MAX from a workstation, specifying the immediate modem port number on the command line. For example:

```
Telnet max01 5000
```

Where “max01” is the system name of the MAX and “5000” is the Immediate Modem Port.

**2** Use the standard Rockwell AT commands to dial out on the modem, just as if using a modem connected directly to a workstation. For example:

```
ATDT 1V1 ^M
```

**3** Press Ctrl-C to terminate the connection.

### Example dialout configuration

This example enables direct access on port 5000:

**1** Open Ethernet>Mod Config>TServ Options.

**2** Enable the use of the modem dialout.

**3** Enable the direct access (immediate modem) feature.

```
Ethernet
   Mod Config
      TServ options...
         Modem dialout=Yes
         Immediate Modem=Yes
```

**4** Specify on which port the immediate modem feature will function.

**5** Specify a password for modem access.

```
Ethernet
   Mod Config
      TServ options...
         Imm. Modem port=5000
         Imm. Modem Pwd=dialoutpwd
```

**6** Close the Ethernet profile.

# Configuring Frame Relay

# 4

This chapter contains these topics:

# Using the MAX as a frame relay concentrator

In a frame-relay backbone, every access line connects directly to a frame relay switch. In the past, most connections to the frame relay network were relatively high speed, such as full T1 or E1 lines. With recent changes in frame relay pricing, many sites now want to concentrate many low-speed dial-in connections into one high-speed nailed connection to a frame relay switch. When the MAX is configured as a frame relay concentrator, it accepts incoming dial-in connections as usual and forwards them out to a frame relay switch.

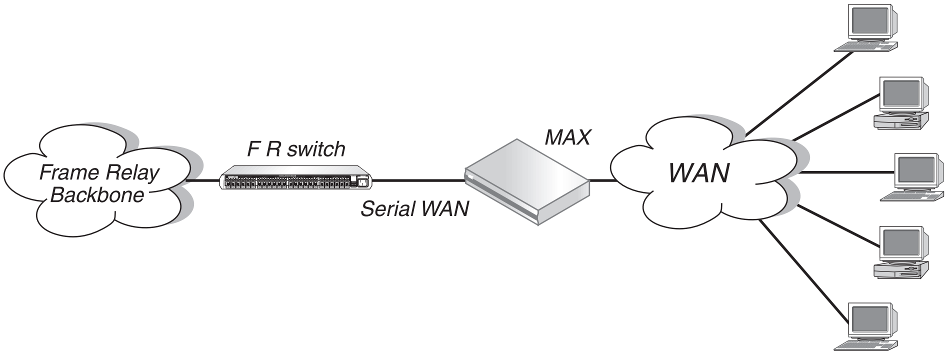


*Figure 4-1. The MAX operating as a frame relay concentrator*

In this model, up to 96 low-speed connections in North America/Japan or 120 low-speed connections in Europe could be concentrated into a single MAX unit. If all of the frame relay connections are concentrated onto the single 8-Mbps serial WAN interface, the MAX turns a single high-cost frame relay port on a traditional frame relay switch into approximately 100 ports operationally.

Configuring the MAX as a frame relay concentrator involves the following elements:

- An interface to the frame relay switch (usually serial WAN).
- A logical datalink to the frame relay switch (defined in a Frame Relay profile)
- User connections (defined in Connection profiles or RADIUS)

## Kinds of physical network interfaces

The MAX typically uses the serial WAN port to connect to a frame relay switch. For details on configuring these interfaces, see Chapter 2, “Configuring the MAX for WAN Access.”

## Kinds of logical interfaces to a frame relay switch

Figure 4-2 shows the types of frame relay interfaces supported in the MAX:

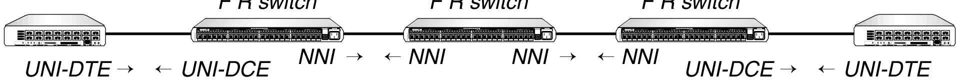


*Figure 4-2. Types of logical interfaces to frame relay switches*

**Note:** As a frame relay concentrator, the MAX can operate as a CPE (Customer Premise Equipment) device or as a FR switch, or both. In Figure 4-2, all of the elements could be Ascend units, but are not necessarily so.

These types of interfaces to the frame relay network are supported in the MAX:

- NNI (Network to network interface)

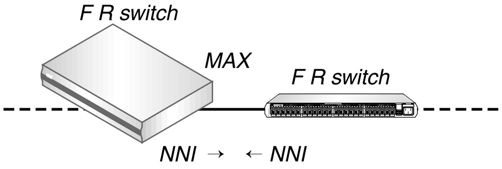


*Figure 4-3. NNI interface in a MAX unit*

An NNI interface connection allows the MAX to appear as a frame relay network interface based on the NNI specifications. It performs both DTE and DCE link management, and allows two separate frame relay networks to connect via a common protocol. See “Configuring an NNI interface” on page 4-6.

- UNI-DCE (User to network interface — data communications equipment)

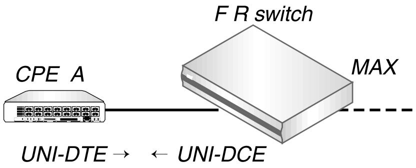


*Figure 4-4. UNI-DCE interface*

UNI is the interface between an end-user and a network end point (a router or a switch) on the frame relay network. In a UNI-DCE connection, the MAX operates as a frame relay router communicating with a DTE device. To the DTE devices, it appears as a frame relay network end point. See “Configuring a UNI-DCE interface” on page 4-7.

- UNI-DTE (User to network interface — data terminal equipment)

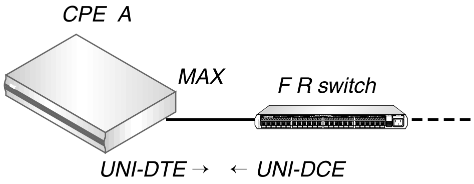


*Figure 4-5. UNI-DTE interface*

In a UNI-DTE connection, the MAX is configured as a UNI-DTE communicating with a frame relay switch. It acts as a frame relay “feeder” and performs the DTE functions specified for link management. See “Configuring a UNI-DTE interface” on page 4-7.

**Note:** For NNI or UNI-DTE connections, the MAX is able to query the device at the other end of the link about the status of the DLCIs in the connection. If any of the DLCIs become unusable and the DLCI’s Connection profile has a specified Backup connection, the MAX dials the Connection profile specified in the Backup parameter in Connections>Session Options. See the description of the Backup parameter for details.

## Kinds of dial-in connections that use frame relay

The three kinds of connections that make use of frame relay in the MAX are:

- Gateway connections

  The MAX receives an incoming PPP call, examines the destination IP address, and brings up the appropriate Connection profile to that destination, as usual. If the Connection profile specifies frame-relay encapsulation, the Frame-Relay profile, and a DLCI, the MAX encapsulates the packets in frame relay (RFC 1490) and forwards the data stream out to the frame relay switch using the specified DLCI. The frame relay switch uses the DLCI to route the frames. This is known as gateway mode.

- Frame relay circuits

  A circuit is a permanent virtual circuit (PVC) segment that consists of two DLCI end points and possibly two Frame Relay profiles. It requires two and only two DLCI numbers: data is dropped if the circuit has only one DLCI and if more than two are defined, only two are used. Circuits are defined in two Connection profiles. Data coming in on the DLCI configured in the first Connection profile is switched to the DLCI configured in the second one.

- Redirect connections (rarely used)

  When the MAX receives an incoming PPP call for which the session options specify FR Direct, it ignores the destination IP address in the packets from the dial-in client. Instead, it routes the packet using the FR DLCI specified in the session options. In effect, the MAX doesn’t route packets from the client in the usual sense, it simply passes them on to the frame relay network and assumes that another device will route the packets based on the destination IP address. This is known as redirect mode, and is not commonly used.

# Configuring the logical link to a frame relay switch

The Frame Relay profile specifies a  link, usually across a single cable, to the frame relay network. This link can support many permanent virtual circuits (PVCs), each with a different endpoint. These are the Frame Relay  parameters:

```
Ethernet
   Frame Relay
      Name=NNI
      Active=Yes
      Call Type=Nailed
      FR Type=NNI
      LinkUp=Yes
      Nailed Grp=1
      Data Svc=64k
      PRI # Type=N/A
      Dial #=N/A
      Bill #=N/A
      Call-by-Call=N/A
      Transit #=N/A
      Link Mgmt=Q.933A
      N391=6
      DTE N392=3
      DTE N393=4
      DCE N392=3
      DCE N393=4
```

```
T391=10
T392=15
MRU=1532
```

For details on each of these parameters, see the *MAX Reference Guide*.

## Understanding the frame relay parameters

This section provides some background information about the frame relay parameters:

- Specifying a profile name and activating the profile

  User connections link up with the frame relay connection specified in this profile by specifying its profile name. The name must be unique and cannot exceed 15 characters.

  The Active parameter must be set to Yes to make this profile available for use.

- Bringing down the datalink when DLCIs are not active

  LinkUp indicates that the datalink comes up automatically and stays up even when the last DLCI has been removed. If this parameter is set to No, the datalink does not come up unless a Connection profile (DLCI) brings it up, and it shuts down after the last DLCI has been removed.

  **Note:** You can start and drop frame relay datalink connections by using the DO DIAL and DO HANGUP commands. DO DIAL brings up a datalink connection. DO HANGUP closes the link and any DLCIs on it. If LinkUp=Yes, DO HANGUP brings the link down, but it will be automatically restarted. A restart will also occur if there is a DLCI profile invoking the datalink.

- Defining the nailed connection to the switch

  Nailed is the default for frame relay connections. When the call type is nailed, dial numbers and other telco options are N/A. You can specify switched if the frame relay switch allows dial-in; however, frame relay networks currently have no dial-out connection capability. The two types of data service that are available are 64K or 56K.

- Specifying the type of frame relay interface

  You can set the FR Type parameter to NNI (for an NNI interface to the switch), DCE (for a UNI-DCE interface), or DTE (for a UNI-DTE interface). See “Kinds of logical interfaces to a frame relay switch” on page 4-2.

- Link management protocol

  The Link Mgmt setting may be None (no link management), T1.617D (for T1.617 Annex D), and Q.933A (for Q.933 Annex A).

- Frame relay timers and event counts

  Frame relay timers and event counts are as follows:

  – N391 specifies the interval at which the MAX requests a Full Status Report (between 1 and 255 seconds). It is N/A if FR Type is DCE.

  – DCE N392 specifies the number of errors during DCE N393 monitored events which causes the network side to declare the user side procedures inactive. Its value should be less than DCE N393 (between 1 and 10). It is N/A when FR Type is DTE.

  – DCE N393 specifies the DCE monitored event count (between 1 and 10). It is N/A when FR Type is DTE.

  - DTE N392 specifies the number of errors during DTE N393 monitored events which cause the user side to declare the network side procedures inactive. Its value should be less than DTE N393 (between 1 and 10). It is N/A when FR Type is DCE.
  - DTE N393 specifies the DTE monitored event count (between 1 and 10). It is N/A when FR Type is DCE.
  - T391 specifies the Link Integrity Verification polling timer (between 5 and 30 seconds). Its value should be less than T392. It is N/A when FR Type is DCE.
  - T392 specifies the time for Status Enquiry messages (between 5 and 30 seconds). An error is recorded if no Status Enquiry is received within T392 seconds. This parameter is N/A when FR Type is DTE.
- MRU (Maximum Receive Units)

  The MRU parameter specifies the maximum number of bytes the MAX can receive in a single packet across this link. Usually the default 1532 is the right setting, unless the far end device requires a lower number.

## Example Frame Relay profile configurations

This section shows an example Frame Relay profile configuration for each type of frame relay interface (NNI, UNI-DCE, and UNI-DTE).

### Configuring an NNI interface

In this example, the MAX has a nailed connection to another frame relay switch and will be configured with an NNI interface to that switch. The sample network looks like this:

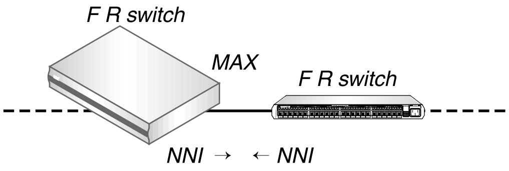


*Figure 4-6. Example NNI interface to another switch*

To configure the Frame Relay profile for this NNI interface:

1. Open a Frame Relay profile.
2. Assign the profile a name and activate it.

```
Ethernet
   Frame Relay
      Name=ATT-NNI
      Active=Yes
```

3. Set the FR Type to NNI.

```
      FR Type=NNI
```

4. Set up the nailed connection to the remote switch and specify the data service for the link. For example:

```
      Call Type=Nailed
      Nailed Grp=1
      Data Svc=64k
```

5. Specify the link management protocol and its configuration parameters. For example:

```
            Link Mgmt=T1.617D
            N391=6
            T391=10
            T392=15
            MRU=1532
```

6 Close the Frame Relay profile.

## Configuring a UNI-DCE interface

In this example, the MAX has a nailed  connection to customer premises equipment (CPE) and will be configured with an UNI-DCE interface to that equipment.  The sample network connection looks like this:

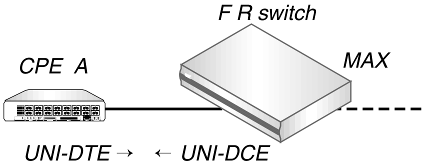


*Figure 4-7. Example UNI-DCE interface to an end-point (DTE)*

To configure the Frame Relay profile for this UNI-DCE interface:

1 Open a Frame Relay profile.

2 Assign the profile a name and activate it.

```
Ethernet
   Frame Relay
      Name=ATT-DCE
      Active=Yes
```

3 Set the FR Type to DCE.

```
      FR Type=DCE
```

4 Set up the nailed connection to  the remote switch and specify the data service for the link. For example:

```
      Call Type=Nailed
      Nailed Grp=1
      Data Svc=64k
```

5 Specify the link management protocol and its configuration parameters. For example:

```
      Link Mgmt=T1.617D
      DCE N392=3
      DCE N393=4
      T392=15
```

6 Close the Frame Relay profile.

## Configuring a UNI-DTE interface

In this example, the MAX has a nailed connection to a frame relay switch configured as a DCE and will be configured with a UNI-DTE interface to that switch. The sample network connection looks like this:

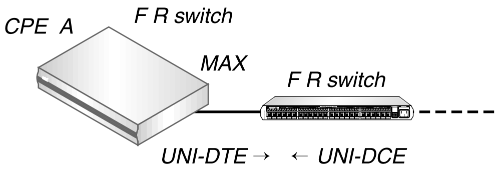


*Figure 4-8. UNI-DTE interface to a frame relay switch*

To configure the Frame Relay profile for this UNI-DTE link:

**1** Open a Frame Relay profile.

**2** Assign the profile a name and activate it.

```
Ethernet
   Frame Relay
      Name=ATT-DTE
      Active=Yes
```

**3** Set the FR Type to DTE.

```
      FR Type=DTE
```

**4** Set up the nailed connection to the remote switch and specify the data service for the link. For example:

```
      Call Type=Nailed
      Nailed Grp=1
      Data Svc=64k
```

**5** Specify the link management protocol and its configuration parameters. For example:

```
      Link Mgmt=Q.933A
      N391=6
      DTE N392=3
      DTE N393=4
      T391=10
```

**6** Close the Frame Relay profile.

# Configuring connections that use frame relay

All connections that use frame relay must specify the name of a configured Frame Relay profile as the datalink between the MAX and the frame relay network. Connections that are forwarded or routed over the frame relay link use the following parameters:

```
Ethernet
   Answer
      Encaps...
         PPP=Yes
         FR=Yes

      PPP Options...
         Route IP=Yes
```

For gateway connections:

```
Ethernet
   Connections
      Encaps=FR
      Encaps options...
         FR Prof=pacbell
         DLCI=16
         Circuit=N/A

      Route IP=Yes

      Ip options...
         LAN Adrs=10.2.3.4/24
```

For frame relay circuits:

```
Ethernet
   Connections
      Encaps=FR_CIR
      Encaps options...
         FR Prof=pacbell
         DLCI=16
         Circuit=circuit-1
```

For redirect connections:

```
Ethernet
   Connections
      Encaps=PPP
      Route IP=Yes
      Ip options...
         LAN Adrs=10.2.3.4/24

      Session options...
         FR Direct=Yes
         FR Prof=pacbell
         FR DLCI=16
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the frame relay connection parameters

This section provides some background information about the frame relay connection parameters:

- Gateway connections (Encaps=FR)

  Gateway connections require FR encapsulation, a Frame Relay profile name, and a DLCI. Your frame relay provider tells you the DLCI to assign to each connection.

  The far end specified in a frame-relay encapsulated Connection profile lies at the end of a PVC, whose first hop is known by the DLCI named in the Connection profile. The MAX does not allow you to enter duplicate DLCIs, except when they are carried by separate physical links specified in different Frame Relay profiles.

- Frame relay circuits (Encaps=FR_CIR)

  A circuit is a PVC segment configured in two Connection profiles. Data coming in on the DLCI configured in one Connection profile is switched to the DLCI configured in the other. Data is dropped if the circuit has only one DLCI. If more than two Connection profiles specify the same circuit name, only two of them are used.

  In a circuit, both Connection profiles must specify FR_CIR encapsulation and the same circuit name. Each profile must specify a unique DLCI. The MAX does not allow you to enter duplicate DLCIs, except when they are carried by separate physical links specified in different Frame Relay profiles.

- Redirect connections (FR Direct=Yes)

  In an FR Direct connection, the MAX simply “attaches” a frame relay PVC to multiple Connection profiles. It does so on the Session Options subprofile by enabling FR Direct, specifying a Frame Relay profile, and setting a DLCI for the PVC endpoint in the FR DLCI parameter. Any packet coming into the MAX on these connections gets switched out on the DLCI. In this mode, the MAX allows multiple Connection profiles to specify the same PVC (the same DLCI).

  In this unusual mode called "frame relay redirect", the MAX ignores the destination of these packets. It assumes that some device at the far end of the PVC makes the routing decisions. However, the Connection profile must use IP routing to enable the MAX to route data back to the client.

# Example connection configurations

This section shows example Connection profile configurations for frame relay gateway, circuit, and redirect configurations.

## Configuring a frame relay gateway connection

This example configuration shows how to configure a frame relay gateway connection. It presumes that dial-in users who need to reach the distant IP network have valid Connection profile (or RADIUS user profiles). This example shows the Connection profile that assigns a DLCI and passes the data stream out to a frame relay switch. The example network is shown in Figure 4-9:

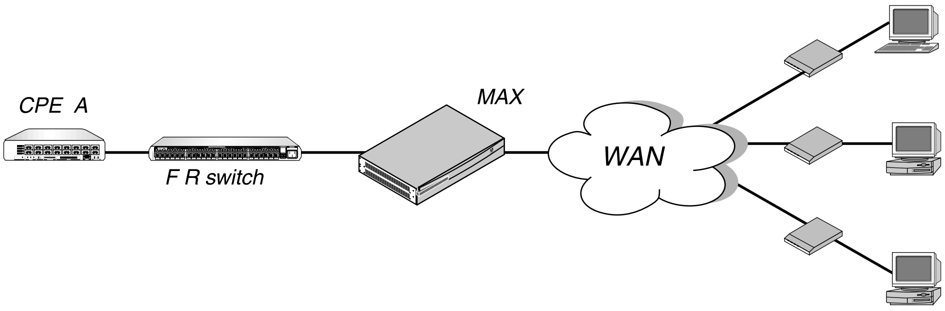


*Figure 4-9. Gateway connections*

In this example, the MAX communicates with a remote frame relay switch using a Frame Relay profile named “ATT-NNI.” To configure this link:

1. Open a Connection profile.
2. Specify the station name, activate the profile, and specify FR encapsulation.

```
Ethernet
   Connections
      Station=gateway-1
      Active=Yes
      Encaps=FR
```

3. Enable IP routing and specify the address of the remote IP router.

```
      Route IP=Yes
      Ip options...
         LAN Adrs=10.2.3.4/24
```

4 Open the Encaps Options subprofile and specify the name of the Frame Relay profile with a nailed connection to the frame relay switch, and a DLCI assigned by the frame relay administrator.

```
      Encaps options...
         FR Prof=ATT-NNI
         DLCI=55
         Circuit=N/A
```

5 Close the Connection profile.

## Configuring a frame relay circuit

This example configuration configures a circuit between a UNI-DCE and NNI datalinks. A circuit between any two interfaces within the MAX would be configured in much the same way. The example network looks like this:

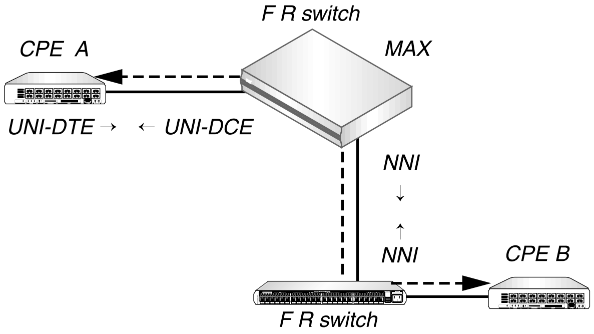


*Figure 4-10. A frame relay circuit*

The Frame Relay profile for the UNI-DCE interface in the MAX is named “ATT-DCE.” For the NNI interface, the Frame Relay profile is named “ATT-NNI.” To configure this circuit:

1 Open the first Connection profile.

2 Specify the station name, activate the profile, and specify FR_CIR encapsulation.

```
Ethernet
   Connections
      Station=victor
      Active=Yes
      Encaps=FR_CIR
```

3 Open the Encaps Options subprofile and specify the name of the Frame Relay profile with a nailed connection to the frame relay switch, a DLCI assigned by the frame relay administrator, and a name for the frame relay circuit.

```
      Encaps options...
         FR Prof=ATT-DCE
         DLCI=18
         Circuit=Circuit-1
```

4 Close the Connection profile.

5 Open the second Connection profile.

6 Specify the station name, activate the profile, and specify FR_CIR encapsulation.

```
Ethernet
   Connections
      Station=marty
      Active=Yes
      Encaps=FR_CIR
```

**7** Open the Encaps Options subprofile and specify the name of the Frame Relay profile with a nailed connection to the frame relay switch, a DLCI assigned by the frame relay administrator, and a name for the frame relay circuit.

```
      Encaps options...
         FR Prof=ATT-NNI
         DLCI=23
         Circuit=Circuit-1
```

**8** Close the second Connection profile.

## Configuring a redirect connection

This example shows how to configure two PPP dial-in connections to be redirected out to the frame relay network.

**Note:** A frame relay redirect connection is not a full-duplex tunnel between the PPP dial-in and the switch. The IP packets coming back from the frame relay switch are handled by the MAX router software, so they must contain the PPP caller's IP address to be routed correctly back across the WAN.

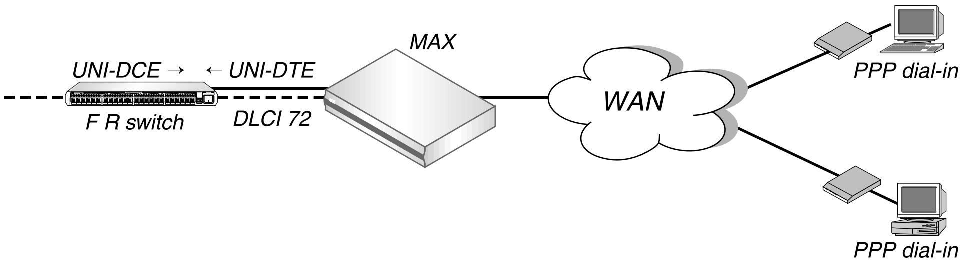


*Figure 4-11. Redirect connection*

In this example, the MAX communicates with a frame relay switch using a Frame Relay profile named "ATT-DTE." To configure two PPP dial-in connections to be redirected using the same DLCI:

**1** Open a Connection profile.

**2** Specify the station name, activate the profile, and specify PPP encapsulation.

```
Ethernet
   Connections
      Station=caller-1
      Active=Yes
      Encaps=PPP
```

**3** Make sure that IP routing is enabled.

```
      Route IP=Yes
```

**4** Open the Session Options subprofile, enable FR Direct, and specify the name of the Frame Relay profile to use.

```
      Session options...
         FR Direct=Yes
         FR Prof=ATT-DTE
```

5. Assign a DLCI that will be available for this redirect connection, which may already be in use by other redirect Connection profiles.

```
            FR DLCI=72
```

6. Close the Connection profile.
7. Open a second Connection profile.
8. Specify the station name, activate the profile, and specify PPP encapsulation.

```
Ethernet
   Connections
      Station=caller-2
      Active=Yes
      Encaps=PPP
```

9. Make sure that IP routing is enabled.

```
      Route IP=Yes
```

10. Open the Session Options subprofile, enable FR Direct, and specify the name of the Frame Relay profile to use.

```
      Session options...
         FR Direct=Yes
         FR Prof=ATT-DTE
```

11. Assign a DLCI that will be available for this redirect connection. For example, you may assign the same DLCI used in the previous redirect Connection profile.

```
         FR DLCI=72
```

12. Close the Connection profile.

# Monitoring frame relay connections

The terminal server command-line interface has new Show FR commands for monitoring frame relay in the MAX. To see the options, invoke the terminal server interface (System>Sys Diag>Term Serv) and then use the Show FR command. For example:

```
ascend% show fr ?

show fr ?           Display help information
show fr stats       Display Frame relay information
show fr lmi         Display Frame relay LMI information
show fr dlci [name] Display all DLCI information or just for [name]
show fr circuits    Display the FR Circuit table
```

## Displaying frame relay statistics

To display frame relay statistics:

```
ascend% show fr stats

Name          Type   Status    Speed    MTU     InFrame     OutFrame
fr1           DCE    Down     64000    1532           0            1
fr1-temp      DCE      Up     64000    1532           0            1
fr1-temp-9    DCE      Up     64000     1532          0            0
```

The output contains these fields:

- Name: The name of the Frame Relay profile associated with the interface.

- Type: The type of interface.
- Status: The status of the interface. “Up” means the interface is functional, but is not necessarily handling an active call. “Down” means the interface is not functional.
- Speed: The data rate in bits per second.
- MTU: The maximum packet size allowed on the interface.
- InFrame: The number of frames the interface has received.
- OutFrame: The number of frames transmitted.

## Displaying link management information

To display LMI (Link Management Information) for each link activated by a Frame Relay profile, enter this command:

```
ascend% show fr lmi

T1_617D LMI for fr1
  Invalid Unnumbered info         0  Invalid Prot Disc               0
  Invalid Dummy Call Ref          0  Invalid Msg Type                0
  Invalid Status Message          0  Invalid Lock Shift              0
  Invalid Information ID          0  Invalid Report Type             0
  Num Status Enqs Sent            0  Num Status Msgs Rcvd            0
 Num Update Status Rcvd         0  Num Status Timeouts         2779

LMI is not on for fr1-temp

LMI is not on for fr1-temp-9
```

This information is based on the ANSI T1.617 Annex D local in-channel signaling protocol. (See Annex D for a full definition of each of the fields reported.)

## Displaying DLCI status

To display the status of each DLCI:

```
ascend% show fr dlci

DLCIs for fr1

DLCIs for fr1-temp

eng-lab-236-Cir   DLCI =   17    Status = ACTIVE
        input pkts               0        output pkts              0
        input octets             0        output octets            0
        input FECN               0        input DE                 0
        input BECN               0
last time status changed: 03/05/1997  14:44:17

DLCIs for fr1-temp-9

eng-lab-236-Cir-9  DLCI =   16    Status = ACTIVE
        input pkts               0        output pkts              0
        input octets             0        output octets            0
        input FECN               0        input DE                 0
        input BECN               0
last time status changed: 03/05/1997  14:45:07

DLCIs not assigned
```

DLCI information is reported using these fields:

- DLCI: The DLCI number.
- Status: ACTIVE if the connection is up or INACTIVE if not.
- input pkts: The number of frames the interface has received.
- output pkts: The number of frames the interface has transmitted.
- input octets: The number of bytes the interface has received.
- output octets: The number of bytes the interface has transmitted.
- in FECN pkts: The number of packets received with the FECN (Forward Explicit Congestion Notification) bit set. This field always contains a 0 (zero) because congestion management is not currently supported.
- in BECN pkts: The number of packets received with the BECN (Backward Explicit Congestion Notification) bit set. This field always contains a 0 (zero) because congestion management is not currently supported.
- in DE pkts: The number of packets received with the DE (Discard Eligibility) indicator bit set.
- last time status changed: The last time the DLCI state changed.

## Displaying circuit information

The Show FR Circuit command shows the Frame Relay profile name, DLCI, and status of configured circuits.

```
ascend% show fr circuits

cir-9 User Setting Up
fr1-temp-9                   16           Up
fr1-temp                     17           Up
```

## Turning off a circuit without disabling its endpoints

The Set Circuit command enables you to “turn off” traffic going through a frame relay circuit without disabling the circuit endpoints. This command prevents traffic from going between endpoints without disrupting the state of the DLCI. To see the support options:

```
ascend% set circuit ?

set circuit ?       Display help information
set circuit active [name]  Set the CIRCUIT to active
set circuit inactive [name]  Set the CIRCUIT to inactive
```

To allow data to flow through a circuit, use the active parameter; for example:

```
ascend% set circuit active circuit-1
```

- To turn off data flow without disrupting the state of the DLCIs, use the inactive parameter; for example:

```
ascend% set circuit inactive circuit-2
```

# Configuring X.25

# 5

This chapter contains these topics:

# Introduction to Ascend X.25 implementation

This chapter describes X.25 support on the MAX. Full technical specifications for X.25, X.3, X.28, X.29, and LAPB (Link Access Protocol–Balanced) can be found in the CCITT Blue Book Recommendation X series 1988. Technical specification for IP over X.25 (X25/IP) can be found in IETF RFC 1356.

X.25 is a connection oriented (virtual circuits) protocol, providing services such as multiplexing, in-sequence delivery, transfer of addressing information, segmenting and reassembly, flow control, transfer of expedited data, error control, reset and restart. Allocation of logical channels can be either static (PVC) or dynamic (SVC).

Configuring the MAX to communicate with  an X.25 switch involves the following elements:

- A physical interface to the X.25 switch

  The MAX typically has a nailed connection to an X.25 switch via serial WAN, T1 or E1 PRI, or BRI . (X.25 PAD connections require a leased line or nailed ISDN connection.) The MAX supports only one physical connection for X.25 support. For details on configuring these  interfaces, see Chapter 2, “Configuring the MAX for WAN Access.”
- A logical datalink to the X.25 DCE (defined in an X.25 profile)

  The MAX unit’s logical link is usually a switched virtual circuit (SVC). See “Configuring the logical link to an X.25 switch” next.
- Dial-in connections that use X.25 (defined in Connection profiles)

  The application layer of an X.25 connection may be a TCP/IP network connection or terminal emulation using  X.25 PAD (Packet Assembler/Disassembler). See “Configuring X.25 IP connections” on page 5-7 and “Configuring X.25 PAD connections” on page 5-9.

# Configuring the logical link to an X.25 switch

The logical data link between the MAX and a remote X.25 switch is defined in an X.25 profile. X.25 profiles are located below the Ethernet menu. They contain these parameters:

```
Ethernet
      X.25...
      Name=x25prof
      Active=Yes
      Call Type=Nailed
      Nailed Grp=32
      Data Svc=64K
      PRI # Type=N/A
      Dial #=N/A
      Bill #=N/A
      Call-by-Call=N/A
      Transit #=N/A
      LAPB T1=3
      LAPB T2=0
      LAPB N2=20
      LAPB k=7
      X.25 Seq Number Mode=NORMAL
      X.25 Link Setup Mode=ACTIVE
      X.25 Node Type=DTE
      X.25 window size=2
```

```
X.25 pkt size=128
X.25 Min pkt size=64
X.25 Max pkt size=4096
X.25 lowest PVC=0
X.25 highest PVC=0
X.25 lowest SVC=1
X.25 highest SVC=8
X.25 Clear/Diag=Yes
X.25 Reset/Diag=Yes
X.25 Restart/Diag=Yes
X.25 options=NPWS
X.25 Rev Charge Accept=No
X.25 Network Type=CCITT
X.25 T20=18
X.25 R20=1
X.25 T21=20
X.25 T22=18
X.25 R22=1
X.25 T23=18
X.25 R23=1
X.121 src addr=
VCE Timer Val=300
```

For details on each of these parameters, see the *MAX Reference Guide*.

## Understanding the X.25 parameters

This section provides some background information about the X.25 parameters.

- Profile name and activation

  User connections link up with the X.25 connection specified in this profile by specifying the profile name. The name must be unique and cannot exceed 15 characters.

  The Active parameter must be set to Yes to make this profile available for use.

- Physical connection type

  The call type  may be nailed or switched (X.25 PAD requires nailed). If it is a nailed connection, you must specify the Nailed Grp number. If it is a switched call, you'll specify the Dial #  and telco options.

- LAPB and reliable data transfer

  The X.25 frame layer implements LAPB (Link Access Protocol–Balanced), an HDLC-like protocol that facilitates the exchange of information packets.

  – LAPB T1 is the maximum number of seconds the transmitter waits for acknowledgment before initiating a recovery procedure (Response timeout). The default is 3 seconds.

  – LAPB T2 is maximum number of milliseconds LAPB waits for outgoing data before sending a Restart-Request packet to the network. The default zero means immediate acknowledgment.

  – LAPB N2 specifies how many times the MAX can resend a frame when the LAPB T1 timer expires.  The default is 20. This relatively high value increases the probability of a correct transfer of data.

  – LAPB k specifies the maximum number of sequentially numbered frames that may be unacknowledged at a given time. This value is also called the Level 2 Window Size or the Frame Window Size. The default is 7.  Higher values enable faster throughput.

- X.25 packet handling

  The X.25 packet layer defines the packet format as well as the procedures for the exchange of packets containing control information and user data.

  - X.25 Seq Number Mode selects between modulo 8 or modulo 128 sequence number mode. NORMAL is modulo 8 (the default), EXTENDED is modulo 128.
  - X.25 Link Setup Mode specifies whether the X.25 link comes up in active or passive disconnect mode. In ACTIVE disconnect mode (the default) the link layer comes up sending a DISC, and the packet layer sends a Restart-Request packet at initialization. In PASSIVE disconnect mode the link layer comes up sending SABM(E), and issues a restart to the network only upon receipt of a request restart token. It will not issue a Restart-Request packet upon initialization, but responds to restart packets it receives.
  - X.25 Node Type specifies whether the MAX interacts with the remote end of the connection as a DTE (the default) or DCE.
  - X.25 window size establishes the maximum number of data packets that can be outstanding before acknowledgment is required. The default is 2.
  - X.25 packet sizes specify the default, maximum, and minimum number of bytes in the data field of a data packet.

- X.25 PVC and SVC numbers

  - The highest and lowest PVC numbers define a range of PVCs between 1 and 4096. If the lowest PVC number is zero, no PVCs are supported.
  - The highest and lowest SVC numbers define a range of SVCs between 1 and 4096. If the lowest SVC number is zero, no SVCs are supported.

- X.25 diagnostic fields in packet types

  - X.25 Clear/Diag specifies whether Clear-Request packets include the diagnostic field. The default is No.
  - X.25 Reset/Diag specifies whether Reset-Request include the diagnostic field. The default is No.
  - X.25 Restart/Diag specifies whether Restart-Request packets include the diagnostic field. The default is No.

- X.25 options

  X.25 options can be set to None (no options) or NPWS (specifying that the MAX will negotiate packet and window size). None is the default.

- X.25 reverse charge accept

  This parameter specifies whether the MAX accepts call packets with "0101" in the facility field to request reverse charge. The default is No.

- X.25 network type

  At present, only the CCITT network type is supported.

- Controlling Restart-Requests

  X.25 T20 sets the duration of the Restart timer (the number of ten-second ticks the MAX waits before retransmitting a Restart-Request packet) and the corresponding X.25 R20 parameter specifies the number of Restart-Request retransmits the MAX will send before waiting indefinitely for a response.

- Controlling Call-Requests

  X.25 T21 sets the duration of the Call-Request timer (the number of ten-second ticks the MAX waits before clearing an outgoing call that has not been accepted).

- Controlling Reset-Requests

  X.25 T22 sets the duration of the Reset-Request timer (the number of ten-second ticks the MAX waits before retransmitting a Reset-Request packet) and the corresponding R22 parameter specifies the number of times the MAX retransmits a Reset-Request packet before clearing a call.
- Controlling Clear-Requests

  X.25 T23 sets the duration of the Clear-Request timer (the number of ten-second ticks the MAX waits before retransmitting a Clear-Request packet) and the corresponding R23 parameter specifies the number of Clear-Request retransmits the MAX will send before waiting indefinitely for a response.
- The X.121 source address is the MAX source address for logical links using this profile.

  An X.121 address contains between 1 and 15 decimal digits, such as 031344159782738.
- Setting the VCE (Virtual Call Establishment) timer value

  Virtual Call Establishment timer interval specifies the number of seconds to maintain a connection to a character-oriented device (such as a terminal server) that has not established a virtual call. This timer value is link-wide. Each X.25 PAD connection has a parameter to enable or disable this timer on a per-connection basis. A value of 0 disables this timer system-wide regardless of the value of the VC timer enable flag per connection. The default is 300 seconds.

## Example X.25 profile configuration

This example configuration shows an example X.25 profile that establishes the logical link to an X.25 switch. It does not show how to configure the nailed channels used for the physical connection to the switch. For details on configuring physical nailed connections, see Chapter 2, “Configuring the MAX for WAN Access.”

**Note:** You must obtain a copy of the telco’s subscription form containing the values provisioned in the switch and configure the MAX X.25 profile to comply with those values.

Table 5-1 shows a sample telco subscription form for X.25 service:

*Table 5-1. Sample Telco subscription form*

| Subscription Form | Value | X.25 Profile |
|---|---|---|
| Maximum seconds the transmitter waits for acknowledgment before starting recovery procedure (T1): | 5 | LAPB T1=5 |
| Maximum times to resend a frame after the T1 timer expires (N2): . | 10 | LAPB N2=10 |
| Maximum sequentially numbered frames that a given DTE/DCE link may have unacknowledged at any given time (k):. | 7 | LAPB k=7 |
| Is the X.25 node a DTE or DCE?: | DTE | X.25 Node Type=DTE |
| Is the link SVC or PVC?: | SVC | X.25 Link Setup Mode=Active<br>X.25 lowest PVC=1<br>X.25 highest PVC=8 |

*Table 5-1. Sample Telco subscription form*

| **Subscription Form** | **Value** | **X.25 Profile** |
|---|---|---|
| Maximum packet size: | 2048 | X.25 Max pkt size=2048 |
| Maximum number of data packets that can be outstanding between a DTE and a DCE before acknowledgment is required (W): | 2 | X.25 window size=2 |
| Number of PVCs: | 0 | X.25 highest PVC=0 |
| Highest PVC channel number: | 0 | X.25 highest PVC=0 |
| Default packet size: | 256 | X.25 pkt size=256 |
| Minimum packet size: | 64 | X.25 Min pkt size=64 |
| Maximum packet size: | 2048 | X.25 Max pkt size=2048 |

To configure the X.25 profile to comply with this subscription form:

**1** Open the X.25 profile, assign the profile a name, and activate it.

```
Ethernet
   X.25...
      Name=ATT
      Active=Yes
```

**2** Set the Call Type to Nailed and specify the nailed group number.

```
      Call Type=Nailed
      Nailed Grp=7
```

**3** Set the LAPB parameters to comply with the settings in the subscription form.

```
      LAPB T1=5
      LAPB T2=0
      LAPB N2=10
      LAPB k=7
```

**4** Set the X.25 node type to DTE, as specified in the subscription form.

```
      X.25 Node Type=DTE
```

**5** Configure the profile to support up to 8 switched virtual circuits.

```
      X.25 Link Setup Mode=ACTIVE
      X.25 lowest PVC=0
      X.25 highest PVC=0
      X.25 lowest SVC=1
      X.25 highest SVC=8
```

**6** Configure packet sizes and flow control.

```
      X.25 window size=2
      X.25 pkt size=128
      X.25 Min pkt size=64
      X.25 Max pkt size=4096
```

**7** Specify the X.121 source address to use on this link.

```
      X.121 src addr=031344159782738
```

**8** Close the X.25 profile.

# Configuring X.25 IP connections

This section describes how to configure the MAX to exchange IP datagrams over the X.25 network connection specified in an X.25 profile. X.25 IP connections must be routed, they cannot be bridged. These are the related parameters:

```
Ethernet
   Answer
      Encaps...
      X25/IP=Yes

Ethernet
   Connections
      Encaps=X25/IP

      Encaps options...
         X.25 Prof=ATT
         LCN=0
         Encaps Type=RFC877
         Reverse Charge=No
         Max Unsucc. calls=0
         Inactivity Timer=0
         MRU=1500
         Call Mode=Both
         Answer X.121 Addr=
         Remote X.121 addr=

      Route IP=Yes

      Ip options...
         LAN Adrs=10.65.212.226/24
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the X.25 IP connection parameters

This section provides some background information about the X.25 IP connection parameters and the required IP configuration for this type of connection.

- X.25 profile name

  This 15-character text field contains the name of an X.25 profile that will be used for this logical connection. If the matching X.25 profile can not be found, the MAX does not start a session for this Connection profile. To guard against this misconfiguration, an active Connection profile specifying X.25 encapsulation can not be saved unless the named X.25 profile has been defined and is active.

- LCN (logical channel number) number

  The LCN specifies the logical channel number to use in the case of a PVC. The default zero means no LCN is provided, so the connection is not a PVC.

- Encapsulation type

  The encapsulation type may be RFC877 for backward compatibility, SNAP, or NULL (multiplexing) encapsulation. This fields specifies which encapsulation to use when calling the remote site. When receiving a call, the MAX will accept any of the three types of encapsulation. The default is RFC877.

- X.25 reverse charge

  This parameter specifies whether the X.25 facility field indicates "reverse charge request" when the X.25 user calls a host. The default is No.

- Maximum number of unsuccessful calls

  You can specify the maximum number of unsuccessful X.25 calls the MAX should try to place before dropping the modem connection. The default zero means an unlimited number.

- Inactivity timer

  The inactivity timer specifies the number of seconds to allow a connection to remain inactive before dropping the virtual circuit.

- MRU

  This parameter specifies the maximum number of bytes the MAX can receive in a single IP packet on the X.25 link. The IP packet is further fragmented/reassembled to fit the maximum X.25 packet size, if the MRU is larger than the X.25 packet size. The default is 1500 bytes.

- Call mode

  The call mode specifies whether the MAX can initiate a call request on this connection.

  - Incoming means the MAX does not issue a call request when data shows up for forwarding. If there is no virtual circuit established, the IP packet is dropped. If an incoming call is received from a host whose address matches the Answer X.121 address (below), the call is accepted.
  - Outgoing means the MAX issues a call request to the Remote X.121 address (below) when data shows up for forwarding.  If there is no virtual circuit established and an incoming call request is received, the call is rejected.
  - Both means the MAX accepts both incoming and outgoing call requests if the CUD indicates encapsulation that are supported. The called address must match the Answer X.121 address. If no virtual circuit is established and IP packets show up, a call request is issued to the Remote X.121 address.

- Answer X.121 address

  This specifies the X.121 address of the remote X.25 host to which this profile connects. The remote host is assumed to also support RFC1356 encapsulation of IP packets. This field cannot be left empty if  Call Mode is set to Both or Incoming .

- Remote X.121 address

  This specifies the X.121 address of the remote X.25 host to which this profile connects. The remote host is assumed to also support RFC1356 encapsulation of IP packets. This field cannot be left empty if Call Mode is set to Both or Outgoing.

- IP configuration parameters

  The IP configuration for an X.25 IP connection is identical to an IP routing connection using PPP encapsulation. You must specify the address of the remote Ascend unit in the LAN Adrs parameter. If you are using numbered interfaces, you can also specify local IF Adrs and a remote WAN Alias value. For details on IP routing configurations, see Chapter 9, “Configuring IP Routing.”

## Example X.25 IP configuration

This section shows an example configuration enabling two IP networks to connect through a Public or Private Packet Switched Network (PSPDN).

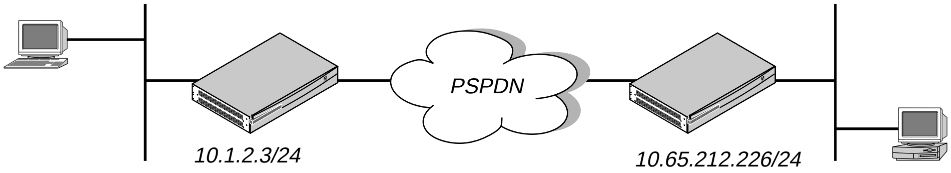


*Figure 5-1. Example X.25 IP connection*

To configure this example connection:

**1** Open the Answer profile and enable X.25 IP encapsulation.

```
Ethernet
   Answer
      Encaps...
         X25/IP=Yes
```

**2** Open a Connection profile, name it, and activate the profile.

```
Ethernet
   Connections
      Name=newyork
      Active=Yes
```

**3** Turn on IP routing and specify the IP address of the answering unit.

```
      Route IP=Yes
      Ip options...
         LAN Adrs=10.65.212.226/24
```

**4** Enable X.25/IP encapsulation and then open the Encaps Options subprofile.

**5** Specify the name of the X.25 profile that will carry this connection.

```
      Encaps=X25/IP
      Encaps options...
         X.25 Prof=ATT
```

**6** Set the inactivity timer. For example, set it to 30 seconds.

```
         Inactivity Timer=30
```

**7** Set the call mode and the local and remote X.121 addresses.

```
         Call Mode=Both
         Answer X.121 Addr=031344159782111
         Remote X.121 addr=031344159782111
```

**8** Close the Connection profile.

# Configuring X.25 PAD connections

An X.25 PAD (Packet Assembler/Disassembler) is an asynchronous terminal concentrator that enables several terminals to share a single network line. It has its own command interface and uses an X.3 profile to fine-tune its parameters.

When a user calls X.25 PAD through a modem, the call is processed by a digital modem and forwarded to the terminal server. The terminal server authenticates the call using the password specified in the caller’s Connection profile and  establishes the session. When the session is established, the caller may see the terminal-server command line or be directed immediately to an X.121 host. If the connection auto-calls an X.121 host, the initial session display looks like this:

```
ATDT 555-1212
CONNECT 9600
ASCEND TERMINAL PAD v0.99:  ASYNC PORT # 1, 9600 BAUD
*
```

If the user is directed instead to the terminal-server command line, the user sees the terminal-server login banner instead. The user can then establish a PAD session by using the Pad command, for example:

```
ascend% pad
*
```

(The asterisk is the PAD prompt for input.) The user can then place a call, for example:

```
*call 031344159782738
```

See “X.25 PAD user commands” on page 5-16 for more details. This section describes how to configure these X.25 PAD connections. These are the related parameters:

```
Ethernet
   Answer
      Encaps...
         X25/PAD=Yes
Ethernet
   Connections
      Encaps=X25/PAD
      Encaps options...
         X.25 Prof=ATT
         Recv PW=localpw
         LCN=0
         X.3 Param Prof=CRT
         Max Unsucc. calls=0
         VC Timer enable=DISABLE
         Auto-Call X.121 addr=
         Reverse Charge=No
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the X.25 PAD connection parameters

This section provides some background information about the X.25 PAD connection parameters.

- X.25 profile name

  This 15-character text field contains the name of an X.25 profile that will be used for this logical connection. If the matching X.25 profile can not be found, the MAX does not start a session for this Connection profile. To guard against this misconfiguration, an active Connection profile specifying X.25 encapsulation can not be saved unless the named X.25 profile has been defined and is active.
- Receive password

  This specifies a case-sensitive password to use to authenticate the caller.

- LCN (logical channel number) number

  The LCN specifies the logical channel number to use in the case of a PVC. The default zero means no LCN is provided, so the connection is not a PVC.
- X.3 parameter profile

  Supported X.3 parameter profiles are listed in Table 5-3 on page 15. The user can specify a profile using a PAD command, and you can specify a connection default profile in the X.3 Param Prof parameter. A profile specified on the command line overrides this default for the length of the current session.
- Maximum number of unsuccessful calls

  You can specify the maximum number of unsuccessful X.25 calls the MAX should try to place before dropping the modem connection. The default zero means an unlimited number.
- VC (Virtual Call Establishment) timer enabled

  You can enable or disable use of the VCE timer on a per-user basis. The VCE timer specifies the number of seconds to maintain a connection to a character-oriented device (such as the terminal server) that has not established a virtual call. If the X.25 profile disables this parameter, it has no effect in a Connection profile.
- Auto-call to an X.121 address

  The Auto-Call X.121 Addr specifies an X.25 host to call immediately when an X.25/PAD session is established via this Connection profile. If this parameter specifies an address, the PAD session can begin automatically; otherwise, the MAX displays the terminal-server prompt, where the user can issue the “pad” command to begin a session.
- X.25 reverse charge

  This parameter specifies whether the X.25 facility field indicates "reverse charge request" when the X.25 user calls a host. The default is No.

## Example X.25 PAD configuration

This section shows an example configuration in which the X.25 modem caller is directed immediately to a PAD interface on the host whose X.121 address is shown in Figure 5-3.

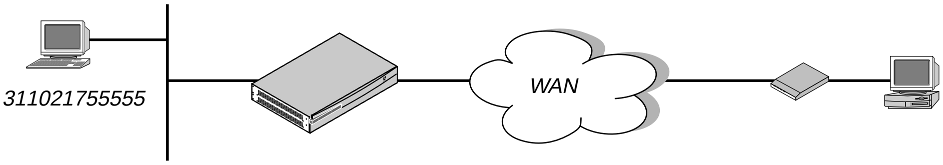


*Figure 5-2. Example X.25 PAD connection*

To configure this example X.25 PAD connection:

**1** Open the Answer profile and enable X.25/PAD encapsulation.

```
Ethernet
   Answer
      Encaps...
         X25/PAD=Yes
```

**2** Open a Connection profile, name it, and activate the profile.

```
Ethernet
   Connections
```

```
Name=rchan
Active=Yes
```

**3** Enable X.25/PAD encapsulation and then open the Encaps Options subprofile.

```
Encaps=X25/PAD
```

**4** Specify the name of the X.25 profile that will carry this connection.

```
Encaps options...
   X.25 Prof=ATT
```

**5** Specify the password that will be used to authenticate the user connection.

```
   Recv PW=localpw
```

**6** Specify a default X.3 parameter profile for this connection.

```
   X.3 Param Prof=CRT
```

**7** Specify the X.121 address and password to auto-call.

```
   Auto-Call X.121 Addr=031344159782111 *Dpassword
```

**8** Close the Connection profile

# Setting up X.25 PAD sessions

This section describes some of the PAD commands and X.3 parameter profiles that can affect how users' terminal sessions operate.

## X.3 parameters and profiles

The user's terminal or host DTE can modify operations the PAD performs by setting one or more X.3 parameters or by applying an X.3 profile. This section lists the X.3 parameters and profiles and then describes how to set them from the PAD. These are the X.3 parameters, numbered 1 through 22.

*Table 5-2. X.3 parameters*

| Parameter | Description | Possible values |
|---|---|---|
| 1r | PAD recall | 0—Escape not allowed<br>1—Escape allowed (the default) |
| 2 | Echo | 0—No echo<br>1—Echo (the default) |
| 3 | Data forwarding characters | 0—None (full packet)<br>1—Alphanumeric<br>2—Carriage return (the default)<br>4—ESC, BEL, ENQ, ACK<br>8—DEL, CAN, DC2<br>16—ETX, EOT<br>32—HT, LT, VT, FF<br>64—All other characters in columns 0 and 1 of International Alphabet #5 |

*Table 5-2. X.3 parameters*

| Parameter | Description | Possible values |
|---|---|---|
| 4 | Idle timer delay | 0—No timer<br>1–255—Delay value in twentieths of a second |
| 5 | Ancillary device control | 0—Not operational<br>1—Use X-ON (DC1 of International Alphabet #5) and X-OFF (DC3 of International Alphabet #5) |
| 6 | PAD service and command signals | 0—Do not transmit service signals 1—Transmit service signals |
| 7 | PAD operation on receipt of break signal from the start-stop mode DTE | 0—No action<br>1—Transmit Interrupt packet<br>2—Reset<br>4—Indication of break (PAD message)<br>8—Escape from data transfer<br>16—Discard output to DTE-C<br>21—Combine actions 1, 4, and 16 |
| 8 | Discard output | 0—Normal data delivery (the default)<br>1—Discard output to the DTE-C |
| 9 | Padding after carriage return | 0—No padding<br>1-7—Number of padding characters inserted after the carriage return |
| 10 | Line folding | 0—No line folding (the default)<br>1–255—Number of characters per line |
| 11 | Terminal server access speed | 10—50 bps<br>5—75 bps<br>9—100 bps<br>0—110 bps<br>1—134.5 bps<br>6—150 bps<br>8—200 bps<br>2—300 bps<br>... |

*Table 5-2. X.3 parameters*

| Parameter | Description | Possible values |
|---|---|---|
| 11 (continued) | Terminal server access speed | The following values are dependent on the PAD type:<br>4—600 bps<br>3—1200 bps<br>7—1800 bps<br>11—75 bps from, 1200 bps to DTE-C.<br>12—2400 bps<br>13—4800 bps<br>14—9600 bps<br>15—19200 bps<br>16—48000 bps<br>17—56000 bps<br>18—64000 bps |
| 12 | Flow control of the PAD by the start-stop mode DTE | 0—Not operational<br>1—Use X-ON and X-OFF (DC1 and DC3 of International Alphabet #5) |
| 13 | Linefeed insertion after carriage return | 0—Option not selected<br>1—Linefeed insertion after a carriage return in data the PAD sends to the DTE-C<br>2—Linefeed insertion after a carriage return in data the PAD receives from the DTE-C<br>4—Linefeed insertion after echo of each carriage return to the DTE-C |
| 14 | Linefeed padding | 0—No padding<br>1-7—Number of padding characters inserted after the linefeed |
| 15 | Editing | 0—No editing in data transfer<br>1—Editing in data transfer |
| 16 | Character delete | 0–127 (a character from the International Alphabet #5) |
| 17 | Line delete | 0–127 (a character from the International Alphabet #5) |
| 18 | Line display | 0–127 (a character from the International Alphabet #5) |
| 19 | Editing PAD service signals | 0—No editing PAD service signals<br>1—Editing PAD service signals |

*Table 5-2. X.3 parameters*

| Parameter | Description | Possible values |
|---|---|---|
| 20 | Echo mask | 0—None (full packet)<br>1—Alphanumeric<br>2—Carriage return (the default)<br>4—ESC, BEL, ENQ, ACK<br>8—DEL, CAN, DC2<br>16—ETX, EOT<br>32—HT, LT, VT, FF<br>64—All other characters in columns 0 and 1 of International Alphabet #5 |
| 21 | Parity treatment | 0—No parity checking or generation<br>1—Parity checking<br>2—Parity generation |
| 22 | Page wait | 0—No page wait<br>1–255—The number of linefeed characters sent by the PAD before page wait condition |

Table 5-3 lists the supported X.3 profiles, shown with the profile name and the settings of each X.3 parameter in that profile.

*Table 5-3. X.3ß profiles*

| X.3 profile | Contents |
|---|---|
| CRT | 1:64, 2:1, 3:2, 4:0, 5:0, 6:5, 7:2, 8:0, 9:0, 10:0, 11:0, 12:1, 13:4, 14:0, 15:1, 16:8, 17:24, 18:18, 19:2, 20:0, 21:3, 22:0 |
| INFONET | 1:1, 2:0, 3:2, 4:0, 5:0, 6:0, 7:21, 8:0, 9:2, 10:0, 12:1, 13:0, 14:2, 15:1, 16:8, 17:24, 18:18, 19:0, 20:0, 21:0, 22:0 |
| SCEN | 1:64, 2:1, 3:2, 4:0, 5:1, 6:5, 7:21, 8:0, 9:0, 10:0, 12:1, 13:4, 14:0, 15:1, 16:127, 17:24, 18:18, 19:1, 20:0, 21:0, 22:0 |
| CC_SSP | 1:1, 2:1, 3:126, 4:0, 5:1, 6:1, 7:2, 8:0, 9:0, 10:0, 12:1, 13:0, 14:0, 15:0, 16:127, 17:24, 18:18, 19:1, 20:0, 21:0, 22:0 |
| CC_TSP | 1:0, 2:0, 3:0, 4:20, 5:0, 6:0, 7:2, 8:0, 9:0, 10:0, 12:0, 13:0, 14:0, 15:0, 16:127, 17:24, 18:18, 19:1, 20:0, 21:0, 22:0 |
| HARDCOPY | 1:64, 2:1, 3:2, 4:0, 5:2, 6:5, 7:21, 8:0, 9:5, 10:80, 12:1, 13:4, 14:5, 15:1, 16:8, 17:24, 18:18, 19:1, 20:0, 21:3, 22:0 |
| HDX | 1:1, 2:1, 3:2, 4:0, 5:2, 6:5, 7:2, 8:0, 9:0, 10:0, 12:1, 13:4, 14:0, 15:1, 16:8, 17:24, 18:18, 19:2, 20:0, 21:3, 22:0 |
| SHARK | 1:0, 2:0, 3:2, 4:0, 5:0, 6:0, 7:2, 8:0, 9:0, 10:0, 12:0, 13:0, 14:0, 15:0, 16:0, 17:0, 18:0, 19:0, 20:0, 21:0, 22:0 |
| DEFAULT (MINIMAL) | 1:64, 2:1, 3:2, 4:0, 5:2, 6:5, 7:2, 8:0, 9:25, 10:72, 12:1, 13:5, 14:25, 15:1, 16:8, 17:24, 18:18, 19:1, 20:0, 21:0, 22:0 |

*Table 5-3. X.3ß profiles*

| X.3 profile | Contents |
|---|---|
| NULL | 1:0, 2:0, 3:0, 4:0, 5:0, 6:0, 7:0, 8:0, 9:0, 10:0, 12:0, 13:0, 14:0,15:0, 16:0, 17:0, 18:0, 19:0, 20:0, 21:0, 22:0 |

# X.25 PAD user commands

This section describes the X.25 PAD user commands in two categories: those used to manage calls from the PAD and those used to affect X.3 profile and parameter settings for the local or remote PAD.

To display a list of all X.25 PAD commands and syntax, use the Help command. Underlined letters in a command indicate the minimum string you have to type to execute the command. For example:

```
HELP
```

## Commands for working with X.3 parameters and profiles

These are the commands you can enter at the PAD prompt (*) to change an X.3 parameter setting or profile:

- PAR? [<param1>[,<param2>,...]]

  The Par? command display the current values of the specified X.3 parameters, or if no parameters are specified, it displays all current X.3 settings. For example:

  ```
  PAR 2
  ```

- PROF [<profile> | ?]

  The Prof command activates the X.3 profile (specified by the name shown in Table 5-3 on page 15), or if used with the question mark (?) keyword, it displays the currently active profile followed by a list of available profiles. If you do not specify any arguments, the Prof command displays the currently active profile. For example:

  ```
  PROF INFONET
  ```

- SET [<param1>:<value1> [,<param2>:<value2>,...]]

  The Set command sets one or more X.3 parameter values. For example:

  ```
  SET 1:0, 2:1
  ```

- SET? [<param1>:<value1> [,<param2>:<value2>,...]]

  This command is identical to the Set command immediately above, except that it displays all X.3 parameter values after setting those specified on the command line.

- TABS {LCL <num1>}{REM <num2>}{EXP <num3>}

  The Tabs command sets and reads three non-standard X,3 parameters that control tab expansion. These parameters are not accessible by the remote host using Q-bit packet PAD commands. You must keep the PAD's view of the current screen position accurate by setting EXP to 0 (zero) and LCL to the number of columns to which your terminal expands tabs. These settings enable the PAD to perform correct line folding, line deletion, and character deletion.

  – The LCL keyword sets the number of columns to which tabs are expanded locally (<num1>). If the EXP keyword disables local tab expansion, LCL <num1> specifies the number of columns to which the asynchronous device expands tabs sent to it. You can specify a number between 0 and 16. Zero specifies that no expansion takes place.

- The REM keyword sets the number of columns to which tabs are expanded remotely (<num2>)—that is, on input from the terminal to the network. You can specify a number between 0 and 16. Zero specifies that no expansion takes place.
- The EXP keyword enables (1) or disables (0) tab expansion locally. If you specify 1 after this keyword, tabs are expanded according to the LCL specification.

There are similar commands for changing X.3 settings on the remote PAD:

- RPAR? [<param1>[,<param2>,...]]

  The Rpar? command display the current values of the specified X.3 parameters on the remote PAD, or if no parameters are specified, it displays all current X.3 settings. For example:

  ```
  RPAR 2
  ```

- RPROF [<profile> | ?]

  The Rprof command activates the X.3 profile for the remote PAD, or if used with the question mark (?) keyword, it displays the currently active profile followed by a list of available profiles. If you do not specify any arguments, the Rprof command displays the currently active profile. For example:

  ```
  RPROF INFONET
  ```

- RSET [<param1>:<value1> [,<param2>:<value2>,...]]

  The Rset command sets one or more X.3 parameter values for the remote PAD. For example:

  ```
  SET 1:0, 2:1
  ```

- RSET? [<param1>:<value1> [,<param2>:<value2>,...]]

  This command is identical to the Set command immediately above, except that it displays all X.3 parameter values after setting those specified on the command line.

## X.25 PAD commands for managing calls

These are the commands you can enter at the X.25 PAD prompt to generate calls, specify a matching pattern for incoming calls, and perform related functions:

- CALL [?] | [[<address>][*P|*D|*F <data>]]

  The Call command generates a call by sending a Call-Request packet. If you enter the Call command with only a question mark (?), the MAX displays the address the PAD would use if you entered the Call command with no address.

  - The <address> argument specifies the X.121 address to which the call is made.
  - The address can contain up to 15 characters. If you do not specify a value for <address> , the MAX makes the call request for the last address specified.
  - The <data> following the *P and *D keywords is inserted into the last 12 bytes of the user data field. If you specify *P, the screen does not echo the data as you enter it, even if you set X.3 parameter number 2 to Echo. This specification is useful for entering passwords. If you specify *D, the screen echoes the data as you enter it.
  - If you specify *F, all the <data> is inserted into the user data portion of the call packet (with a maximum length of 124 bytes), and the packet is flagged as a “fast select” call.

For example,

```
CALL 3331055567
```

- `CLR`

  The Clr command clears a virtual circuit by sending a Clear-Request packet (from a DTE) or a Clear-Indication packet (from a DCE).

- FACILITIES [ * | <facilities> ]

  The Facilities command specifies which  facilities to use in subsequent Call commands. If you enter the Facilities command with no arguments, the MAX displays the current facilities.

  – When you specify an asterisk (*), the command clears the current facilities and resets them to their default values.  The default facilities are window size 2 and packet size 128 (420202430707).

  – The <facilities> argument can consist of up to 63 hexadecimal digits.  The value you specify is converted from hexadecimal format and becomes the byte sequence inserted in the Facilities field of outgoing Call-Request packets.

  For example,

  ```
  FACIL *
  ```

- `FULL`

  The Full command selects full-duplex mode.

- HALF [*] | [[-] <ch1>, <ch2>,...]

  The Half command selecs half-duplex mode and specifies the characters echoed. In half-duplex mode, most characters are not echoed. In half-duplex mode with echo enabled, the PAD does most of the work of echoing and then discards the data instead of sending it to the asynchronous device. The PAD can therefore provide line folding, tab expansion, linefeed insertion, carriage return and linefeed padding, and character and line deletion. For details on these features, see "X.3 parameters and profiles" on page 5-12.

  If you disable echo, the amount of processing the PAD must do on every character decreases substantially, and the PAD cannot perform line folding, tab expansion, or other actions described in the previous paragraph. This mode is most efficient for file transfers.

  – When you specify an asterisk (*), no characters are echoed.

  – When you specify only a list of characters (<ch1>, <ch2>, and so on), only these characters are echoed.

  – You must specify each character in decimal format.

  – When you insert a hyphen (-) before the list of characters, only the characters you specify are not echoed.

  – If you enter the Half command with no arguments, the command sets half-duplex mode without altering the characters selected for echo using any previously entered Half command.

- `INTERRUPT`

  The Interrupt command generates an Interrupt packet. An Interrupt packet can transmit between 1 and 32 bytes of data to the remote DTE without being subject to flow control. The exchange of Interrupt packets does not affect the exchange of data packets and flow-control packets.

- LISTEN [ADDR=<address> | DATA=<data>]

  The Listen command specifies the match pattern for accepting an incoming call. It uses this syntax:

- The MAX matches the <address> argument against the subaddress specified by the incoming call; if the subaddresses match, the incoming call is accepted on this asynchronous port.
- The MAX matches the <data> against the last 12 bytes of the user data field of incoming calls; if the data matches, the incoming call is accepted on this asynchronous port.

- RESET

  The Reset command resets a virtual circuit by generating a Reset-Request packet with 0 (zero) cause (DTE originated) and 0 (zero) diagnostic.

- STATUS

  The Status command requests the status of a virtual call placed to a remote DTE.

## PAD service signals

The PAD transmits PAD service signals to the terminal server in order to acknowledge PAD commands and to inform the user about the internal state of the PAD. The terminal server user can suppress the reception of PAD service signals by setting PAD parameter #6 to 0 (zero). The following table lists the PAD service signals.

*Table 5-4. PAD service signals*

| Service signal | Description |
|---|---|
| RESET DTE | The remote DTE has reset the virtual circuit. |
| RESET ERR | A reset has occurred because of a local procedure error. |
| RESET NC | A reset has occurred because of network congestion. |
| COM | A call has been connected. |
| PAD ID | Precedes a string that identifies the PAD. |
| ERROR | The terminal server user entered an X.25/PAD command using faulty syntax. |
| CLR | A virtual circuit has been cleared. |
| ENGAGED | In response to the STAT command, this signal indicates that a virtual call is up. |
| FREE | In response to the STAT command, this signal indicates that a virtual call is cleared. |
| PAR with X.3 parameter reference numbers and their current values | This string is a response to the SET? command. |

## X.25 clear cause codes

Table 5-5 shows hexadecimal X.25 clear cause codes:

*Table 5-5. Clear cause codes*

| Hex value | Cause code |
|---|---|
| 01 | Number busy |
| 03 | Invalid facility request |
| 05 | Network congestion |
| 09 | Out of order |
| 0B | Access barred |
| 0D | Not obtainable |
| 11 | Remote procedure error |
| 13 | Local procedure error |
| 15 | RPOA out of order |
| 19 | Reverse charging acceptance not subscribed |
| 21 | Incompatible destination |
| 29 | Fast select acceptance not subscribed |
| 39 | Ship absent |
| C1 | Gateway-detected procedure error |
| C3 | Gateway congestion |

## X.25 diagnostic field values

Table 5-6 shows X.25 diagnostics:

*Table 5-6. X.25 diagnostic field values*

| Hex value | Dec value | Diagnostic |
|---|---|---|
| 0 | 0 | No additional information |
| 1 | 1 | Invalid P(S) |
| 2 | 2 | Invalid P(R) |
| 10 | 16 | Packet type invalid |
| 11 | 17 | for state r1 |
| 12 | 18 | for state r2 |
| 13 | 19 | for state r3 |
| 14 | 20 | for state p1 |
| 15 | 21 | for state p2 |

*Table 5-6. X.25 diagnostic field values*

| Hex value | Dec value | Diagnostic |
|---|---|---|
| 16 | 22 | for state p3 |
| 17 | 23 | for state p4 |
| 18 | 24 | for state p5 |
| 19 | 25 | for state p6 |
| 1A | 26 | for state p7 |
| 1B | 27 | for state d1 |
| 1C | 28 | for state d2 |
| 1D | 29 | for state d3 |
| 20 | 32 | Packet not allowed |
| 21 | 33 | unidentifiable packet |
| 22 | 34 | call on one-way LC |
| 23 | 35 | invalid packet type on a PVC |
| 25 | 37 | Reject not subscribed to |
| 26 | 38 | packet too short |
| 27 | 39 | packet too long |
| 29 | 41 | Restart packet with non-zero LC |
| 2B | 43 | unauthorized interrupt confirmation |
| 2C | 44 | unauthorized interrupt |
| 2D | 45 | unauthorized reject |
| 30 | 48 | Timer expired |
| 31 | 49 | for incoming call (or for DTE timer expired for all request) |
| 32 | 50 | for clear indication (or for DTE timer expired or retransmission count surpassed for clear request) |
| 33 | 51 | for reset indication (or for DTE timer expired or retransmission count surpassed for reset request) |
| 34 | 52 | for restart indication (or for DTE timer expired or retransmission count surpassed for restart request) |
| 40 | 64 | Call setup, call clearing, or registration problem |
| 41 | 65 | Facility/registration code not allowed |
| 42 | 66 | Facility parameter not allowed |
| 43 | 67 | Invalid called address |
| 44 | 68 | Invalid calling address |
| 45 | 69 | Invalid facility/registration length |

*Table 5-6. X.25 diagnostic field values*

| Hex value | Dec value | Diagnostic |
|---|---|---|
| 46 | 70 | Incoming call barred |
| 47 | 71 | No logical channel available |
| 48 | 72 | Call collision |
| 49 | 73 | Duplicate facility requested |
| 4A | 74 | Nonzero address length |
| 4B | 75 | Nonzero facility length |
| 4C | 76 | Facility not provided when expected |

# Monitoring X.25 and PAD service

The terminal server supports two  commands for obtaining information about X.25 and PAD service. To invoke the terminal server, select System>Sys Diag>Term Serv and press Enter.

## Displaying information about PAD sessions

To display information about PAD sessions:

```
ascend% show pad

Port   State        LCN        BPS       User     Called Addr.
1     connected      0         9600      rchan     419342855555
2     connected      0         9600      dhersh
```

The output includes the following fields:

- Port: The port for the X.25 connection.
- Stat: The state of the connection.
  - Idle means the PAD is open, but no call has been issued.
  - Calling means a call has been issued and is awaiting acceptance.
  - Connected means the call is connected and in session.
  - Clearing means a Clear command has been issued  and the transmitter is awaiting a clear confirmation.
- LCN: The logical channel number for a PVC. An LCN of 0 means this is not a PVC (it is a switched virtual circuit instead).
- BPS: The data rate of the connection in bits per second.
- User: The Connection profile name of the caller.
- Called Add: The X.121 address of the remote node.

## Displaying information about X.25

To view information about  X.25 frame and packet layers:

```
ascend% show x25

Frame     State           BytesIn        BytesOut
 1        LinkUp            15             45


Packet     State          BytesIn         BytesOut
 1         Ready             0               0
```

The output includes these fields:

- Frame: The frame layer and Packet means the packet layer.
- Stat: The state of the connection at that layer.

  For the frame layer, these states can occur:

  – SABMSent: An SABM (Set Asynchronous Balanced Mode) message has been sent to establish the operating mode as LAPB (Link Access Balanced Protocol), and the transmitter is awaiting a UA (Unnumbered Acknowledge response).

  – DISCSent: A DISC message has been sent to disconnect the frame level, and the transmitter is awaiting a UA (Unnumbered Acknowledge response).

  – FRMRSent: An FRMR has been sent, indicating that a malformed frame was received, and the sender is awaiting an SABM message.

  – LinkUp: The link is up and sending I-frames and S-frames.

  – Disconnected: A disconnect has been requested, and the sender is awaiting an SABM message.

  For the packet layer, these states can occur:

  – Ready: The packet level is ready to send and receive data.

  – DTERestart: The DTE has issued a Restart-Request.

  – DCERestart: The DCE has issued a Restart-Request.

  – BothRestart: Restart-Requests have been sent to both the DTE and the DCE.

  – InitState: Indicates the initial state of a call.
- BytesIn: The number of bytes received from the remote node.
- BytesOut: The number of bytes transmitted to the remote node.

# Creating and Applying Packet Filters

6

This chapter covers these topics:

# Introduction to packet filters

A packet filter contains rules describing packets and what to do when those packets are encountered. When a packet filter is applied to an interface, the MAX monitors the data stream on that interface and takes a specified action when packet contents match the filter rules. Depending on how the filter is defined, it may apply to inbound or outbound packets, or both. In addition, filter rules are flexible enough to take an action (such as forward or drop) on those packets that match the rules, or all packets *except* those that match the rules.

**Note:** The MAX ships with three predefined filters. Many sites use these filters as is or add rules pertinent to their networks. See “Predefined filters” on page 6-19.

## Kinds of packet filters

The MAX supports two types of “static” packet filters:

- Generic filters, which examine the byte- or bit-level contents of any packet.

  Generic filters focus on certain bytes or bits in a packet and compare the contents of that location with a value defined in the filter. To use generic filters effectively, you need to know the contents of certain bytes in the packets you wish to filter. Protocol specifications are usually the best source of such information.
- IP filters, which examine higher-level fields specific to IP packets.

  IP filters focus on known fields in IP packets, such as source or destination address, protocol number, and so forth. They operate on logical information, which is relatively easy to obtain.

The MAX also supports Secure Access, which provides “dynamic” firewalls. Firewalls differ from filters in that they alter their behavior as traffic passes through them, where filters remain unchanged through their lifetimes. Unlike the static packet filters, which have a limited number of rules, router memory is the only limitation in Secure Access firewalls.

If your MAX unit has Secure Access support installed, see the *Ascend Secure Access User’s Guide* (part number 7820-0429-001) for complete instructions on creating and applying firewalls.

## Ways to apply packet filters to an interface

After you have defined a packet filter, you apply it to an interface to monitor packets crossing that interface. You can apply the filter as one of the following:

- A data filter, to define which packets can or cannot cross the interface
- A call filter, to define which packets can or cannot bring up a connection or reset the idle-timer for an established connection (WAN interfaces only)

Packets can pass through both a data filter and call filter on a WAN interface. If both a data and call filter are applied, the data filter comes first.

### Data filters for dropping or forwarding certain packets

Data filters are commonly used for security, but they can apply to any purpose that requires the MAX to drop or forward only specific packets. For example, you can use data filters to drop packets addressed to particular hosts or to prevent broadcasts from going across the WAN. You can also use data filters to allow users to access only specific devices across the WAN.

When you apply a data filter, its forwarding action (forward or drop) affects the actual data stream by preventing certain packets from reaching the Ethernet from the WAN, or vice versa. Data filters do not affect the idle timer, and a data filter applied to a Connection profile does not affect the answering process.

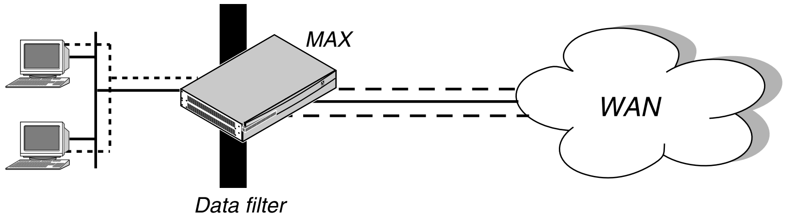


*Figure 6-1. Data filters can drop or forward certain packets*

### Call filters for managing connections

Call filters prevent unnecessary connections and help the MAX distinguish active traffic from “noise.” By default, any traffic to a remote site triggers a call, and any traffic across an active connection resets the connection’s idle timer.

When you apply a call filter, its forwarding action (forward or drop) does not affect which packets are sent across an active connection. The forwarding action of a call filter determines which packets can either initiate a connection or reset a session’s timer. When a session’s idle-timer expires, the session is terminated. The idle timer is set to 120 seconds by default, so if a connection is inactive for two minutes, the MAX terminates the connection.

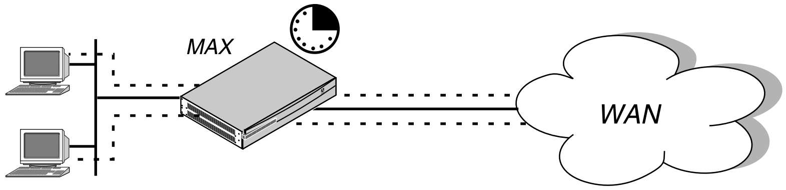


*Figure 6-2. Call filters can prevent certain packets from resetting the timer*

## How filters work

The details of how a filter matches a value in a packet are described in “Understanding the packet filter parameters” on page 6-5. This section provides an overview.

A Filter profile can contain up to 12 input and output filter specifications (rules). Each rule has its own forwarding action—forward or drop. A match occurs at the first successful comparison between a filter and the packet being examined. When a comparison succeeds, the filtering process stops and the forward action in that rule is applied to the packet.

If no comparisons succeed, the packet does not match this filter. However, this does not mean that the packet is forwarded. When no filter is in use, the MAX forwards all packets, but once you apply a filter to an interface, this default is *reversed*. For security purposes, the MAX does not automatically forward non-matching packets. It requires a rule that explicitly allows those packets to pass. For an example of an input filter that forwards all packets that did not match a previous rule, see “Defining a filter to prevent IP address spoofing” on page 6-12.

**Note:** For a call filter to prevent an interface from remaining active unnecessarily, you must define rules for both input and output packets. Otherwise, if only input rules are defined, output packets will keep a connection active, or vice versa.

In a generic filter, all parameter settings in a rule work together to specify a location in a packet and a number to be compared to that location. The Compare parameter specifies whether a comparison succeeds when the contents of the packet equal or do not equal that number.

In an IP filter, a set of distinct comparisons are made in order. When a comparison fails, the packet is allowed to go on to the next comparison. When a comparison succeeds, the filtering process stops and the forward action in that rule is applied to the packet. The IP filter tests proceed in this order:

1. Compare source address parameters to the source address of the packet. If they are not equal, the comparison fails.
2. Compare destination address parameters to the destination address in the packet. If they are not equal, the comparison fails.
3. If the protocol parameter is zero (which matches any protocol), the comparison succeeds. If it is non-zero and not equal to the protocol field in the packet, the comparison fails.
4. If the Src Port Cmp parameter is not set to none, compare the source port parameter to the source port of the packet. If they do not match as specified in the Src-Port-Cmp parameter, the comparison fails.
5. If the Dst Port Cmp parameter is not set to none, compare the destination port parameter to the destination port of the packet. If they do not match as specified in the Dst-Port-Cmp parameter, the comparison fails.
6. If TCP Estab is Yes and the protocol number is 6, the comparison succeeds.

# Defining packet filters

Filter profiles provide rules for defining which packets will be affected. The rules are the same for Input or Output filters. These are the filter parameters:

```
Ethernet
   Filters
      Name=filter-name
      Input filters...
         In filter 01–12
            Valid=Yes
            Type=GENERIC
            Generic...
               Forward=No
               Offset=14
               Length=8
               Mask=ffffffffffffffff
               Value=aaaa0300000080f3
               Compare=Equals
               More=No
            Ip...
               Forward=No
               Src Mask=255.255.255.192
               Src Adrs=192.100.50.128
               Dst Mask=0.0.0.0
               Dst Adrs=0.0.0.0
               Protocol=0
               Src Port Cmp=None
               Src Port #=N/A
               Dst Port Cmp=None
               Dst Port #=N/A
               TCP Estab=N/A
      Output filters...
         Out filter 01–12
            Valid=Yes
            Type=GENERIC
            Generic...
               Forward=No
               Offset=14
               Length=8
               Mask=ffffffffffffffff
               Value=aaaa0300000080f3
               Compare=Equals
               More=No
            Ip...
               Forward=No
               Src Mask=255.255.255.192
               Src Adrs=192.100.50.128
               Dst Mask=0.0.0.0
               Dst Adrs=0.0.0.0
               Protocol=0
               Src Port Cmp=None
               Src Port #=N/A
               Dst Port Cmp=None
               Dst Port #=N/A
               TCP Estab=N/A
```

Note that the parameters for defining the actual packet conditions are identical for Input and Output filters. For details on each parameter, see the *MAX Reference Guide*.

## Understanding the packet filter parameters

This section provides some background information on configuring packet filters.

- Assigning a name to the Filter profile

  Each filter must be assigned a name so it can be referenced from other profiles. The names of defined filters will appear in the main Filters menu.

- Input and Output filters

  Each filter can contain up to 12 Input filters and Output filters, which are defined individually and applied in order (1–12) to the packet stream. Input filters are applied to inbound packets. Output filters are applied to outbound packets.

- Enabling a specific In or Out filter

  Valid enables or disables the current In or Out filter. When a filter is deactivated, all of its parameters are not applicable. (You cannot configure the filter until it is enabled.)

- Specifying a generic or IP filter type

Type can be set to GENERIC or IP. Only the parameters in the corresponding subprofile (Generic or Ip) are applicable.

## Generic filter rules

Generic filters can affect any packet, regardless of its protocol type or header fields. They use these parameters:

```
Generic...
   Forward=No
   Offset=14
   Length=8
   Mask=ffffffffffffff
   Value=aaaa0300000080f3
   Compare=Equals
   More=No
```

This section provides some background information on how these parameters work together.

- Defining the action to take when a packet matches the filter

  Forward specifies whether the MAX discards or forwards packets that match the filter specification. When no filters are in use, the MAX forwards all packets by default. When a filter is in use, the default is to discard matching packets (Forward=No).

- Specifying an offset to the bytes in a packet to be examined

  Offset specifies a byte-offset from the start of a frame to the data in the packet to be tested against this filter. For example, with this filter specification:

  ```
  Generic...
     Forward=No
     Offset=2
     Length=8
     Mask=0F FF FF FF 00 00 00 F0
     Value=07 FE 45 70 00 00 00 90
     Compare=Equals
     More=No
  ```

  and the following packet contents:

  ```
  2A 31 97 FE 45 70 12 22 33 99 B4 80 75
  ```

  The first two byes in the packet (2A and 31) are ignored due to the two-byte offset.

  **Note:** If the current filter is linked to the previous one (if More=Yes in the previous filter), the offset starts at the endpoint of the previous segment.

- Specifying the number of bytes to test

  Length specifies the number of bytes to test in a frame, starting at the specified Offset. The MAX compares the contents of those bytes to the value specified in the filter's Value parameter. For example, with this specification:

  ```
  Generic...
     Forward=No
     Offset=2
     Length=8
     Mask=0F FF FF FF 00 00 00 F0
     Value=07 FE 45 70 00 00 00 90
     Compare=Equals
     More=No
  ```

  and the following packet contents:

```
2A 31 97 FE 45 70 12 22 33 99 B4 80 75
```

The filter applies the mask only to the eight bytes following the two-byte offset.

- Masking the value before comparison

  Mask is a 16-bit mask to apply to the Value before comparing it to the packet contents at the specified offset. You can use it to fine-tune exactly which bits you want to compare.

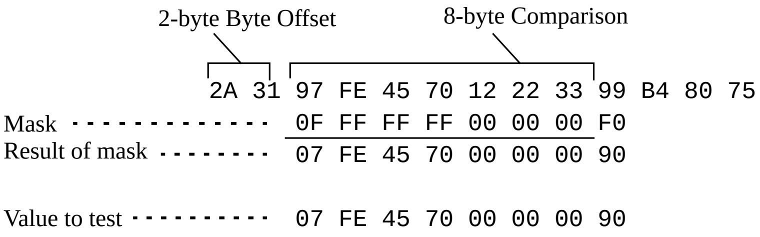
  The MAX applies the mask to the specified value using a logical AND after the mask and value are both translated into binary format. The mask hides the bits that appear behind each binary 0 (zero) in the mask.  A mask of all ones (FF FF FF FF FF FF FF FF) masks no bits, so the full Compare To value must match the packet contents. For example, with this filter specification:

```
Generic...
   Forward=No
   Offset=2
   Length=8
   Mask=0F FF FF FF 00 00 00 F0
   Value=07 FE 45 70 00 00 00 90
   Compare=Equals
   More=No
```

  and the following packet contents:

```
2A 31 97 FE 45 70 12 22 33 99 B4 80 75
```

  The mask is applied as shown below, resulting in a value that matches the Value.



```
                2-byte Byte Offset        8-byte Comparison

                         2A 31  97 FE 45 70 12 22 33 99 B4 80 75
Mask ---------------            0F FF FF FF 00 00 00 F0
Result of mask --------         07 FE 45 70 00 00 00 90

Value to test ----------        07 FE 45 70 00 00 00 90
```

  The packet matches this filter. Because the Filter Action is “Discard”, the packet will be dropped. The byte comparison works as follows:

  – 2A  and 31 are ignored due to the two-byte offset.

  – 9 in the lower half of the third byte is ignored, because the mask has a 0 in its place. The 7 in the third byte matches the value parameter’s 7 in the upper half of that byte.

  – F and E in the fourth byte match the value parameter for that byte.

  – 4 and 5 in the fifth byte match the value parameter for that byte.

  – 7 and 0 in the sixth byte match the value parameter for that byte.

  – 12 and 22 and 33 in the seventh, eighth and ninth bytes are ignored because the mask has a 0 in those places.

  – 9 in the tenth byte equals the matches the value parameter’s 9 in the lower half of that byte. The second 9 in the upper-half of the packet’s tenth byte is ignored because the mask has a 0 in its place.

- The value to match up in the packet contents

  Value specifies a hexadecimal number to be compared to specific bits contained in packets after the Offset, Length, and Mask calculations have been applied.

- The type of comparison to be performed when matching the packet

Compare specifies the type of comparison to make between the specified value and the packet's contents: less than, equal, greater than, or not equal.

- Linking the filter to the next In filter or Out filter in sequence

  More specifies whether the MAX includes the next filter condition before determining whether the frame matches the filter. If checked, the current filter condition is linked to the one immediately following it, so the filter can examine multiple non-contiguous bytes within a packet. In effect, this parameter "marries" the current filter to the next one, so that the next filter is applied before the forwarding decision is made. The match occurs only if *both* non-contiguous bytes contain the specified values. The next filter must be enabled; otherwise, the MAX ignores the filter.

## IP filter rules

IP filter rules affect only IP and related packets. IP filters use these parameters:

```
Ip...
   Forward=No
   Src Mask=255.255.255.192
   Src Adrs=192.100.50.128
   Dst Mask=0.0.0.0
   Dst Adrs=0.0.0.0
   Protocol=0
   Src Port Cmp=None
   Src Port #=N/A
   Dst Port Cmp=None
   Dst Port #=N/A
   TCP Estab=N/A
```

This section provides some background information on how these parameters work.

- Defining what action to take when a packet matches the filter

  Forward specifies whether the MAX discards or forwards packets that match the filter specification. When no filters are in use, the MAX forwards all packets by default. When a filter is in use, the default is to discard matching packets.

- Specifying which part of the source IP address to use for comparison

  Src Mask specifies a mask to apply to the Src Adrs value before comparing it to the source address in a packet. You can use it to mask out the host portion of an address, for example, or the host and subnet portion.

  The MAX applies the mask to the address using a logical AND after the mask and address are both translated into binary format. The mask hides the portion of the address that appears behind each binary 0 (zero) in the mask. A mask of all zeros (the default) masks all bits, so all source addresses are matched. A mask of all ones (255.255.255.255) masks no bits, so the full source address from a single host is matched.

- Filtering on the packet's source IP address

  This parameter specifies a source IP address. After this value has been modified by applying the specified Src Mask, it is compared to a packet's  source address.

- Specifying which part of the destination IP address to use for comparison

  Dst Mask specifies a mask to apply to the Dst Adrs before comparing it to the destination address in a packet. You can use it to mask out the host portion of an address, for example, or the host and subnet portion. The MAX applies the mask to the address using a logical AND after the mask and address are both translated into binary format. The mask hides the portion of the address that appears behind each binary 0 (zero) in the mask. A mask of all zeros (the default) masks all bits, so all destination addresses are matched. A mask of all ones (255.255.255.255) masks no bits, so the full destination address to a single host is matched.

- Filtering on the packet's destination IP address

  Dst Adrs specifies a destination IP address. After this value has been modified by applying the specified Mask, it is compared to a packet's  destination address.

- Filtering on the protocol number field in IP packets

  If you specify a protocol number, the MAX compares it to the protocol number field in packets to match them to this filter. The default protocol number of zero matches all protocols. Common protocols are listed below, but protocol numbers are not limited to this list. For a complete list, see the section on Well-Known Port Numbers in RFC 1700, *Assigned Numbers,* by Reynolds, J. and Postel, J., October 1994.

  – 1: ICMP
  – 5: STREAM
  – 8: EGP
  – 6: TCP
  – 9: Any private interior gateway protocol (such as Cisco's IGRP)
  – 11: Network Voice Protocol
  – 17: UDP
  – 20: Host Monitoring Protocol
  – 22: XNS IDP
  – 27: Reliable Data Protocol
  – 28: Internet Reliable Transport Protocol
  – 29: ISO Transport Protocol Class 4
  – 30: Bulk Data Transfer Protocol
  – 61: Any Host Internal Protocol
  – 89: OSPF

- Filtering on source port numbers

  Src Port # specifies a value to compare with the source port number in a packet. The default setting (zero) indicates that the MAX disregards the source port in this filter. Port 25 is reserved for SMTP; that socket is dedicated to receiving mail messages. Port 20 is reserved for FTP data messages, port 21 for FTP control sessions, and port 23 for telnet.

  The Src Port Cmp parameter specifies the type of comparison to be made.

- Filtering on destination port numbers

  Dst Port # specifies a value to compare with the destination port number in a packet. The default setting (zero) indicates that the MAX disregards the destination port in this filter. Port 25 is reserved for SMTP; that socket is dedicated to receiving mail messages. Port 20 is reserved for FTP data messages, port 21 for FTP control sessions, and port 23 for telnet.

  The Dst Port Cmp parameter specifies the type of comparison to be made.

- Filtering based only on established TCP sessions.

  TCP Estab can be used to restrict the filter to packets in an established TCP session. You can only use it if the Protocol number has been set to 6 (TCP). Otherwise, it is not applicable.

# Example filter specifications

This section shows some example generic and IP filter specifications.

## Defining a filter to drop AppleTalk broadcasts

This example shows a generic filter whose purpose is to prevent local AppleTalk AEP and NBP traffic from going across the WAN. It is supposed to drop packets, so it will be applied as a data filter. The filter first defines packets that should be forwarded across the WAN: AARP (AppleTalk Address Resolution Protocol) packets, AppleTalk packets that are not addressed to the AppleTalk multicast address (such as regular traffic related to an actual AppleTalk File Server connection), and all non-AppleTalk traffic.

The filter then specifies that AEP (AppleTalk Echo Protocol) and NBP (Name Binding Protocol) packets should be dropped. To define this filter:

**1** Open a Filter profile and assign it a name. For example:

```
Ethernet
   Filters
      Name=AppleTalk Broadcasts
```

**2** Open Output Filters>Out filter 01.

**3** Set Valid to Yes and Type to GENERIC.

```
      Output filters...
         Out filter 01
            Valid=Yes
            Type=GENERIC
```

**4** Open the Generic subprofile and specify the following rules:

```
            Generic...
               Forward=Yes
               Offset=14
               Length=8
               Mask=ffffffffffffffff
               Value=aaaa0300000080f3
               Compare=Equals
               More=No
```

These rules define the bytes in AARP packets that contain the protocol type number (0x80f3). The Value setting specifies the same value (0x80f3), so AARP packets will match these rules.

**5** Close this filter. Then open Out filter 02, and set Valid to Yes and Type to GENERIC.

```
      Output filters...
         Out filter 02
            Valid=Yes
            Type=GENERIC
```

**6** Open the Generic subprofile and specify the following rules:

```
            Generic...
            Forward=Yes
               Offset=32
               Length=6
               Mask=ffffffffffff0000
               Value=090007ffffff0000
```

```
         Compare=NotEquals
         More=No
```

These rules specify the multicast address used by AppleTalk broadcasts. The MAX will forward any AppleTalk packet that does not match the specified rules.

**7** Close this filter. Then open Out filter 03, and set Valid to Yes and Type to GENERIC.

```
Output filters...
   Out filter 03
      Valid=Yes
      Type=GENERIC
```

**8** Open the Generic subprofile and specify the following rules:

```
      Generic...
         Forward=Yes
         Offset=14
         Length=8
         Mask=ffffffffffffffff
         Value=aaaa03080007809b
         Compare=NotEquals
         More=No
```

These rules define the bytes in AppleTalk packets that specifies the protocol type number (0x809b).These rules define non-AppleTalk traffic (packets that do not contain that value in the specified location). The MAX will forward non-AppleTalk outbound packets.

**9** Close this filter. Then open Out filter 04, and set Valid to Yes and Type to GENERIC.

```
Output filters...
   Out filter 04
      Valid=Yes
      Type=GENERIC
```

**10** Open the Generic subprofile and specify the following rules:

```
      Generic...
         Forward=No
         Offset=32
         Length=3
         Mask=ffffffffffffffff
         Value=0404040000000000
         Compare=Equals
         More=No
```

These rules specify AEP packets. For details, see *Inside AppleTalk* (Addison Wesley, Inc.)

**11** Close this filter. Then open Out filter 05, and set Valid to Yes and Type to GENERIC.

```
Output filters...
   Out filter 05
      Valid=Yes
      Type=GENERIC
```

**12** Open the Generic subprofile and specify the following rules:

```
      Generic...
         Forward=No
         Offset=32
         Length=4
         Mask=ff00fff000000000
         Value=0200022000000000
         Compare=Equals
         More=Yes
```

Notice that More is set to Yes, linking Out filter 05 with the Out filter 06. Together, these two Out filters specify NBP lookup packets with a wildcard entity name.

**13** Close this filter. Then open Out filter 06, and set Valid to Yes and Type to GENERIC.

```
      Output filters...
         Out filter 06
            Valid=Yes
            Type=GENERIC
```

**14** Open the Generic subprofile and specify the following rules:

```
            Generic...
               Forward=No
               Offset=42
               Length=2
               Mask=ffff000000000000
               Value=013d000000000000
               Compare=Equals
               More=No
```

**15** Close this filter.

**16** Close the Filter profile.

## Defining a filter to prevent IP address spoofing

IP address spoofing occurs when a remote device illegally acquires a local address to break through a firewall. This example filter first defines input filters that drop packets whose source address is on the local IP network or the loopback address (127.0.0.0). In effect, these filters say: “If you see an inbound packet with one of these source addresses, drop the packet.” The third input filter defines every other source address (0.0.0.0) and specifies “Forward everything else to the local network.”

**Note:** If you apply this filter to the Ethernet interface, the MAX will drop IP packets it receives from local LAN and you will not be able to Telnet to the unit.

This example filter then defines an output filter that specifies: “If an outbound packet has a source address on the local network, forward it; otherwise, drop it.” The MAX drops all outbound packets with a non-local source address. This filter uses a local IP network address of 192.100.50.128, with a subnet mask of 255.255.255.192. These addresses are just examples. To define this IP filter:

**1** Open a Filter profile and assign it a name. For example:

```
Ethernet
   Filters
      Name=IP Spoofing
```

**2** Open Input Filters>In filter 01.

**3** Set Valid to Yes and Type to IP.

```
      Input filters...
         In filter 01
            Valid=Yes
            Type=IP
```

**4** Open the IP subprofile and specify the following rules:

```
            Ip...
               Forward=No
               Src Mask=255.255.255.192
               Src Adrs=192.100.50.128
               Dst Mask=0.0.0.0
               Dst Adrs=0.0.0.0
               Protocol=0
               Src Port Cmp=None
               Src Port #=N/A
               Dst Port Cmp=None
               Dst Port #=N/A
               TCP Estab=N/A
```

The Src Mask parameter specifies the local netmask The Src Adrs parameter specifies the local IP address. If an incoming packet has the local address, the MAX does not forward it onto the Ethernet.

**5** Close this filter. Then open In filter 02, and set Valid to Yes and Type to IP.

```
      Input filters...
         In filter 02
            Valid=Yes
            Type=IP
```

**6** Open the IP subprofile and specify the following rules:

```
            Ip...
               Forward=No
               Src Mask=255.0.0.0
               Src Adrs=127.0.0.0
               Dst Mask=0.0.0.0
               Dst Adrs=0.0.0.0
               Protocol=0
               Src Port Cmp=None
               Src Port #=N/A
               Dst Port Cmp=None
               Dst Port #=N/A
               TCP Estab=N/A
```

These rules specify the loopback address in the Src Mask and Src Adrs fields. If an incoming packet has this address, the MAX does not forward it onto the Ethernet.

**7** Close this filter. Then open In filter 03, and set Valid to Yes and Type to IP.

```
      Input filters...
         In filter 03
            Valid=Yes
            Type=IP
```

**8** Open the IP subprofile and specify the following rules:

```
            Ip...
               Forward=Yes
               Src Mask=0.0.0.0
               Src Adrs=0.0.0.0
               Dst Mask=0.0.0.0
               Dst Adrs=0.0.0.0
               Protocol=0
               Src Port Cmp=None
               Src Port #=N/A
               Dst Port Cmp=None
               Dst Port #=N/A
               TCP Estab=N/A
```

These rules specify every other source address (0.0.0.0) If an incoming packet has any non-local source address, the MAX forwards it onto the Ethernet.

9. Close this In filter and the Input filters subprofile. Then, open the Output filters subprofile and select the first Out filter in the list (01).
10. Set Valid to Yes and Type to IP.

```
      Output filters...
         Out filter 01
            Valid=Yes
            Type=IP
```

11. Open the IP subprofile and specify the following rules:

```
            Ip...
               Forward=Yes
               Src Mask=255.255.255.192
               Src Adrs=192.100.40.128
               Dst Mask=0.0.0.0
               Dst Adrs=0.0.0.0
               Protocol=0
               Src Port Cmp=None
               Src Port #=N/A
               Dst Port Cmp=None
               Dst Port #=N/A
               TCP Estab=N/A
```

The Src Mask parameter specifies the local netmask The Src Adrs parameter specifies the local IP address. If an outgoing packet has a local source address, the MAX forwards it.

12. Close the Filter profile.

## Defining a filter for more complex IP security issues

This example illustrates some of the issues you may need to consider when writing your own IP filters. The sample filter presented here does not address the fine points of network security. You may want to use this sample filter as a starting point and augment it to address your security requirements. See the *MAX Security Supplement* for details.

In this example, the local network supports a Web server and the administrator needs to carry out these tasks:

- Provide dial-in access to the server's IP address.
- Restrict dial-in traffic to all other hosts on the local network.

However, many local IP hosts need to dial out to the Internet and use IP-based applications such as Telnet or FTP; therefore, their response packets need to be directed appropriately to the originating host. In this example, the Web server's IP address is 192.9.250.5. This filter will be applied in Connection profiles as a data filter.

To define this filter:

1. Open a Filter profile and assign it a name.

```
Ethernet
   Filters
      Name=Web Safe
```

2. Open Input Filters>In filter 01.
3. Set Valid to Yes and Type to IP.

```
      Input filters...
         In filter 01
```

```
            Valid=Yes
            Type=IP
```

**4** Open the IP subprofile and specify the following rules:

```
            Ip...
               Forward=Yes
               Src Mask=0.0.0.0
               Src Adrs==0.0.0.0
               Dst Mask=255.255.255.255
               Dst Adrs=192.9.250.5
               Protocol=6
               Src Port Cmp=None
               Src Port #=N/A
               Dst Port Cmp=Eql
               Dst Port #=80
               TCP Estab=No
```

This input filter specifies the Web server’s IP address as the destination and sets IP forward to Yes. The MAX forwards all IP packets received with that destination address.

**5** Close this filter. Then open In filter 02, and set Valid to Yes and Type to IP.

```
      Input filters...
         In filter 02
            Valid=Yes
            Type=IP
```

**6** Open the IP subprofile and specify the following rules:

```
            Ip...
               Forward=Yes
               Src Mask=0.0.0.0
               Src Adrs=0.0.0.0
               Dst Mask=0.0.0.0
               Dst Adrs=0.0.0.0
               Protocol=6
               Src Port Cmp=None
               Src Port #=N/A
               Dst Port Cmp=Gtr
               Dst Port #=1023
               TCP Estab=No
```

These rules specify TCP packets (Protocol=6) *from* any address and *to* any address. The filter forwards them if the destination port is greater than the source port. For example, Telnet requests go out on port 23 and responses come back on some random port greater than port 1023. So, this filter defines packets coming back to respond to a user's request to Telnet to a remote host.

**7** Close this filter. Then open In filter 03, and set Valid to Yes and Type to IP.

```
      Input filters...
         In filter 03
            Valid=Yes
            Type=IP
```

**8** Open the IP subprofile and specify the following rules:

```
            Ip...
               Forward=Yes
               Src Mask=0.0.0.0
               Src Adrs=0.0.0.0
               Dst Mask=0.0.0.0
               Dst Adrs=0.0.0.0
```

```
         Protocol=17
         Src Port Cmp=None
         Src Port #=N/A
         Dst Port Cmp=Gtr
         Dst Port #=1023
         TCP Estab=No
```

These rules specify UDP packets (Protocol=17) *from* any address and *to* any address. The filter forwards them if the destination port is greater than the source port. For example, suppose a RIP packet goes out as a UDP packet to destination port 520. The response to this request goes to a random destination port greater than 1023.

**9** Close this filter. Then open In filter 04, and set Valid to Yes and Type to IP.

```
Input filters...
   In filter 04
      Valid=Yes
      Type=IP
```

**10** Open the IP subprofile and specify the following rules:

```
      Ip...
         Forward=Yes
         Src Mask=0.0.0.0
         Src Adrs=0.0.0.0
         Dst Mask=0.0.0.0
         Dst Adrs=0.0.0.0
         Protocol=1
         Src Port Cmp=None
         Src Port #=N/A
         Dst Port Cmp=None
         Dst Port #=N/A
         TCP Estab=No
```

These rules specify unrestricted pings and traceroutes. ICMP does not use ports like TCP and UDP, so a port comparison is unnecessary.

**11** Close the Filter profile.

# Applying packet filters

Filters must be applied to an interface to examine packets passed across that interface in the MAX. They can be applied as a data filter, to forward or drop certain packets, or as a call filter, to affect which packets reset the Idle timer. See “Introduction to packet filters” on page 6-2 for background information on these two applications. These are the relevant parameters:

```
Ethernet
   Answer
      Session options...
         Data Filter=0
         Call Filter=0
         Filter Persistence=No
```

```
Ethernet
   Connections
      Session options...
         Data Filter=5
         Call Filter=0
         Filter Persistence=No
```

```
Ethernet
   Mod Config
      Ether options...
         Filter=1
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding how filters are applied

This section provides some background information about the parameters for applying filters to a local or WAN interface.

- Applying filters in the Answer profile

  Filters applied in the Answer profile are not used if the caller has a Connection profile. They are only used if configured profiles are not required for callers, or if the caller is authenticated using a Name profile. If the Answer profile filters are used, they have the same effect as those ordinarily specified in a Connection profile, described next.
- Specifying a data filter

  A data filter affects the actual data stream on the WAN interface, forwarding or dropping packets according to its rules. See “Data filters for dropping or forwarding certain packets” on page 6-2. When you apply a filter to a WAN interface, it takes effect when a connection is brought up on that interface.
- Specifying a call filter

  A call filter does not forward or drop packets. When the filter rules specify “forward”, the call filter lets matching packets initiate the connection or reset the idle time if the connection is active. See “Call filters for managing connections” on page 6-3.

  If both a data filter and call filter are applied, the data filter comes first. This means that only those packets that pass the data filter reach the call filter.
- Filter persistence

  Before Secure Access was supported, the MAX simply constructed a filter on a WAN interface when the connection was established and destroyed the filter when the connection was brought down, even if the connection just timed out momentarily. This works fine for static packet filters, but does not accommodate Secure Access firewalls. Filter Persistence is needed to allow firewalls to persist across connection state changes, but it is not needed for filters. If you do set it for a static packet filter, the filter persists across connection state changes. See the *MAX Security Supplement* for details.
- Applying a data filter on Ethernet

  Call filters do not apply to the local network interface, so only one Filter parameter is needed in the Ethernet profile. This is a data filter that affects which packets are allowed to reach the Ethernet or leave the Ethernet for another interface.

  A filter applied to the Ethernet interface takes effect immediately. If you change the Filter profile definition, the changes apply as soon as you save the Filter profile.

**Note:** Use caution when applying a filter to the Ethernet interface. You could inadvertently render the MAX inaccessible from the local LAN.

# Example configurations applying filters

After you have created a filter, as described in “Defining packet filters” on page 6-4, you can apply it as a data filter or call filter. This section shows some example configurations.

## Applying a data filter in a Connection profile

To apply a data filter in a Connection profile:

**1** Open the Session Options subprofile of the Connection profile.

**2** Specify the filter’s number in the Data Filter parameter. For example:

```
Ethernet
   Connections
      Session options...
         Data Filter=5
         Call Filter=0
         Filter Persistence=No
```

Specify the unique portion of the number preceding the filter’s name in the Filters menu.

**3** Close the Connection profile.

## Applying a call filter and resetting the idle timer

When you apply a call filter in a Connection profile, it determines which packets will reset the idle timer for a connection. In this example, the idle timer is reset to 20 seconds, so if no packets pass the call filter for 20 seconds, the connection will be torn down.

To apply a call filter and reset the idle timer in a Connection profile:

**1** Open Connections>Session Options.

**2** Specify the filter’s number in the Call Filter parameter.

The filter’s number is the unique portion of the number preceding the filter’s name in the Filters menu.

**3** Specify 20 seconds in the Idle parameter.

```
Ethernet
   Connections
      Session options...
         Data Filter=0
         Call Filter=2
         Filter Persistence=No
         Idle=20
```

Or, if the profile specifies a terminal server call, use the TS Idle Mode and TS Idle parameters instead; for example:

```
Ethernet
   Connections
      Session options...
         Data Filter=0
         Call Filter=2
         Filter Persistence=No
         Idle=0
         TS Idle Mode=Input/Output
         TS Idle=20
```

**4** Close the Connection profile.

### Applying a data filter to the Ethernet interface

To apply a data filter to the local network interface:

1. Open the Ethernet>Mod Config>Ether Options.
2. Specify the filter's number in the Filter parameter. For example:

   ```
   Ethernet
      Mod Config
         Ether options...
            Filter=1
   ```

   (Call filters are not applicable to the local network interface.)
3. Close the Ethernet profile.

# Predefined filters

The MAX ships with three predefined Filter profiles, one for each commonly used protocol suite. Some sites modify the predefined call filters to make them more full-featured for the types of packets commonly seen at that site. As shipped, they provide a base that you can build on to fine-tune how the MAX handles routine traffic on your network. They are intended for use as call filters, to help keep connectivity costs down. These are the predefined filters:

- IP Call (for managing connectivity on IP connections)
- NetWare Call (for managing connectivity on IPX connections)
- AppleTalk Call (for managing connectivity on bridged AppleTalk connections)

## IP Call filter

The predefined IP Call filter prevents inbound packets from resetting the Idle Timer. It does not prevent any type of outbound packets from resetting the timer or placing a call. This is how it is defined:

```
Ethernet
   Filters
      IP Call...
         Name=IP Call
         Input filters...
            In filter 01
               Valid=Yes
               Type=GENERIC
               Generic...
                  Forward=No
                  Offset=0
                  Length=0
                  Mask=000000000000000000
                  Value=000000000000000000
                  Compare=None
                  More=No
         Output filters...
            Out filter 01
               Valid=Yes
               Type=GENERIC
               Generic...
```

```
                  Forward=Yes
                  Offset=0
                  Length=0
                  Mask=000000000000000000
                  Value=000000000000000000
                  Compare=None
                  More=No
```

The IP Call filter contains one input filter, which defines all inbound packets, and one output filter, which defines all outbound packets (all outbound packets destined for the remote network).

## NetWare Call filter

The predefined NetWare Call filter is designed to prevent SAP (Service Advertising Protocol) packets originating on the local IPX network from resetting the Idle Timer or initiating a call. NetWare servers broadcast SAP packets every 60 seconds to make sure that all routers and bridges know about available services. To prevent these packets from keeping a connection up unnecessarily, apply the predefined NetWare Call filter in the Session Options subprofile of Connection profiles in which IPX routing is configured.

The predefined NetWare Call filter contains six output filters, which identify outbound SAP packets and prevent them from resetting the Idle Timer or initiating a call. This is how it is defined:

```
Ethernet
   Filters
      NetWare Call...
         Name=NetWare Call
         Output filters...
            Out filter 01
               Valid=Yes
               Type=GENERIC
               Generic...
                  Forward=No
                  Offset=14
                  Length=3
                  Mask=ffffff000000000000
                  Value=e0e0030000000000
                  Compare=Eqls
                  More=Yes
            Out filter 02
               Valid=Yes
               Type=GENERIC
               Generic...
                  Forward=No
                  Offset=27
                  Length=8
                  Mask=ffffffffffffffff
                  Value=ffffffffffff0452
                  More=Yes
            Out filter 03
               Valid=Yes
               Type=GENERIC
               Generic...
                  Forward=No
                  Offset=47
                  Length=2
                  Mask=ffff000000000000
                  Value=0002000000000000
                  More=No
            Out filter 04
               Valid=Yes
               Type=GENERIC
               Generic...
                  Forward=No
                  Offset=12
                  Length=4
                  Mask=fc00ffff00000000
                  Value=0000ffff00000000
                  More=Yes
            Out filter 05
               Valid=Yes
               Type=GENERIC
               Generic...
                  Forward=No
                  Offset=24
                  Length=8
                  Mask=ffffffffffffffff
                  Value=ffffffffffff0452
                  More=Yes
            Out filter 06
               Valid=Yes
               Type=GENERIC
               Generic...
                  Forward=No
                  Offset=44
                  Length=2
                  Mask=ffff000000000000
                  Value=0002000000000000
                  More=No
```

## AppleTalk Call filter

The AppleTalk Call filter instructs the MAX to place a call and reset the Idle Timer based on AppleTalk activity on the LAN, but to prevent inbound packets or AppleTalk Echo (AEP) packets from resetting the timer or initiating a call. It includes one input and five output filters.

The input filter prevents inbound packets from resetting the timer or initiating a call. The output filters identify the AppleTalk Phase II and Phase I AEP protocols. The last filter allows all other outbound packets to reset the timer or initiate a call.

```
Ethernet
   Filters
      AppleTalk Call...
         Name=AppleTalk Call
         Input filters...
            In filter 01
               Valid=Yes
               Type=GENERIC
               Generic...
                  Forward=No
         Offset=0
         Length=0
         Mask=000000000000000000
         Value=0000000000000000
         More=No
Output filters...
   Out filter 01
      Valid=Yes
      Type=GENERIC
      Generic...
         Forward=No
         Offset=14
         Length=8
         Mask=ffffff000000ffff
         Value=aaaa03000000809b
         More=Yes
   Out filter 02
      Valid=Yes
      Type=GENERIC
      Generic...
         Forward=No
         Offset=32
         Length=3
         Mask=ffffff0000000000
         Value=0404040000000000
         More=No
   Out filter 03
      Valid=Yes
      Type=GENERIC
      Generic...
         Forward=No
         Offset=12
         Length=2
         Mask=ffff000000000000
         Value=809b000000000000
         More=Yes
   Out filter 04
      Valid=Yes
      Type=GENERIC
      Generic...
         Forward=No
         Offset=24
         Length=3
         Mask=ffffff0000000000
         Value=0404040000000000
         More=No
   Out filter 05
      Valid=Yes
      Type=GENERIC
      Generic...
         Forward=Yes
         Offset=0
         Length=0
         Mask=0000000000000000
         Value=0000000000000000
         More=No
```

# Configuring Packet Bridging

# 7

This chapter covers these topics:

# Introduction to Ascend bridging

Packet bridging can be configured on any kind of WAN link (PPP, Multilink PPP, Combinet, frame relay, etc.). When you enable packet bridging, the MAX operates in bridging mode for all packets that are not routed (IP packets and IPX packets using the specified frame type). Usually, bridging is not used when routing is available, but the MAX can operate in bridging mode to join two segments of any network at the link layer, including IP or IPX networks.

In bridging mode, the MAX acts as if the far end of the connection is another segment of the local Ethernet network. It forwards packets to that remote network segment if the hardware address of the addressee does not reside on the local segment. It does not care what protocols are in use, so bridging is often used to provide connectivity for non-routed protocols.

Routers have better performance than bridges, because bridges examine *all* packets on the LAN (the Ethernet controller runs in promiscuous mode") so they incur greater processor and memory overhead than routers. On heavily loaded networks, this increased overhead can result in noticeably slower performance.

Routers examine packets at the network layer (instead of the link layer), so they can filter on logical addresses for security purposes. In addition, routers support multiple transmission paths to a given destination, providing faster and more reliable packet delivery.

Another important difference between bridging and routing is that routers usually ignore broadcast packets, but bridges forward them across the link. So, bridges are also used to support protocols that depend on broadcasts to function, such as BOOTP.

## How the MAX establishes a bridged connection

Because the MAX does not examine logical network addresses when it is operating in bridging mode, it uses the station name and password to find the matching Connection profile for a bridged connection. This is shown in Figure 7-1.

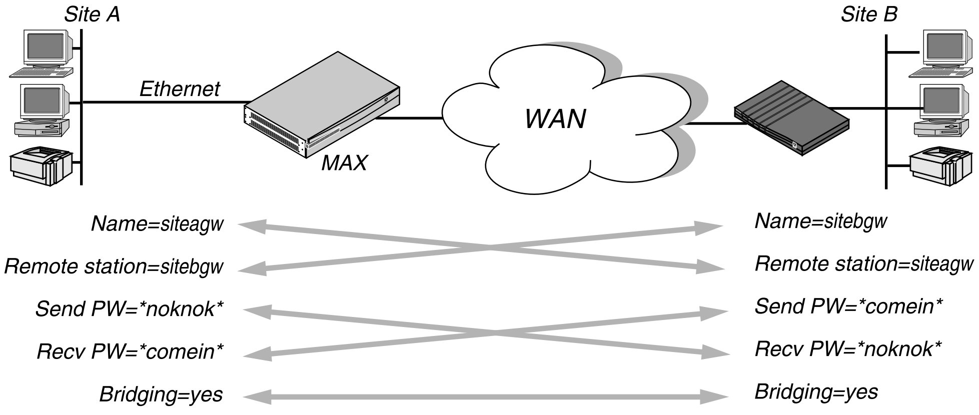


*Figure 7-1. Negotiating a bridge connection (PPP encapsulation)*

**Note:** The information exchange shown in Figure 7-1 differs slightly for Combinet bridging, where the bridges' MAC addresses are exchanged instead of station names, and passwords may be configured as optional. Otherwise, the way in which a Combinet bridge connection is established across the WAN is very similar to the PPP bridged connection shown above. For more information about Combinet, see Chapter 3, "Configuring WAN Links."

The system name assigned to the MAX in the Name parameter of System>Sys Config must *exactly* match the device name specified in the Connection profile on the remote bridge, including case changes. Similarly, the name assigned to the remote bridge must exactly match the name specified in the Station parameter of that Connection profile, including case changes.

**Note:** The most common cause of trouble when initially setting up a PPP bridged connection is that the wrong name is specified for the MAX or the remote device. Often case changes are not specified, or a dash, space, or underscore is not entered.

## What causes the MAX to dial out a bridged connection

In bridging mode, the MAX accepts all packets on the Ethernet. The packets that are forwarded across WAN lines are either broadcast packets or unicast packets with a hardware address that is not on the local Ethernet segment (the segment to which the MAX is connected).

Because the MAX does not examine network addresses for bridging, it needs a way to determine where to forward bridged packets. These are the methods it supports:

- Dial on broadcast (bring up all connections that enable the dial-on-broadcast feature whenever a broadcast packet is received).
- Bridge table entries (bring up the specified connection when a packet with the specified hardware address is received).

### Broadcast packets and dial on broadcast

A broadcast address is recognized by multiple nodes on a network; for example, the Ethernet broadcast address at the physical level is:

```
FFFFFFFFFFFF
```

All devices on the same network receive packets with that destination address. As a router, the MAX discards broadcast packets. In bridging mode, however, it forwards packets with the broadcast address across all active sessions that have bridging enabled ,and dials a link for all Connection profiles in which the Dial Brdcast parameter is set to Yes.

The dial broadcast method of bringing up bridged connections is easy to configure but inefficient if a large number of connections support bridging. Whenever the MAX receives broadcast packets, it brings up *all* connections that have dial broadcast enabled.

If Dial Brdcast is turned off in a Connection profile, the MAX does not initiate dialing for that connection based on broadcast requests. Instead, it relies on its bridge table to recognize which Connection profile to use. If you turn off Dial Brdcast and the MAX does not have a bridge table entry for a destination address, the MAX will not bring up that connection.

### Hardware addresses and the bridge table

A physical address, or Media Access Control (MAC) address, is a unique hardware-level address associated with a specific network controller. On Ethernet, the physical address is a six-byte hexadecimal number assigned by the Ethernet hardware manufacturer, for example:

```
0000D801CFF2
```

If the MAX receives a packet whose destination MAC address is not on the local network, it first checks its internal bridge table. If it finds the packet's destination MAC address in its bridge table, the MAX dials the connection and bridges the packet. If the address is *not* specified in its bridge table, the MAX checks for active sessions that have bridging enabled. If there is one or more active bridging links, the MAX forwards the packet across *all* active sessions that have bridging enabled.

**Note:** The MAX does not dial a connection for packets that are not on the local network and not specified in its bridge table, because it has no way of finding the proper Connection profile.

## How the bridge table works

The MAX is a transparent bridge (also called a learning bridge). That means it builds a bridge table dynamically by keeping track of the source addresses passed across a bridged connection. It also adds the entries defined in its Bridge profiles, described in “Understanding the bridging parameters” on page 7-5. Bridge profiles are analogous to static routes in a routing environment.

The bridge table associates end nodes with a particular connection. For example, Figure 7-2 shows the physical addresses of some end nodes on the local Ethernet and at a remote site. The MAX at site A is operating in bridging mode on this connection.

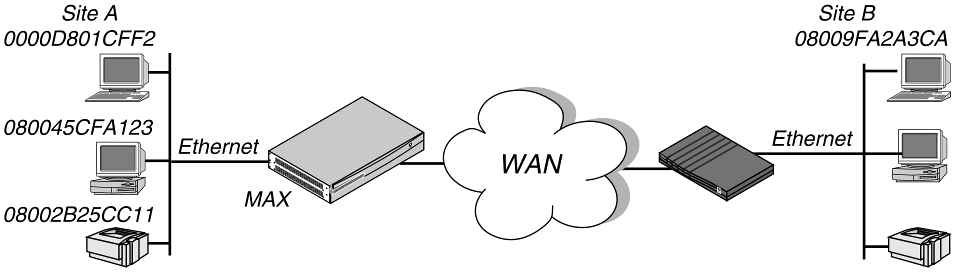


*Figure 7-2. How the MAX creates a bridging table*

The MAX at site A gradually learns the addresses on both networks by looking at each packet’s source address, and it develops a bridge table like this:

```
0000D801CFF2      SITEA
080045CFA123      SITEA
08002B25CC11      SITEA
08009FA2A3CA      SITEB (Connection profile #5)
```

A Connection profile may be associated with a bridging link either because it was used to dial the link or because it matched an incoming call. Entries in the MAX unit’s bridge table must be relearned within a fixed aging time limit, or they are removed from the table.

# Enabling packet bridging

You enable packet bridging by opening Ethernet>Mod Config and setting the Bridging parameter to Yes:

```
Ethernet
   Mod Config
      Bridging=Yes
```

The Bridging parameter causes the MAX unit's Ethernet controller to run in promiscuous mode. In promiscuous mode, the Ethernet driver accepts all packets regardless of address or packet type and passes them up the protocol stack for a higher-layer decision on whether to route, bridge, or reject the packets.

**Note:** Running in promiscuous mode incurs greater processor and memory overhead than the standard mode of operation for the Ethernet controller. On heavily loaded networks, this increased overhead can result in slower performance, even if no packets are actually bridged.

# Configuring bridged connections

Bridged connections require both Answer and Connection (or Name) profiles settings. They also require a method of recognizing when to dial the connection, which may be the dial-on-broadcast feature or a Bridge profile (Ethernet>Bridge Adrs). If a connection has an associated Bridge profile, it does not need dial-on-broadcast. You can define up to 100 Bridge profiles.

These are the bridging parameters with example values:

```
Ethernet
   Answer
      PPP options...
         Bridge=Yes
         Recv Auth=Either
Ethernet
   Connections
      Station=farend
      Bridge=Yes
      Dial Brdcast=No
      IPX options...
         NetWare t/o=N/A
         Handle IPX=Client
Ethernet
   Names / Passwords
      Name=Brian
      Active=yes
      Recv PW=brianpw
Ethernet
   Bridge Adrs
      Enet Adrs=CFD012367
      Net Adrs=10.1.1.12
      Connection #=7
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the bridging parameters

This section provides some background information on the bridging parameters.

- Bridging in the Answer profile

  Both the Bridge parameter and a form of password authentication must be enabled for the MAX to accept inbound bridged connections.

**Note:** Bridge is N/A in the Answer profile if the packet bridging has not already been enabled in the Ethernet profile. See "Enabling packet bridging" on page 7-4.

- Station name and password

  Name and password authentication is required, as described in "How the MAX establishes a bridged connection" on page 7-2.
- Bridging and dial broadcast in a Connection profile

  Bridge specifies that the Connection will bridge packets at the link level, provided that a method of bringing up the connection exists. Either the Connection profile must be specified in a static bridge table entry or Dial Brdcast must be turned on. See "What causes the MAX to dial out a bridged connection" on page 7-3.
- IPX bridging options

  See "IPX bridged configurations" on page 7-8.
- Names and passwords

  The MAX uses station names and passwords to sync up a bridged connection. These may be provided in a Connection profile, a Name profile, or an external authentication profile.
- Bridge profile parameters

  If a Connection profile does not use dial broadcast, it must have a bridge table entry for the MAX to be able to bring up the connection on demand. The Bridge profile defines a bridge table entry by specifying three parameters:

  – Ethernet address

    Each bridge table entry specifies an Ethernet (node) address that is not on the local segment. See "Hardware addresses and the bridge table" on page 7-3 for details on Ethernet addresses.

  – Network address

    If you are bridging between two segments *of the same IP network*, you can use the Net Adrs parameter in a Bridge profile to enable the MAX to respond to ARP requests while bringing up the bridged connection. See "Example bridge connection with ARP" on page 7-12.

  – Connection number

    Bridge profiles are associated with one Connection profile, which the MAX uses to bring up the connection to the specified node address. You specify a Connection profile by the unique portion of its number in the Connections menu.

## Example bridged connection

An AppleTalk connection at the link level requires a bridge at either end of the connection. This is unlike a dial-in connection using AppleTalk Remote Access (ARA) encapsulation, in which the MAX acts as an ARA server negotiating a session with ARA client software on the dial-in Macintosh.

Figure 7-3 shows an example bridged connection between a branch office at site B, which supports Macintosh systems and printers, and a corporate network at site A. Both site A and site B support CHAP and require passwords for entry.

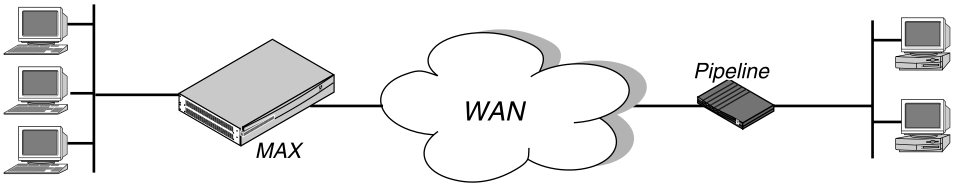


*Figure 7-3. An example connection bridging AppleTalk*

The most common cause of trouble when initially setting up a bridged connection is that the wrong name is specified for the MAX or the remote device. Often case changes are not specified correctly, or a dash or underscore is entered incorrectly. Make sure you type the name exactly as it appears in the remote device.

**Note:** In this example, Dial Brdcast is turned off in the Connection profiles and a Bridge profile is specified. This is not required. You can turn on Dial Brdcast and omit the Bridge profile if you prefer.

To configure the site A MAX for a bridged connection:

**1** If necessary, assign the MAX a station name in System>Sys Config. This example uses the name SITEAGW for the MAX.

**2** Turn on bridging and specify an authentication protocol in Ethernet>Answer>PPP Options.

```
Ethernet
   Answer
      PPP options...
         Bridge=Yes
         Recv Auth=Either
```

**3** Open Connection profile #5 and set these parameters:

```
Ethernet
   Connections
      profile #5...
         Station=SITEBGW
         Active=Yes
         Encaps=PPP
         Bridge=Yes
        Dial Brdcast=No
```

**Note:** Dial Brdcast is not needed because of the Bridge profile, configured next.

**4** Configure password authentication.

```
         Encaps options...
            Send Auth=CHAP
            Recv PW=localpw
            Send PW=remotepw
```

**5** Close Connection profile #5.

**6** Open Ethernet>Bridge Adrs.

**7** Specify a node's Ethernet address on the remote network, and the number of the Connection profile to bring up a link to that network.

```
Ethernet
   Bridge Adrs
      Enet Adrs=0080AD12CF9B
      Net Adrs=0.0.0.0
      Connection #=5
```

8 Close the Bridge profile.

To configure the site B Pipeline unit for the bridged connection:

1 If necessary, assign the remote Pipeline unit a station name in its System profile. This example uses the name SITEBGW for the remote unit.

2 Turn on bridging and specify an authentication protocol in the Pipeline unit's Answer profile.

```
Ethernet
   Answer
      PPP options...
         Bridge=Yes
         Recv Auth=Either
```

3 Open Connection profile #2 on the Pipeline and set these parameters:

```
Ethernet
   Connections
      profile #2...
         Station=SITEAGW
         Active=Yes
         Encaps=PPP
         Bridge=Yes
         Dial Brdcast=No
```

**Note:** Dial Brdcast is not needed because of the Bridge profile, configured next.

4 Configure password authentication.

```
         Encaps options...
            Send Auth=CHAP
            Recv PW=remotepw
            Send PW=localpw
```

5 Close Connection profile #2.

6 Open a Bridge profile.

7 Specify a node's Ethernet address on the remote network, and the number of the Connection profile to bring up a link to that network.

```
Ethernet
   Bridge Adrs
      Enet Adrs=0CFF1238FFFF
      Net Adrs=0.0.0.0
      Connection #=2
```

8 Close the Bridge profile.

# IPX bridged configurations

For NetWare WANs in which NetWare servers reside only on one side of the connection, you can configure an IPX bridged connection. IPX bridging has special requirements for facilitating NetWare client-server logins across the WAN and preventing IPX RIP and SAP broadcasts from keeping a bridged connection up indefinitely. These options vary depending on whether the local network supports NetWare servers, NetWare clients, or both.

## Understanding the IPX bridging parameters

This section does not describe the general bridging parameters explained earlier, although those parameters do apply to an IPX bridging connection. It focuses only on IPX issues.

These are the related parameters:

```
Ethernet
   Mod Config
      Ether options...
         IPX Frame=802.2
Ethernet
   Connections
      Route IPX=No
      IPX options...
         Handle IPX=Client
         NetWare t/o=N/A
```

Here is some background information about these parameters:

- IPX frame type

  The Handle IPX parameter is set to N/A if an IPX frame type is not specified in the Ethernet profile. For more information about IPX frame types and how they affect routing and bridging connections, see Chapter 8, “Configuring IPX Routing,”

- Route IPX

  If Route IPX is set to Yes in the Connection profile, the Handle IPX parameter is set to N/A, but acts as if set to Server.

- How IPX bridged packets are handled

  Handle IPX can be set to Server (IPX server bridging) or Client (IPX client bridging).

  IPX server bridging is used when the local Ethernet supports NetWare servers (or a combination of clients and servers) and the remote network supports NetWare clients only.

  IPX client bridging is used when the local Ethernet supports NetWare clients but no servers. In an IPX client bridging configuration, you want the local clients to be able to bring up the WAN connection by querying (broadcasting) for a NetWare server on a remote network. You also want to filter IPX RIP and SAP updates, so the connections do not remain up permanently.

  **Note:** If NetWare servers are supported on both sides of the WAN connection, we strongly recommend that you use an IPX routing configuration instead of bridging IPX. If you bridge IPX in that type of environment, client-server logins will be lost when the MAX brings down an inactive WAN connection.

- Netware t/o (“watchdog spoofing”)

  NetWare servers send out NCP watchdog packets to monitor client connections. Only clients that respond to watchdog packets remain logged into the server.

  In an IPX server bridging configuration, you want the MAX to respond to NCP watchdog requests for remote clients, but to bring down inactive connections whenever possible. To enable this, set the Netware t/o timer. The timer begins counting down as soon as the link goes down. At the end of the specified time, the MAX stops responding to watchdog packets and the client-server connections may be released by the server. If there is a reconnection of the WAN session before the end of the selected time, the timer is reset.

**Note:** The MAX performs watchdog spoofing only for packets encapsulated in the IPX frame type specified in the Ethernet profile. For example, if IPX Frame=802.3, only logins to servers using that packet frame type will be spoofed.

## Example IPX client bridge (local clients)

In this example, the local Ethernet supports NetWare clients, and the remote network supports both NetWare servers and clients, so IPX client bridging is required. When Handle IPX=Client, the MAX applies a data filter that discards RIP and SAP periodic broadcasts at its WAN interface, but forwards RIP and SAP queries. That way, local clients can locate a NetWare server across the WAN, but routine broadcasts do not keep the connection up unnecessarily.

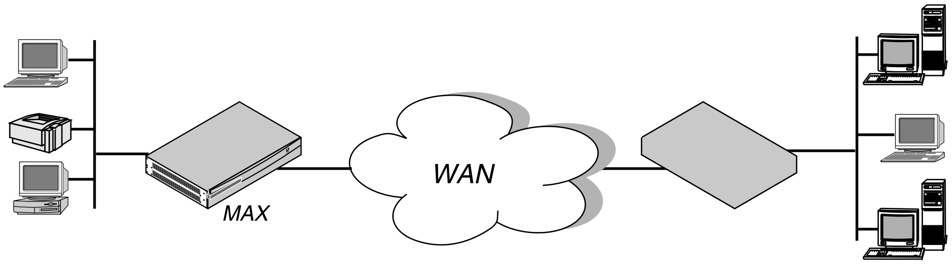


*Figure 7-4. An example IPX client bridged connection*

To configure the site A MAX in this example:

1 If necessary, assign the MAX a station name in the System profile. This example uses the name SITEAGW for the MAX.

2 Set the IPX frame type in the Ethernet profile.

```
Ethernet
   Mod Config
      Ether options...
         IPX Frame=802.3
```

3 Turn on bridging and specify an authentication protocol in the Answer profile.

```
Ethernet
   Answer
      PPP options...
         Bridge=Yes
         Recv Auth=Either
```

4 Open a Connection profile and set these parameters:

```
Ethernet
   Connections
      Station=SITEBGW
      Active=Yes
      Encaps=PPP
      Route IPX=No
      Bridge=Yes
      Dial Brdcast=Yes
```

**Note:** Dial Brdcast is enabled to allow service queries to bring up the connection.

5 Configure password authentication.

```
      Encaps options...
         Send Auth=CHAP
         Recv PW=localpw
         Send PW=remotepw
```

6 Specify IPX client bridging.

```
   IPX options...
      Handle IPX=Client
```

7 Close the Connection profile.

## Example IPX server bridge (local servers)

In this example, the local network supports a combination of NetWare clients and servers, and the remote network supports clients only, so IPX server bridging is required. When Handle IPX=Server, the MAX applies a data filter that discards RIP and SAP broadcasts at its WAN interface, but forwards RIP and SAP queries. It also uses the value specified in the "NetWare t/o" parameter as the time limit for responding to NCP watchdog requests on behalf of clients on the other side of the bridge, a process called "watchdog spoofing."

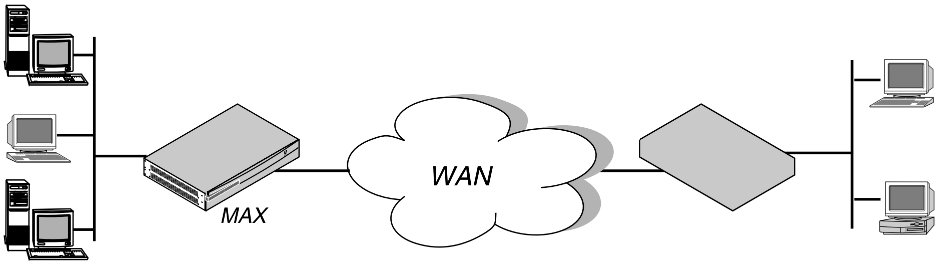


*Figure 7-5. An example IPX server bridged connection*

To configure the site A MAX in this example:

1 If necessary, assign the MAX a station name in the System profile. This example uses the name SITEAGW for the MAX.

2 Set the IPX frame type in the Ethernet profile.

```
Ethernet
   Mod Config
      Ether options...
         IPX Frame=802.3
```

3 Turn on bridging and specify an authentication protocol in the Answer profile.

```
Ethernet
   Answer
      PPP options...
         Bridge=Yes
         Recv Auth=Either
```

4 Open a Connection profile and set these parameters:

```
Ethernet
   Connections
      Station=SITEBGW
      Active=Yes
      Encaps=PPP
      Route IPX=No
      Bridge=Yes
      Dial Brdcast=Yes
```

5 Configure password authentication.

```
      Encaps options...
         Send Auth=CHAP
         Recv PW=localpw
         Send PW=remotepw
```

6 Specify IPX server bridging and configure the timer for watchdog spoofing when an inactive connection has been brought down.

```
      IPX options...
         Handle IPX=Server
         Netware t/o=30
```

7 Close the Connection profile.

## Example bridge connection with ARP

If you are bridging between two segments of the same IP network, you can use the Net Adrs parameter in a Bridge profile to enable the MAX to respond to ARP requests while bringing up the bridged connection. If an ARP packet contains an IP address that matches the Net Adrs parameter of a Bridge profile, the MAX responds to the ARP request with the Ethernet (physical) address specified in the Bridge profile and brings up the specified connection. In effect, the MAX as a proxy for the node that actually has that address. In this example, two segments of an IP network are connected across the WAN.

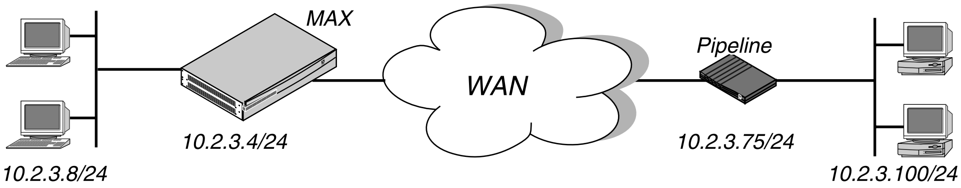


*Figure 7-6. An example IP bridged connection*

To configure the site A MAX in this example:

1 If necessary, assign the MAX a system name System>Sys Config. This example uses the name SITEAGW for the MAX.

2 Turn on bridging and specify an authentication protocol in Ethernet>Answer>PPP Options.

```
Ethernet
   Answer
      PPP options...
         Bridge=Yes
         Recv Auth=Either
```

3 Open Connection profile #11 (for example) and set these parameters:

```
Ethernet
   Connections
      Station=SITEBGW
      Active=Yes
      Encaps=PPP
      Route IP=No
      Bridge=Yes
      Dial Brdcast=No
```

4 Configure password authentication.

```
      Encaps options...
         Send Auth=CHAP
         Recv PW=localpw
         Send PW=remotepw
```

5 Close Connection profile #11.

6 Open Ethernet>Bridge Adrs.

7 Specify a node’s Ethernet address on the remote network, the node’s IP address, and the number of the Connection profile to bring up a link to that network.

```
Ethernet
   Bridge Adrs
      Enet Adrs=0CFF1238FFFF
      Net Adrs=10.2.3.100/24
      Connection #=11
```

8 Close the Bridge profile.

# Configuring IPX Routing

8

This chapter covers these topics:

# Introduction to IPX routing

This chapter explains how to set up the MAX as an IPX router to integrate diverse NetWare LANs into an interconnected wide-area network and enable dial-in NetWare clients to access local NetWare services. IPX routing in the MAX requires that sites run Novell NetWare version 3.11 or newer.

This introduction describes Ascend's implementation and issues related to scaling LAN protocols to the WAN. It includes these topics:

- IPX SAP (Service Advertising Protocol)
- IPX RIP (Routing Information Protocol)
- Ascend extensions to standard IPX
- WAN issues for NetWare client software

## How the MAX uses IPX SAP

The MAX follows standard IPX SAP behavior for routers when connecting to non-Ascend units across the WAN. However, when connecting to another Ascend unit configured for IPX routing, both ends of the connection exchange their entire SAP tables, so all remote services are immediately added to the MAX unit's SAP table and vice versa.

NetWare servers broadcast SAP packets every 60 seconds to make sure that routers know about their services, and routers build a SAP table with an entry for each service advertised by each known server. When a router stops receiving SAP broadcasts from a server, it ages that entry in its SAP table and eventually removes it from the table.

Routers use SAP tables to respond to client queries. When a NetWare client sends a SAP request to locate a service, the MAX consults its SAP table and replies with its own hardware address and the internal address of the requested server. This is analogous to proxy ARP in an IP environment. The client can then transmit packets whose destination address is the internal address of the server. When the MAX receives those packets, it consults its RIP table. If it finds an entry for that destination address, it brings up the connection or forwards the packet across the active connection.

## How the MAX acquires and maintains IPX routes

The MAX follows standard IPX RIP behavior for routers when connecting to non-Ascend units. However, when connecting to another Ascend unit configured for IPX routing, both ends of the connection immediately exchange their entire RIP tables. In addition, the MAX maintains those RIP entries as static until the unit is reset or power-cycled.

IPX RIP is similar to the routing information protocol in the TCP/IP protocol suite, but it is a different protocol. In this chapter, RIP always refers to IPX RIP.

The destination of an IPX route is the internal network of a server. For example, NetWare file servers are assigned an internal IPX network number by the network administrator and typically use the default node address of 000000000001. This is the destination network address for file read/write requests. (If you are not familiar with internal network numbers, see your NetWare documentation for details.)

IPX routers broadcast RIP updates periodically and when a WAN connection is established. The MAX receives RIP broadcasts from a remote device, adds 1 to the hop count of each advertised route, updates its own RIP table, and broadcasts updated RIP packets on connected networks in a split-horizon fashion.

The MAX recognizes network number –2 (0xFFFFFFFE) as the IPX RIP default route. When it receives a packet for an unknown destination, it forwards the packet to the IPX router advertising the default route. If more than one IPX router is advertising the default route, a routing decision is made based on Hop and Tick count. For example, if the MAX receives an IPX packet destined for network 77777777 and it does not have a RIP table entry for that destination, the MAX forwards the packet towards network number FFFFFFFE, if available, instead of simply dropping the packet.

## Support for IPXWAN negotiation

The MAX supports the IPXWAN protocol, which is essential for communicating with Novell software that supports dial-in connections, such as NetWare Connect2, and the Multi-Protocol Router. For full specifications of the IPXWAN protocol, see RFC 1634 and *NetWare Link Services Protocol Specification—IPX WAN Version 2*.

IPX routing connections are established after IPX NCP has been negotiated successfully. IPXWAN negotiation begins when IPX NCP has reached the OPEN state. The negotiation process differs based on the type of device communicating with the MAX.

- For connections with the Multi-Protocol Router or other Novell software that supports dial-ins, IPXWAN options supersede those negotiated by IPXCP.
- Connections that use Novell software operating over PPP do not negotiate options during the IPXCP phase, so all options are negotiated during the IPXWAN phase of link establishment.
- When an IPX connection is brought up between two Ascend units, all options are negotiated during the IPXCP phase. IPXWAN negotiation never takes place between two Ascend units, because neither unit initiates the negotiation process by sending out an IPX-WAN Timer_Request packet.

IPXWAN negotiation is triggered in the MAX when the far-end device sends an IPXWAN Timer_Request packet. The devices compare internal network numbers and assign the slave role to the unit with the lower number. The other unit becomes the master of this link for the duration of the IPXWAN negotiation. The slave unit returns an IPXWAN Timer_Response packet, and the master unit initiates an exchange of information about the final router configuration. The MAX supports the following routing options:

- Ascend Routing (Unnumbered RIP/SAP without aging).
- Novell Routing (Unnumbered RIP/SAP with aging).
- None (The peer is a Dialin Client. No RIP/SAP except on request and we may assign Net and Node Numbers.)

Header compression is rejected as a routing option. After IPXWAN negotiation is completed, transmission of IPX packets begins, using the negotiated routing option.

## Ascend extensions to standard IPX

NetWare uses dynamic routing and service location, so clients expect to be able to locate a server dynamically, regardless of where it is physically located. This scheme was designed to work in a LAN environment and not for WAN operations, and Ascend provides these extensions to standard IPX for enhancing WAN functionality:

- Routing to dial-in NetWare clients using PPP software

  Dial-in clients can be assigned a network from a "virtual" IPX network defined in the MAX unit's Ethernet profile. To enable routing to a client, the Peer option must be set to Dialin in the client's Connection profile. See "Understanding the IPX connection parameters" on page 8-8.
- Controlling RIP and SAP transmissions

  You can configure IPX RIP and SAP to transmit information, receive it, both, or neither for any IPX routing connection.
- Dial Query

  You can specify that a connection will be brought up in response to service queries.
- Watchdog spoofing

  To allow NetWare clients to remain logged into a server even while their connection has been brought down due to inactivity, the MAX responds to NCP watchdog packets from the server for a specified number of minutes. This process of responding as proxy for the remote clients is called watchdog spoofing.
- IPX Route profiles

  Even though the MAX learns its routes via RIP, it clears the entire RIP table when it is reset or powered down. Some sites choose to configure at least one static IPX route to enable it to download a RIP table from another location when it is powered up. See "Creating static IPX routes" on page 8-15
- IPX SAP filters

  The table of all available services can become very large if SAP entries are added from all remote sites. IPX SAP filters let you manage the service table and explicitly include or exclude services. See "Creating and applying IPX SAP filters" on page 8-17.

## Special WAN considerations for NetWare client software

NetWare clients on a wide-area network do not need special configuration in most cases. These are some issues that sometimes affect NetWare clients in an IPX routing environment:

- Preferred servers

  If the local IPX network supports NetWare servers, configure NetWare clients with a preferred server on the local network, not at a remote site. If the local Ethernet does not support NetWare servers, configure local clients with a preferred server on the network that requires the least expensive connection costs. See your NetWare documentation for more information.
- Local copy of LOGIN.EXE

  Due to possible performance issues, executing programs remotely is not recommended. We recommend that you put LOGIN.EXE on each client's local drive.
- Packet Burst (NetWare 3.11)

  Packet Burst lets servers send a data stream across the WAN before a client sends an acknowledgment. It is included automatically in server and client software for NetWare

3.12 or later. If local servers are running NetWare 3.11, the servers should have PBURST.NLM loaded. See your NetWare documentation for more information.

- Macintosh or UNIX clients

  Both Macintosh and UNIX clients can use IPX to communicate with servers. However, both types of clients also support native support using AppleTalk (Macintosh) or TCP/IP (UNIX). If Macintosh clients must access NetWare servers across the WAN by using AppleTalk software (rather than MacIPX), the WAN link must support bridging. Otherwise, AppleTalk packets will not make it across the connection.

  If UNIX clients will access NetWare servers via TCP/IP (rather than UNIXWare), the MAX must also be configured as a bridge or IP router. Otherwise, TCP/IP packets will not make it across the connection.

# Enabling IPX routing in the MAX

The Ethernet profile configures system-global parameters that affect all IP interfaces in the MAX. These are the related parameters:

```
Ethernet
   Mod Config
      IPX Routing=Yes
      Ether options…
         IPX Frame=802.2
         IPX Enet #=00000000
         IPX Pool #=CCCC1234
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the global IPX parameters

This section provides some background information about IPX routing in the Ethernet profile.

- Enabling IPX routing

  IPX Routing enables IPX routing mode. When you turn on IPX routing in the MAX and close the Ethernet profile, the MAX comes up in IPX routing mode, uses the default frame type 802.2 (which is the suggested frame type for NetWare 3.12 or later), and listens on the Ethernet to acquire its IPX network number from other IPX routers on that segment.

- Specifying which frame type to route and spoof

  The MAX routes and spoofs only one IPX frame type (IEEE 802.2 by default), which is specified in the IPX Frame parameter. If some NetWare software transmits IPX in a frame type other than the type specified here, the MAX drops those packets, or if bridging is enabled, it bridges them. If you are not familiar with the concept of packet frames, see the Novell documentation.

- Setting or “learning” the proper IPX network number

  IPX Enet specifies the IPX network number for the Ethernet interface of the MAX. The easiest way to ensure that the number is correct is to leave the default null address. This causes the MAX to listen for its network number and acquire it from another router on that interface. If you enter a number other than zero, the MAX becomes a “seeding” router and other routers can learn their IPX network number from the MAX. For details about seeding routers, see the Novell documentation.

- Defining a virtual IPX network for dial-in clients

  Dial-in clients do not belong to an IPX network, so they must be assigned an IPX network number to establish a routing connection with the MAX. The MAX advertises the route to this virtual network and assigns it as the network address for dial-in clients. If the client does not have a unique node address, the MAX assigns the node address as well.

## Example IPX routing configurations

This section shows the simple configuration, where the MAX uses the default frame type and learns its network number from other routers on the Ethernet. It also shows a more complex router configuration, where these values are entered explicitly.

### A basic configuration using default values

In this example, the MAX will route IPX packets in 802.2 frames and will learn its IPX network number from other routers on the Ethernet. It does not define a virtual network for dial-in clients. To configure the MAX Ethernet profile:

**1** Open the Ethernet profile.

**2** Set IPX Routing to Yes.

```
Ethernet
   Mod Config
      IPX Routing=Yes
```

**3** Close the Ethernet profile.

When you close the Ethernet profile, the MAX comes up in IPX routing mode, uses the default frame type 802.2, and acquires its IPX network number from other routers.

### A more complex example

In this example, the MAX will route IPX packets in 802.3 frames (other frame types will be bridged), and uses the IPX network number CF0123FF. It also supports a virtual IPX network for assignment to dial-in clients.

To verify that the MAX should use 802.3 frames, go to the NetWare server’s console and type LOAD INSTALL to view the AUTOEXEC.NCF file. Look for lines similar to these:

```
internal network 1234
Bind ipx ipx-card net=CF0123FF
Load 3c509 name=ipx-card frame=ETHERNET_8023
```

The last line specifies the 802.3 frame type. To verify that the IPX network number you assign to the MAX Ethernet interface is compatible with other servers and routers on that interface, check the BIND line in the AUTOEXEC.NCF file. The second line in the example shown above specifies the number CF0123FF.

**Note:** IPX network numbers on each network segment and internal network within a server on the *entire WAN* must have a unique network number. So, you should know both the external and internal network numbers in use at all sites.

To configure the Ethernet profile:

1 Open Ethernet>Mod Config and set IPX Routing to Yes.

```
Ethernet
   Mod Config
      IPX Routing=Yes
```

2 Open the Ether Options subprofile.

3 Specify the 802.3 frame type and set the IPX network number for the Ethernet interface.

```
      Ether options…
         IPX Frame=802.2
         IPX Enet #=00000000
```

4 Assign a network number for assignment to dial-in clients.

```
         IPX Pool #=CCCC1234
```

**Note:** The most common configuration mistake on NetWare internetworks is in assigning duplicate network numbers. Make sure that the network number you specify in the IPX Pool# field is unique within the entire IPX routing domain of the MAX unit.

5 If more than one frame type needs to cross the WAN, make sure that Bridging is enabled. See Chapter 6, "Configuring Packet Bridging."

```
      Bridging=Yes
```

6 Close the Ethernet profile.

### Verifying the router configuration

You can IPXPING a NetWare server or client from the MAX to verify that it is up and running on the IPX network. To do so:

1 Invoke the terminal server command-line interface.

2 Enter the IPXPING command with the advertised name of a NetWare server. For example:

```
ascend% ipxping server-1
```

3 Terminate IPXPING at any time by typing Ctrl-C.

## Configuring IPX routing connections

This section describes how to configure IPX routing connections. These are the related Answer and Connection parameters:

```
Ethernet
   Answer
      PPP options...
         Route IPX
         Recv Auth=Either

   Session options…
      IPX SAP Filter=1

Ethernet
   Connections
      Station=device-name
      Route IPX=Yes
      Encaps options...
         Recv PW=localpw
```

```
IPX options...
   Peer=Router
   IPX RIP=None
   IPX SAP=Send
   Dial Query=No
   IPX Net#=cfff0003
   IPX Alias#=00000000
   Handle IPX=None
   Netware t/o=30
Sessions options…
   IPX SAP Filter=1
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the IPX connection parameters

This section provides some background information about IPX connections.

- Enabling IPX routing in the Answer profile

  You must enable IPX routing in the Answer profile for the MAX to pass IPX packets to the bridge/router software.

- Authentication method used for passwords received from the far end

  The Recv Auth parameter specifies which protocol to use for authenticating the password sent by the far end during PPP negotiation. This is required for IPX connections, because the MAX cannot verify Connection profiles by address as it does for IP connections.

- Applying IPX SAP filters

  You can apply an IPX SAP filter to exclude or explicitly include certain remote services from the MAX SAP table. If you apply a SAP filter in a Connection profile, you can exclude or explicitly include services in both directions. See “Creating and applying IPX SAP filters” on page 8-17.

- Specifying the station name and password in a Connection profile

  Name and password authentication is required for IPX connections, because the MAX cannot verify Connection profiles by address as it does for IP connections.

- Peer dialin for routing to NetWare clients

  Dial-in NetWare clients do not have an IPX network address. To allow those clients an IPX routing connection to the local network, the clients must dial in using PPP software and the Connection profile must specify Peer=Dialin. In addition, the MAX must have a virtual IPX network defined for assignment to these clients (see “Understanding the global IPX parameters” on page 8-5).

  Peer=Dialin causes the MAX to assign the virtual IPX network number to the dial-in client during PPP negotiation. If the client does not provide its own unique node number, the MAX assigns a unique node number to the client as well. It does not send RIP and SAP advertisements across the connection and ignores RIP and SAP advertisements received from the far end. However, it does respond to RIP and SAP queries received from dial-in clients. See “An example dial-in client connection” on page 7-18.

- Controlling RIP and SAP transmissions across the WAN connection

  IPX RIP and IPX SAP in a Connection profile define how RIP and SAP packets are handled across this WAN connection.

IPX RIP is set to Both by default, indicating that RIP broadcasts will be exchanged in both directions. You can disable the exchange of RIP broadcasts across a WAN connection, or specify that the MAX will only send or only receive RIP broadcasts on that connection.

IPX SAP is also set to Both by default, indicating that SAP broadcasts will be exchanged in both directions. If SAP is enabled to both send and receive broadcasts on the WAN interface, the MAX broadcasts its entire SAP table to the remote network and listens for SAP table updates from that network. Eventually, both networks have a full table of all services on the WAN. To control which services are advertised and where, you can disable the exchange of SAP broadcasts across a WAN connection, or specify that the MAX will only send or only receive SAP broadcasts on that connection.

- Dial query for bringing up a connection based on service queries

  Dial Query configures the MAX to bring up a connection when it receives a SAP query for service type 0004 (File Server) and that service type is not present in the MAX SAP table. If the MAX has no SAP table entry for service type 0004, it brings up every connection that has Dial Query set. If 20 Connection profiles have Dial Query set, the MAX brings up all 20 connections in response to the query.

  **Note:** If the MAX unit has a static IPX route for even one remote server, it will choose to bring up that connection as opposed to the more costly solution of bringing up every connection that has Dial Query set.

- IPX network and alias

  IPX Net # specifies the IPX network number of the remote-end router. It is rarely needed, and is provided only for those remote-end routers that require the MAX to know that router's network number before connecting. The IPX Alias is a second IPX network number, to be used only when connecting to non-Ascend routers that use numbered interfaces.

- IPX client or server bridging

  Handle IPX defines how bridged connections are handled. It is N/A when IPX routing is enabled for a connection. See Chapter 7, "Configuring Packet Bridging."

- Watchdog spoofing

  Netware t/o defines the number of minutes the MAX will enable clients to remain logged in even though their connection has been torn down.

  NetWare servers send out NCP watchdog packets to monitor which logins are active and logout inactive clients. Only clients that respond to watchdog packets remain logged in.

  Repeated watchdog packets would cause a WAN connection to stay up, but if the MAX simply filtered those packets, client logins would be dropped by the remote server. To prevent repeated client logouts while allowing WAN connections to be brought down in times of inactivity, the MAX responds to NCP watchdog requests as a proxy for clients on the other side of an offline IPX routing or IPX bridging connection. Responding to these requests is commonly called watchdog spoofing.

  To the server, a spoofed connection looks like a normal, active client login session, so it does not log the client out. The timer begins counting down as soon as the link goes down. At the end of the selected time, the MAX stops responding to watchdog packets and the client-server connections may be released by the server. If there is a reconnection of the WAN session before the end of the selected time, the timer is reset.

  **Note:** The MAX filters watchdog packets automatically on all IPX routing connections and all IPX bridging connections that have watchdog spoofing enabled. The MAX applies a call filter implicitly, which prevents the Idle timer from resetting when IPX watchdog packets are sent or received. This filter is applied after the standard data and call filters.

## Example IPX routing connections

This section shows example WAN connections using IPX routing. If the MAX has not yet been configured for IPX routing, see "Enabling IPX routing in the MAX" on page 8-5.

### Configuring a dial-in client connection

In this example, a NetWare client dials in to a corporate IPX network using PPP dial-in software. The corporate network supports both NetWare servers and clients, as shown in Figure 7-3.

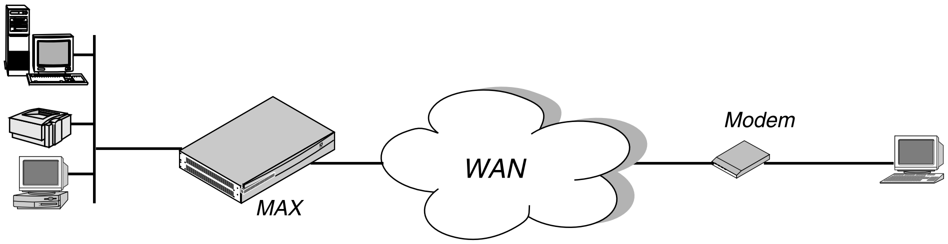


*Figure 8-1. A dial-in NetWare client*

To configure an IPX routing connection for this client:

**1** Open Ethernet>Mod Config>Ether Options and verify that the IPX Pool assignment has been made. For example:

```
Ethernet
   Mod Config
      Ether options…
         IPX Pool #=CCCC1234
```

**2** Close the Ethernet profile.

**3** Open Answer>PPP Options.

**4** Turn on IPX routing and PAP/CHAP authentication.

```
Ethernet
   Answer
      PPP options...
         Route IPX
         Recv Auth=Either
```

**5** Close the Answer profile.

**6** Open the Connection profile for the dial-in user.

**7** Specify the dial-in client's login name and activate the profile.

```
Ethernet
   Connections
      Station=scottpc
      Active=Yes
```

**8** Turn on IPX routing.

```
      Route IPX=Yes
```

**9** Select PPP encapsulation and configure the dial-in client's password.

```
      Encaps=PPP
      Encaps options...
         Recv PW=scottpw
```

**10** Open the IPX Options subprofile and specify a dial-in client.

```
      IPX options...
         Peer=Dialin
         IPX RIP=None
```

**11** Close the Connection profile.

## Configuring a connection between two LANs

In this example, the MAX is connected to an IPX network that supports both servers and clients and will connect with a remote site that also supports both servers and clients.

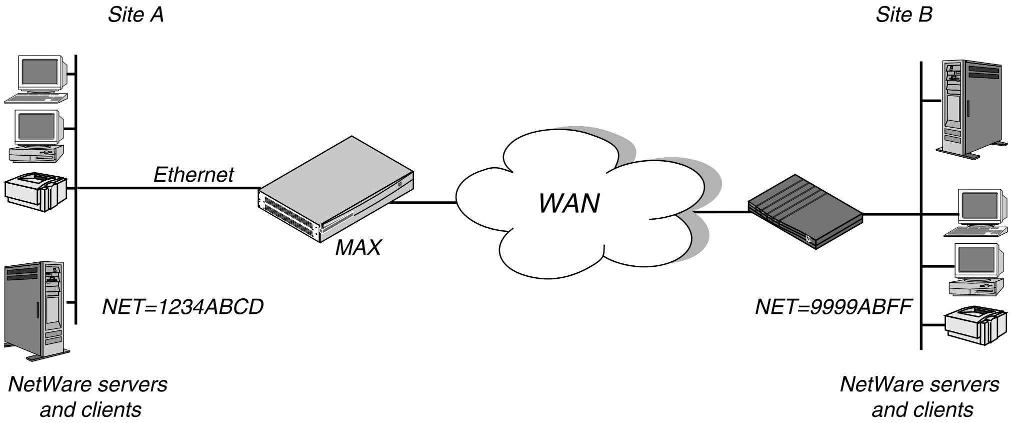


*Figure 8-2. A connection with NetWare servers on both sides*

In this example, site A and site B are both existing Novell LANs that support NetWare 3.12 and NetWare 4 servers, NetWare clients, and a MAX. The NetWare server at site A is configured with this information:

```
Name=SERVER-1
internal net CFC12345
Load 3c509 name=ipx-card frame=ETHERNET_8023
Bind ipx ipx-card net=1234ABCD
```

The NetWare server at site B is configured this information:

```
Name=SERVER-2
internal net 013DE888
Load 3c509 name=net-card frame=ETHERNET_8023
Bind ipx net-card net=9999ABFF
```

To configure the MAX at site A:

**1** Make sure the MAX has been assigned a system name in the System profile. This example uses the name SITEAGW.

**2** If you haven't done so already, configure the Ethernet profile. (See "Enabling IPX routing in the MAX" on page 8-5.)

**3** In Answer>PPP Options, turn on IPX routing and PAP/CHAP authentication, and then close the Answer profile.

```
Ethernet
   Answer
      PPP options...
```

```
         Route IPX
         Recv Auth=Either
```

(If the MAX needs to support multiple IPX frame types, you must also enable bridging in the Answer profile.)

4. Open the Connection profile for site B.

   In this example, the Connection profile for site B is profile #5. A profile’s number is the unique part of the number it is assigned in the Connections menu. For example, the Connection profile defined as 90-105 is #5.

5. Set up the Connection profile like this:

```
Ethernet
   Connections
      profile 5...
         Station=SITEBGW
         Active=Yes
         Encaps=MPP
         PRI # Type=National
         Dial #=555-1212
         Route IPX=Yes

         Encaps options...
            Send Auth=CHAP
            Recv PW=*SECURE*
            Send PW=*SECURE*

         IPX options...
            IPX RIP=None
            IPX SAP=Both
            NetWare t/o=30
```

6. Close Connection profile #5.

7. Open an IPX Route profile.

   Because IPX RIP is set to None in the Connection profile, you must configure a static route to the remote server.

8. Set up a route to the remote NetWare server (SERVER-2) using these settings:

```
Ethernet
   IPX Routes
      Server Name=SERVER-2
      Active=Yes
      Network=013DE888
      Node=000000000001
      Socket=0451
      Server Type=0004
      Connection #=5
```

**Note:** The Connection # parameter in the IPX Route profile must match the number of the Connection profile you configured to that site. The Network must specify the internal network number of the specified server.

9. Close the IPX Route profile.

To configure the Ascend unit at site B:

1. Make sure the Ascend unit at site B has been assigned a system name in the System profile. This example uses the name SITEBGW.

2. Verify that the site B unit’s Ethernet interface is configured for IPX routing. (See “Enabling IPX routing in the MAX” on page 8-5.)

3 Verify that the site B unit's Answer profile enables IPX routing and PAP/CHAP authentication.

4 Open the Connection profile for site A.

In this example, the Connection profile for site A is profile #2. A profile's number is the unique part of the number it is assigned in the Connections menu. For example, the Connection profile defined as 90-102 is #2.

5 Set up the Connection profile like this:

```
Ethernet
   Connections
      profile 2...
         Station=SITEAGW
         Active=Yes
         Encaps=MPP
         PRI # Type=National
         Dial #=555-1213
         Route IPX=Yes

         Encaps options...
            Send Auth=CHAP
            Recv PW=*SECURE*
            Send PW=*SECURE*

         IPX options...
            IPX RIP=None
            IPX SAP=Both
            NetWare t/o=30
```

6 Close Connection profile #2.

7 Open an IPX Route profile.

Because IPX RIP is set to None in the Connection profile, you must configure a static route to the remote server.

8 Set up a route to the remote NetWare server (SERVER-1) using these settings:

```
Ethernet
   IPX Routes
      Server Name=SERVER-1
      Active=Yes
      Network=CFC12345
      Node=000000000001
      Socket=0451
      Server Type=0004
      Connection #=2
```

**Note:** The Connection # parameter in the IPX Route profile must match the number of the Connection profile you configured to that site. The Network must specify the internal network number of the specified server.

9 Close the IPX Route profile.

## Configuring a connection with local servers only

In this example, the MAX is connected to a local IPX network that supports both servers and clients, and will connect to a geographically remote network that supports one or more NetWare clients. Figure 7-3 shows the example setup.

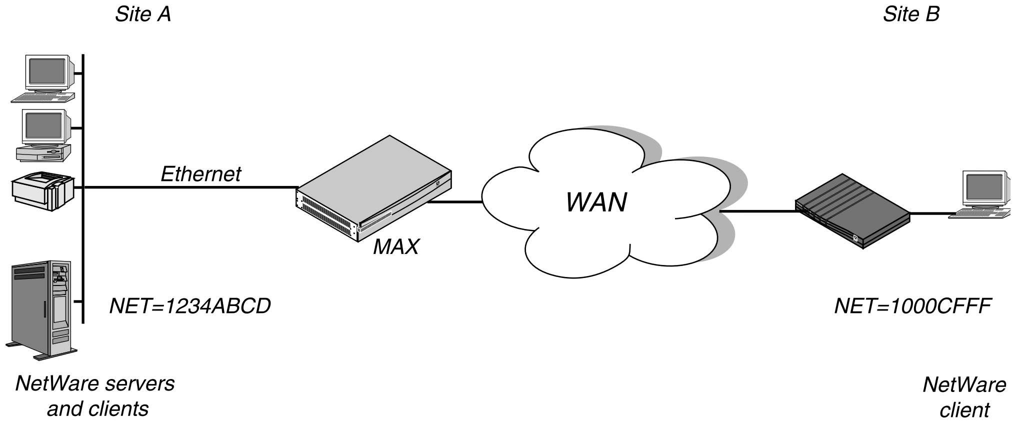


*Figure 8-3. A dial-in client that belongs to its own IPX network*

In this example, site A supports NetWare 3.12 servers, NetWare clients, and a MAX. The NetWare server at site A is configured with this information:

```
Name=SERVER-1
internal net CFC12345
Load 3c509 name=ipx-card frame=ETHERNET_8023
Bind ipx ipx-card net=1234ABCD
```

Site B is a home office that consists of one PC and an Ascend unit. It is not an existing Novell LAN, so the Ascend unit configuration creates a new IPX network (e.g., 1000CFFF).

**Note:** The new IPX network number assigned to site B in this example cannot be in use *anywhere* on the entire IPX wide-area network. (It cannot be in use at site A or any network to which site A connects.)

This example assumes that the Ethernet profile and Answer profile have already been set up to enable IPX routing. Because no static routes are used, the initial connection between the two Ascend units should be manually dialed (using the DO menu).

To configure the MAX at site A:

**1** Make sure the MAX has been assigned a system name in the System profile. This example uses the name SITEAGW.

**2** Open the Connection profile for site B.

**3** Set up the Connection profile like this:

```
Ethernet
   Connections
      Station=SITEBGW
      Active=Yes
      Encaps=MPP
      PRI # Type=National
      Dial #=555-1212
      Route IPX=Yes

      Encaps options...
         Send Auth=CHAP
         Recv PW=*SECURE*
```

```
            Send PW=*SECURE*
         IPX options...
            IPX RIP=Both
            IPX SAP=Both
            NetWare t/o=30
```

4 Close the Connection profile.

To configure the site B Ascend unit:

1 Make sure the Ascend unit at site B has been assigned a system name in the System profile. This example uses the name SITEBGW.

2 Open the Connection profile for site A.

3 Set up the Connection profile like this:

```
Ethernet
   Connections
      Station=SITEAGW
      Active=Yes
      Encaps=MPP
      PRI # Type=National
      Dial #=555-1213
      Route IPX=Yes
      Encaps options...
         Send Auth=CHAP
         Recv PW=*SECURE*
         Send PW=*SECURE*
      IPX options...
         IPX RIP=Both
         IPX SAP=Both
         NetWare t/o=30
```

4 Close the Connection profile.

# Creating static IPX routes

Most sites configure only a few static IPX routes and rely on RIP for most other connections. Static IPX routes are defined in IPX Route profiles. Each static route contains the information needed to reach one NetWare server.

These are the related parameters:

```
Ethernet
   IPX Routes
      Server Name=server-name
      Active=Yes
      Network=CC1234FF
      Node=000000000001
      Socket=0000
      Server Type=0004
      Hop Count=2
      Tick Count=12
      Connection #=0
```

For details on each parameter, see the *MAX Reference Guide*.

## Why to configure static IPX routes

When the MAX is reset or power cycled, its RIP and SAP tables are cleared. Static routes create entries in new RIP and SAP tables as the unit initializes. The static routes enable the MAX to reach at least one NetWare server and download more complete tables from there.

In the case where a MAX is connecting to another Ascend unit, you may choose not to configure any static routes. However, that means that after a power-cycle or reset, you must dial the initial IPX routing connection manually (DO DIAL). After that initial connection is established, the MAX downloads the RIP table from the other Ascend unit and maintains the routes as static until its next power-cycle or reset.

The disadvantage of static routes is that they require manual updating whenever the specified server is removed or has an address change. Their advantages are that they ensure that the MAX can bring up that connection in response to clients' SAP requests, and they help to prevent timeouts when a client takes a long time to locate a server on the WAN.

**Note:** You do not need to create IPX routes to servers that are on the local Ethernet.

## Understanding the static route parameters

This section provides some background information on static route configurations.

- Specifying the server's name

  Each IPX Route profile contains the information needed to reach one NetWare server on a remote network. Server Name is the remote server's name.
- Entering the route in the internal RIP table

  Active must be set to Yes for the MAX to read this route into its internal IPX RIP table.
- Specifying the server's internal network and node numbers

  The network number to enter here is the internal network number of the server. If you are not familiar with internal network numbers, see the Novell documentation. The default 000000000001 is typically the node number for NetWare file servers.
- The server socket

  Typically, Novell file servers use socket 0451. The number you specify must be a well-known socket number. Services that use dynamic socket numbers may use a different socket each time they load and will not work with IPX Route profiles. To bring up a connection to a remote service that uses a dynamic socket number, specify a "master" server on that network that uses a well-known socket number.
- Server type

  SAP advertises services by a type number. For example, NetWare file servers are SAP Service type 0004.
- Hop and tick counts to the server

  Usually the default hop count of 2 and tick count of 12 are appropriate, but you may need to increase these value for very distant servers. Ticks are IBM PC clock ticks (1/18 second). Note that best routes are calculated based on tick count, not hop count.
- Identifying the Connection profile needed to reach the server

  When the MAX receives a query for the specified server or a packet addressed to that server, it finds the referenced Connection profile and dials the connection. Identify a Connection profile by the unique part of its number in the Connection menu.

## Example static route configuration

This example shows a static route configuration to a remote NetWare server. Remember that static IPX routes are manually administered, so they must be updated if there is a change to the remote server. To define an IPX Route profile:

**1** Open an IPX Route profile.

**2** Specify the name of the remote NetWare server and activate the route.

```
Ethernet
   IPX Routes
      Server Name=SERVER-1
      Active=Yes
```

**3** Specify the server's internal network, node, socket, and service type; for example:

```
      Network=CC1234FF
      Node=000000000001
      Socket=0451
      Server Type=0004
```

**4** Specify the distance to the server in hops and IBM PC clock ticks. (The default values are appropriate unless the server is very distant.)

```
      Hop Count=2
      Tick Count=12
```

**5** Specify the number of the Connection profile; for example:

```
      Connection #=2
```

**6** Close the IPX Route profile.

# Creating and applying IPX SAP filters

IPX SAP filters include or exclude services from the MAX service table or from being sent across the WAN to be made visible to remote sites. You can also prevent the MAX from sending its SAP table or receiving a remote site's SAP table by turning off IPX SAP in a Connection profile. See "Understanding the IPX connection parameters" on page 8-8.

These are the parameters related to IPX SAP filters:

```
Ethernet
   IPX SAP Filters
      Name=optional
      Input SAP filters...
         In SAP filter 01–08
            Valid=Yes
            Type=Exclude
            Server Type=0004
            Server Name=SERVER-1
      Output SAP filters
         Out SAP filter 01–08
            Valid=Yes
            Type=Exclude
            Server Type=0004
            Server Name=SERVER-1
Ethernet
   Mod Config
```

```
      Ether options...
         IPX SAP Filter=1
Ethernet
   Answer
      Session options...
         IPX SAP Filter=2
Ethernet
   Connections
      Session options...
         IPX SAP Filter=2
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the SAP filter parameters

This section provides some background information on SAP filters.

- Input and Output filters

  Each filter contains up to 8 Input filters and Output filters, which are defined individually and applied in order (1–8) to the packet stream. Input filters are applied to all SAP packets received by the MAX. They screen advertised services and exclude (or include) them from the MAX service table as specified by the filter conditions.

  Output filters are applied to SAP response packets transmitted by the MAX. If the MAX receives a SAP request packet, it applies Output filters before transmitting the SAP response, and excludes (or includes) services from the response packet as specified by the Output filters.

- Activating the current Input or Output filter

  Valid enables the filter for use.

- The type of action to take (include or exclude)

  Type specifies whether this filter will include the service or exclude it.

- Specifying the name of a NetWare server

  Server Name can be a local or remote NetWare server name.

  If the server is on the local network and this is an Output filter, the Type parameter specifies whether to include or exclude advertisements for this server in SAP response packets.

  If the server is on the remote IPX  network and this is an Input filter, the Type parameter specifies whether to include or exclude this server in the MAX service table.

- Specifying a service type

  Server Type specifies a hexadecimal number representing a type of NetWare service; for example, the number for file services is 0004.

  In an Output filter, the Type parameter specifies whether to include or exclude advertisements for this service type in SAP response packets.

  In an Input filter, the Type parameter specifies whether to include or exclude remote services of this type in the MAX service table.

- Applying SAP filters

  You can apply an IPX SAP filter to the local Ethernet or to WAN interfaces, or both.

  – When applied in the Ethernet profile, a SAP filter includes or excludes specific servers or services from the MAX unit’s SAP table. If directory services is not supported, servers or services that are not in the MAX table will be inaccessible to clients across the WAN. A filter applied to the Ethernet interface takes effect immediately.

- When applied in the Answer profile, a SAP filter screens service advertisements from across the WAN.
- When applied in a Connection profile, a SAP filter screens service advertisements to and from a specific WAN connection.

## Example IPX SAP filter configuration

This example shows how to create an IPX SAP filter that prevents local NetWare users from having access to a remote NetWare server, and how to apply that filter to the Answer profile and the Connection profile used to reach the server's remote network.

To define an IPX SAP filter that excludes a remote file server from the MAX SAP table:

**1** Open IPX SAP Filter profile #1 (for this example) and then open the list of Input filters.

```
Ethernet
   IPX SAP Filters
      profile #1...
         Name=NOSERVER-1
         Input SAP filters...
            In SAP filter 01
            In SAP filter 02
            In SAP filter 03
            In SAP filter 04
            In SAP filter 05
            In SAP filter 06
            In SAP filter 07
            In SAP filter 08
```

**2** Open Input SAP filter 01, activate it, and set Type to Exclude.

**3** Specify the NetWare server's name and service type (for a file server, 0004).

```
            In SAP filter 01
               Valid=Yes
               Type=Exclude
               Server Type=0004
               Server Name=SERVER-1
```

**4** Close the IPX SAP Filter profile.

To apply the IPX SAP Filter in the Answer profile and in a Connection profile:

**5** Open Answer>Session Options.

**6** Specify IPX SAP Filter profile #1, and then close the Answer profile.

```
Ethernet
   Answer
      Session options...
         IPX SAP Filter=1
```

**7** Repeat the same assignment in Connections>Session Options.

```
Ethernet
   Connections
      Session options...
         IPX SAP Filter=1
```

**8** Close the Connection profile.

# Monitoring IPX connections

The terminal server command-line interface supports Show commands for monitoring IPX connections in the MAX. To use these commands, invoke the terminal server interface (System>Sys Diag>Term Serv).

## Verifying the transmission path to NetWare stations

The IPXping command enables you to verify the transmission path to NetWare stations at the network layer. It works on the same LAN as the MAX or across a WAN connection that has IPX Routing enabled. It uses this format:

```
ipxping [-c <count>] [-i <delay>] [-s <packetsize>] <hostname>
```

The arguments to the IPXping command are:

- <hostname>: The IPX address of the host, or if the host is a NetWare server, its hostname.
- [-c <count>](Optional ): Stop the test after sending and receiving the number of packets specified by count.
- [-i <delay>](Optional ): Wait the number of seconds specified by wait before sending the next packet. The default is one second.
- [-s <packet-size>](Optional): Send the number of data bytes specified by packet-size.

where <hostname> is either the IPX address of the NetWare workstation or the advertised name of a server. The IPX address consists of the IPX network and node numbers for a station; for example:

```
ascend% ipxping CFFF1234:000000000001
```

If you are using IPXping to verify connectivity with an advertised NetWare server, you can simply enter the symbolic name of the server; for example:

```
ascend% ipxping server-1
```

You can terminate the IPXping at any time by typing Ctrl-C.

During the IPXping exchange, the MAX calculates and reports this information:

```
PING server-1 (EE000001:000000000001): 12 data bytes
52 bytes from (EE000001:000000000001): ping_id=0 time=0ms
52 bytes from (EE000001:000000000001): ping_id=1 time=0ms
52 bytes from (EE000001:000000000001): ping_id=2 time=0ms
?
--- novl1 Ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 0/0/0 ms
```

These statistics include the following information:

- The IPX address of the source and destination nodes.
- The byte counts of the request and response packets.
- The ping ID of the command. (The ping Request # replied to by target host.)
- The number of milliseconds required to send the IPXping and receive a response.
- The number of packets transmitted and received.

- Duplicate or damaged packets, if applicable.
- Average round-trip times for the ping request and reply.

  In some cases, round-trip times cannot be calculated.

To display statistics related to the IPXping command, type:

```
ascend% show netware pings
InPing Requests/OutPing Replies OutPing Requests/InPing Replies
      10            10                  18            18
```

The output shows how many NetWare stations have pinged the MAX (InPing requests and replies) and how many times the IPXping command has been executed in the MAX.

## Displaying IPX packet statistics

To display IPX packet statistics, enter this command:

```
ascend% show netware stats
27162 packets received.
25392 packets forwarded.
0 packets dropped exceeding maximum hop count.
0 outbound packets with no route.
```

The MAX drops packets that exceed the maximum hop count (that have already passed through too many routers).

## Displaying the IPX service table

To display the IPX service table, enter this command:

```
ascend% show netware servers
IPX address                     type              server name
ee000001:000000000001:0040      0451              server-1
```

The output contains these fields:

- IPX address: The IPX address of the server. The address uses this format:

  <network number>:<node number>:<socket number>
- type: The type of service available (in hexadecimal format). For example, 0451 designates a file server.
- server name: The first 35 characters of the server name.

## Displaying the IPX routing table

To display the IPX routing table, enter this command:

```
ascend% show netware networks
network     next router        hops        ticks   origin
CFFF0001    00000000000        0          1      Ethernet        S
```

The output contains these fields:

- network: The IPX network number.
- next router: The address of the next router, or 0 (zero) for a direct or WAN connection.

- hops: The hop count to the network.
- ticks: The tick count to the network.
- origin: The name of the profile used to reach the network.

**Note:** An S or an H flag can appear next to the origin. S indicates a static route. H indicates a hidden static route. Hidden static routes occur when the router learns of a better route.

# Configuring IP Routing

# 9

This chapter covers these topics:

# Introduction to IP routing and interfaces

This chapter describes the following areas of IP routing configuration:

- Local IP network setup

  The Ethernet profile defines the MAX unit's Ethernet IP interface, as well as network services such as DNS, dynamic address assignment for PPP callers, and routing policies. See "Configuring the local IP network setup" on page 9-7.

- WAN IP interfaces

  Connection profiles (or similar profiles on an external authentication server) define a destination across a WAN interface and add a route to the routing table.

- IP routing table

  The IP routing table determines where IP packets are forwarded and which connections are brought up. See "Configuring IP routes and preferences" on page 9-26 for details.

## IP addresses and netmasks

In the MAX, IP addresses are specified in dotted decimal format (not hexadecimal). If no netmask is specified, the MAX assumes a default netmask based on address "class".

*Table 9-1. IP address classes and default netmasks*

| Class | Address range | Network bits |
|---|---|---|
| Class A | 0.0.0.0 — 127.255.255.255 | 8 |
| Class B | 128.0.0.0 — 191.255.255.255 | 16 |
| Class C | 192.0.0.0 — 223.255.255.255 | 24 |

For example, a class C address such as 198.5.248.40 has 24 network bits, which leaves 8 bits for the host portion of the address. So, up to 253 hosts can be supported on one class C network.

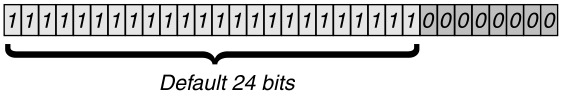


*Figure 9-1. A class C IP address*

To specify a netmask, the MAX includes a netmask modifier that specifies the total number of network bits in the address. For example:

```
ip-address = 198.5.248.40/29
```

In the example address shown above, the /29 specification indicates that 29 bits of the address will be used to specify the network. This is commonly referred to as a 29-bit subnet. The three remaining bits are used to specify unique hosts.

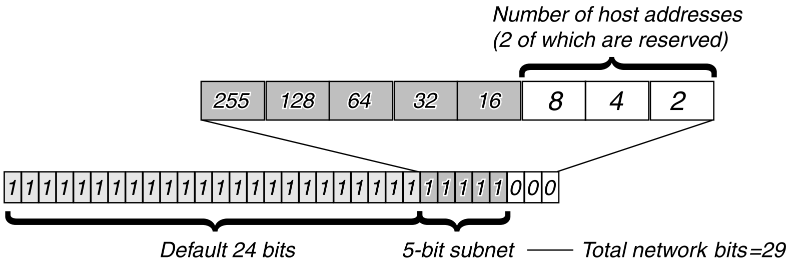


*Figure 9-2. A 29-bit netmask and number of supported hosts*

Eight bit-combinations are possible in 3 bits. Of those 8 possible host addresses, 2 are reserved:

000 — Reserved for the network (base address)
001
010
100
110
101
011
111 — Reserved for the broadcast address of the subnet

**Note:** Early implementations of TCP/IP did not allow zero subnets. That is, subnets could have the same base address that a class A, B, or C network would have. For example, the subnet 192.168.8.0/30 was illegal because it had the same base address as the class C network 192.168.8.0/24, while 192.168.8.4/30 was legal. (192.168.8.0/30 is called a zero subnet, because like a class C base address, its last octet is zero.) Modern implementations of TCP/IP allow subnets to have base addresses that might be identical to the class A, B, or C base addresses. Ascend's implementations of RIP 2 and OSPF treat these so-called zero subnetworks the same as any other network. However, it is important that you treat zero subnets consistently throughout your network. Otherwise, you will encounter routing problems!

Table 9-2 shows how the standard subnet address format relates to Ascend notation for a class C network number.

*Table 9-2. Standard netmasks and Ascend netmask notation*

| Netmask | Number of host addresses | Ascend notation |
|---|---|---|
| 255.255.255.0 | 254 hosts + 1 broadcast, 1 network base | /24 |
| 255.255.255.128 | 126 hosts + 1 broadcast, 1 network base | /25 |
| 255.255.255.192 | 62 hosts + 1 broadcast, 1 network base | /26 |
| 255.255.255.224 | 30 hosts + 1 broadcast, 1 network base | /27 |
| 255.255.255.240 | 14 hosts + 1 broadcast, 1 network base | /28 |
| 255.255.255.248 | 6 hosts + 1 broadcast, 1 network base | /29 |
| 255.255.255.252 | 2 hosts + 1 broadcast, 1 network base | /30 |
| 255.255.255.254 | invalid netmask (no hosts) | /31 |
| 255.255.255.255 | 1 host — a host route | /32 |

The broadcast address of any subnet is specified by setting the host portion of the IP address to all ones. The network address (or base address) represents the network itself, because the host portion of the IP address is all zeros. For example, if the MAX configuration assigns this address to a remote router:

```
198.5.248.120/29
```

The Ethernet attached to that router has the following address range:

```
198.5.248.120 — 198.5.248.127
```

**Note:** A host route is a special case IP address with a subnet mask of /32; for example, 198.5.248.40/32. Host routes are required for a dial-in host.

# IP routes

At system startup, the MAX builds an IP routing table that contains configured routes. When the system is up, it may use routing protocols such as RIP or OSPF to learn additional routes dynamically.

For each route, the Destination field specifies a destination network address that may appear in IP packets, and the Gateway field specifies the address of the next-hop router to reach that destination.

## How the MAX uses the routing table

The MAX relies on the routing table to forward IP packets.

- If the MAX finds a routing table entry whose Destination field matches the destination address in a packet, it routes the packet to the specified next-hop router, bringing up a WAN connection if necessary.
- If the MAX does not find a matching entry, it looks for the Default route, which is indicated in the routing table with a destination 0.0.0.0. If that route has a specified next-hop router, it forwards the packet to that router.
- If the MAX does not find a matching entry or does not have a valid Default route, it drops the packet.

## Static and dynamic routes

A static route is a manually configured path from one network to another, which specifies the destination network and the gateway (router) to use to get to that network.

- Each Static Rtes profile specifies one static route. If a path to a destination must be reliable, the administrator often configures more than one path (a secondary route), in which case the MAX chooses the route based on assigned metrics and availability.
- The Ethernet>Mod Config profile specifies a static connected route, which states “to reach system-A, send packets out this interface to system-A.” Connected routes are low cost, because no remote connection is involved.
- Each IP-routing Connection profile specifies a static route that states “to reach system-A, send packets out this interface to system-B,” where system-B is another router.

A dynamic route is a path to another network that is “learned” dynamically rather than configured in a profile. Routers that use RIP broadcast their entire routing table every 30 seconds, updating other routers about which routes are usable. Hosts that run ICMP can also send ICMP Redirects to offer a better path to a destination network. OSPF routers propagate link-state changes as they occur. Routing protocols such as RIP and OSPF all use some mechanism to propagate routing information and changes to the routing environment.

### Route preferences and metrics

RIP is a distance-vector protocol, which uses a virtual hop count to select the shortest route to a destination network. OSPF is a link-state protocol, which means that OSPF can take into account a variety of link conditions, such as the reliability or speed of the link, when determining the best path to a destination network. Because these two metrics are incompatible, the MAX supports route preferences.

When choosing which routes should be put in the routing table, the router first compares preference values, preferring the lower number. If the preference values are equal, then the router compares the metric field, using the route with the lower metric.

- Connected routes have a default preference of 0
- OSPF routes have a default preference of 10
- ICMP redirects have a default preference of 30
- RIP routes have a default preference of 100
- Static routes have a default preference of 100
- ATMP routes have a default preference of 100

## IP interfaces

The MAX must have at least one system-based IP interface (on Ethernet) to support IP routing. It also creates several internal interfaces at system startup.

### MAX IP interfaces

At system startup, the MAX creates its Ethernet and internal IP interfaces. When the system is up, it adds IP interfaces as they are created. For each IP interface that is not configured as a private route, the MAX also adds a route to the routing table at system startup.

- The Ethernet IP interface is always active, because it is always connected.

  The Ethernet interface label is ie0. Its IP address is assigned in Ethernet>Mod Config>Ether Options.
- The loopback (lo0) interface is always up.

  The loopback address is 127.0.0.1/32.
- The reject (rj0) interface is always up.

  The reject address is 127.0.0.2. Packets routed to this interface are sent back to the source address with an ICMP “host unreachable” message.
- The black-hole (bh0) interface is always up.

  The black-hole address is 127.0.0.3. Packets routed to this interface are discarded silently.
- The inactive interface is where all routes point when their WAN connections are down.

  The inactive interface label is wanidle0.

## WAN IP interfaces

WAN interfaces are created as they are brought up. WAN interfaces are labeled wanN, where N is a number assigned in the order in which the interfaces become active. The WAN IP address may be a local address assigned dynamically when the caller logs in, an address on a subnet of the local network, or a unique IP network address for a remote device.

## Numbered interfaces

The MAX can operate as a both a system-based router and interface-based router. Some applications require numbered interfaces, and some sites use them for trouble-shooting leased point-to-point connections and forcing routing decisions between two links going to the same final destination. More generally, interface-based routing allows the MAX to operate more nearly the way a multi-homed Internet host behaves.

Interface-based routing means that in addition to the system-wide IP configuration, the MAX and the far end of the link have link-specific IP addresses, which are specified in these parameters:

- Connections>IP Options>IF Adrs (the link-specific address for the MAX)
- Connections>IP Options>WAN Alias (the far end link-specific address)

It is also permissible to omit the remote side's system-based IP address from the Connection profile and use interface-based routing exclusively. This is an appropriate mechanism, for example, if the remote system is on a backbone net which may be periodically reconfigured by its administrators, and you want to refer to the remote system only by its mutually agreed-upon interface address. In this case, the link-specific IP addresses are specified in these parameters:

- Connections>IP Options>IF Adrs (the near end numbered interface)
- Connections>IP Options>LAN Adrs (the far end numbered interface)

Note that LAN Adrs must always be filled in, so if the only known address is the interface address, it must be placed in the Lan Adrs parameter rather than the WAN Alias parameter. In this case, a host route is created to the LAN Adrs (interface) address, a net route is created to the subnet of the remote interface, and incoming calls must report their IP addresses as the LAN Adrs address.

It is also possible, although not recommended, to specify the local numbered interface (IF Adrs) and use the far end device's system-wide IP address (LAN Adrs). In this case, the remote interface must have an address on the same subnet as the local, numbered interface.

If a MAX is using a numbered interface, the following differences in operation should be noted, compared to unnumbered (system-based) routing:

- IP packets generated in the MAX and sent to the remote address will have an IP source address corresponding to the numbered interface, not the system-wide (Ethernet) address.
- During authentication of an outbound call using a numbered interface, the MAX reports the address of the interface as its IP address.
- The MAX adds all numbered interfaces to its routing table as host routes.
- The MAX accepts IP packets addressed to the a numbered interface, considering them to be destined for the MAX itself. (The packet may actually arrive over any interface, and the numbered interface corresponding to the packet's destination address need not be active.)

# Configuring the local IP network setup

The Ethernet profile configures system-global parameters that affect all IP interfaces in the MAX. These are the related parameters:

```
Ethernet
   Mod Config
      Ether options…
         IP Adrs=10.2.3.1/24
         2nd Adrs=0.0.0.0/0
         RIP=Off
         Ignore Def Rt=Yes
         Proxy Mode=Off
      WAN options...
         Pool#1 start=100.1.2.3
         Pool#1 count=128
         Pool#2 start=0.0.0.0
         Pool#2 count=0
         Pool#3 start=10.2.3.4
         Pool#3 count=254
         Pool#4 start=0.0.0.0
         Pool#4 count=0
         Pool#5 start=0.0.0.0
         Pool#5 count=0
         Pool#6 start=0.0.0.0
         Pool#6 count=0
         Pool#7 start=0.0.0.0
         Pool#7 count=0
         Pool#8 start=0.0.0.0
         Pool#8 count=0
         Pool#9 start=0.0.0.0
         Pool#9 count=0
         Pool#A start=0.0.0.0
         Pool#A count=0
         Pool only=No
         Pool Summary=No
      Shared Prof=No
      Telnet PW=Ascend
      BOOTP Relay...
         BOOTP Relay Enable=No
         Server=N/A
         Server=N/A
      DNS...
         Domain Name=abc.com
         Sec Domain Name=
         Pri DNS=10.65.212.10
         Sec DNS=12.20 7.23.51
         Allow As Client DNS=Yes
         Pri WINS=0.0.0.0
         Sec WINS=0.0.0.0
         List Attempt=No
         List Size=N/A
         Client Pri DNS=0.0.0.0
         Client Sec DNS=0.0.0.0
```

```
SNTP Server...
   SNTP Enabled=Yes
   Time zone-UTC+0000
   SNTP host#1=0.0.0.0
   SNTP host#2=0.0.0.0
   SNTP host#3=0.0.0.0
UDP Cksum=No
Adv Dialout Routes=Always
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the IP network parameters

This section provides some background information on the IP network configuration. These parameters are divided into areas of functionality in the subsections below.

- The MAX unit's local IP address

  The IP Adrs parameter specifies the MAX unit's IP address on the local Ethernet. It may be a subnet or network (class) address. This is a required setting for the MAX to operate as an IP router.

- A second IP address for the Ethernet interface

  The MAX can assign two unique IP addresses to its single physical Ethernet port and route between them—a feature referred to as "dual IP." This gives the MAX a logical interface on two networks or subnets on the same backbone.

  Usually, devices connected to the same physical wire all belong to the same IP network. With dual IP, a single wire can support two separate IP networks, with devices on the wire assigned to one network or the other and communicating by routing through the MAX.

  Dual IP is also used to distribute the load of routing traffic to a large subnet by assigning IP addresses on that subnet to two or more routers on the backbone. When the routers have a direct connection to the subnet as well as to the backbone network, they route packets to that subnet and include the route in their routing table updates.

  Dual IP also allows you to make a smooth transition when changing IP addresses. That is, a second IP address can act as a placeholder while you are making the transition in other network equipment.

- Enabling RIP on the Ethernet interface

  You can configure an IP interface to send RIP updates (informing other local routers of its routes), receive RIP updates (learning about networks that can be reached via other routers on the Ethernet), or both.

  **Note:** Ascend recommends that you run RIP version 2 (RIP-v2) if possible. Ascend does not recommend running RIP-v2 and RIP-v1 on the same network in such a way that the routers receive each other's advertisements. RIP-v1 does not propagate subnet mask information, and the default class network mask is assumed, while RIP-v2 handles subnet masks explicitly. Running the two versions on the same network can result in RIP-v1 "guesses" overriding accurate subnet information obtained via RIP-v2.

- Ignoring the default route

  You can configure the MAX to ignore default routes advertised by routing protocols. This configuration is recommended, because you typically do not want the default route to be changed by a RIP update. The default route specifies a static route to another IP router, which is often a local router such as a Cisco router or another kind of LAN router. When the MAX is configured to ignore the default route, RIP updates will not modify the default route in the MAX routing table.

- Proxy ARP and inverse ARP

  The MAX can be configured to respond to ARP requests for remote devices that have been assigned an address dynamically. It responds to the ARP request with its own MAC address while bringing up the connection to the remote device. This feature is referred to as Proxy ARP (see “Understanding the IP network parameters” on page 9-8).

  The MAX also supports Inverse Address Resolution Protocol (Inverse ARP). Inverse ARP allows the MAX to resolve the protocol address of another device when the hardware address is known. The MAX does not issue any Inverse ARP requests, but it does respond to Inverse ARP requests that have the protocol type of IP (0x8000) or in which the hardware address type is the 2 byte Q.922 address (Frame Relay). All other types are discarded. The Inverse ARP response packet sent by the MAX has the following information:

  – ARP source protocol address is the MAX unit’s IP address on Ethernet.

  – ARP source hardware address is the Q.922 address of the local DLCI.

  See RFCs 1293 and 1490 for details on Inverse ARP.

- Specifying address pools

  You can define up to 10 address pools in the Ethernet profile, with each pool supporting up to 254 addresses. The Pool#N start parameter specifies the first address in a block of contiguous addresses on the local network or subnet. The Pool#N count parameter specifies how many addresses are in the pool (up to 255). Addresses in a pool do not accept a netmask modifier, because they are advertised as host routes. If you allocate IP addresses on a separate IP network or subnet, make sure you inform other IP routers about the route to that network or subnet, either by statically configuring those routes or configuring the MAX to dynamically send updates.

- Forcing callers configured for a pool address to accept the dynamic assignment

  During PPP negotiation, a caller may reject the IP address offered by the MAX and present its own IP address for consideration. Connection profiles compare IP addresses as part of authentication, so the MAX would automatically reject such a request if the caller has a Connection profile. However, Name-password profiles have no such authentication mechanism, and could potentially allow a caller to spoof a local address. The Pool Only parameter instructs the MAX to hang up if a caller rejects the dynamic assignment.

- Summarizing host routes in routing table advertisements

  IP addresses assigned dynamically from a pool are added to the routing table as individual host routes. You can summarize this network (the entire pool), cutting down significantly on route flappage and the size of routing table advertisements.

  Pool Summary indicates the route summarization is in use; that is, a series of host routes will be summarized into a network route advertisement. Packets destined for a valid host address on that network are routed to the host, and packets destined for an invalid host address are rejected with an ICMP “host unreachable” message.

  To use the pool summary feature, create a network-aligned pool and set the Pool Summary parameter to Yes. To be network-aligned, the Pool Start address must be the first host address. Subtract one from the Pool Start address to determine the network address (the zero address on the subnet). Since the first and last address of a subnet are reserved, you must set the Pool Count to a value that is 2 less than a power of 2. For example, you may use values 2, 6, 14, 30, 62, 126 or 253. The netmask will be deduced from a value that is 2 greater than Pool Count. For example, with this configuration:

```
Pool Summary=Yes
Pool#1 start=10.12.253.1
Pool#1 count=126
```

The network alignment address is Pool Start address –1: 10.12.253.0 and the netmask is Pool Count +2 addresses: 255.255.255.128. The resulting address pool network is:

```
10.12.253.0/25
```

For an example configuration that shows route summarization, see "Configuring DNS" on page 9-13.

- Sharing Connection profiles

  The Shared Prof parameter specifies whether the MAX will allow more than one incoming call to share the same Connection profile. This feature is related to IP routing because sharing profiles cannot result in two IP addresses reached through the same profile.

  In low-security situations, more than one dial-in user can share a name and password for accessing the local network. This would require sharing a single Connection profile that specifies bridging only, or dynamic IP address assignment. Each call would be a separate connection. The name and password would be shared, and a separate IP address would be assigned dynamically to each caller.

  If a shared profile uses an IP address, it must be assigned dynamically, because multiple hosts cannot share a single IP address.

- Telnet password

  The Telnet password is required from all users attempting to access the MAX unit via Telnet. Users are allowed three tries to enter the correct password, after which the connection attempt fails.

- BOOTP relay

  By default, a MAX does not relay BOOTP (Bootstrap Protocol) requests to other networks. If BOOTP is enabled, the MAX can relay BOOTP requests to another network. However, SLIP BOOTP must be disabled in Ethernet>Mod Config>TServ Options. SLIP BOOTP makes it possible for a computer connecting to the MAX over a SLIP connection to use the Bootstrap Protocol. A MAX can support BOOTP on only one connection. If both SLIP BOOTP and BOOTP relay are enabled, you will receive an error message.

  You can specify the IP address of one or two BOOTP servers. You are not required to specify a second BOOTP server.

  **Note:** If you specify two BOOTP servers, the MAX that relays the BOOTP request determines when each server is used. The order of the BOOTP servers in the BOOTP Relay menu does not necessarily determine which server is tried first.

- Local domain name

  The Domain Name is used for DNS lookups. When the MAX is given a hostname to look up, it tries various combinations including appending the configured domain name. The secondary domain name (Sec Domain Name) can specify another domain name that the MAX can search using DNS. The MAX searches the secondary domain only after the domain specified in the Domain Name parameter.

- DNS or WINS name servers

  When the MAX is informed about DNS (or WINS), Telnet and Rlogin users can specify hostnames instead of IP addresses. If you configure a primary and secondary name server, the secondary server is accessed only if the primary one is inaccessible.

- DNS lists

  DNS can return multiple addresses for a hostname in response to a DNS query, but it does not include information about availability of those hosts. Users typically attempt to access the first address in the list. If that host is unavailable, the user must try the next host, and so forth. However, if the access attempt occurs automatically as part of immediate services, the physical connection is torn down when the initial connection fails. To avoid tearing down physical links when a host is unavailable, you can use the List Attempt parameter to enable the user to try one entry in the DNS list of hosts, and if that connection fails, to try the next entry, and so on, without losing the WAN session. The List Size parameter specifies the maximum number of hosts listed (up to 35).

- Client DNS

  Client DNS configurations define DNS server addresses that will be presented to WAN connections during IPCP negotiation. They provide a way to protect your local DNS information from WAN users. Client DNS has two levels: a global configuration that applies to all PPP connections (defined in the Ethernet profile), and a connection-specific configuration that applies only to the WAN connection defined in the Connection profile. The global client addresses are used only if none are specified in the Connection profile.

- SNTP service

  The MAX can use SNTP (Simple Network Time Protocol—RFC 1305) to set and maintain its system time by communicating with an SNTP server. SNTP must be enabled for the MAX to communicate using that protocol. In addition, you must specify your time zone as an offset from the UTC (Universal Time Configuration). UTC is in the same time zone as Greenwich Mean Time (GMT), and the offset is specified in hours using a 24-hour clock. Because some time zones, such as Newfoundland, cannot use an even hour boundary, the offset includes four digits and is stated in half-hour increments. For example, in Newfoundland the time is 1.5 hours ahead of UTC, which is represented as follows:

  ```
  UTC +0130
  ```

  For San Francisco, which is 8 hours ahead of UTC:

  ```
  UTC +0800
  ```

  For Frankfurt, which is 1 hour behind UTC:

  ```
  UTC -0100
  ```

- Specifying SNTP server addresses

  The host parameter lets you specify up to three server addresses. The MAX will attempt to communicate with the first address. It will attempt the second only if the first is inaccessible, and the third only if the second is inaccessible.

- UDP checksums

  If data integrity is of the highest concern for your network and having redundant checks is important, you can turn on UDP checksums to generate a checksum whenever a UDP packet is transmitted. UDP packets are transmitted for queries and responses related to ATMP, SYSLOG, DNS, ECHOSERV, RADIUS, TACACS, RIP, SNTP, and TFTP.

  **Note:** Setting UDP checksums to Yes could cause a slight decrease in performance, but in most environments the decrease is not noticeable.

- Poisoning dialout routes in a redundant configuration

  If you have another Ascend unit backing up the MAX in a redundant configuration on the same network, you can use the Adv Dialout Routes parameter to instruct the MAX to stop advertising IP routes that use dial services if its trunks are in the alarm condition. Otherwise, it continues to advertise its dialout routes, which prevents the redundant unit from taking over the routing responsibility.

# Example IP network configurations

This section shows some example Ethernet profile IP configurations. For a more complete example that shows an Ethernet profile, Route profile, and Connection profile configuration that work together, see "Configuring DNS" on page 9-13.

## Configuring the MAX IP interface on a subnet

On a large corporate backbone, many sites configure subnets to increase the network address space, segment a complex network, and control routing in the local environment. For example, suppose the main backbone IP network is 10.0.0.0, and supports a Cisco router at 10.0.0.17.

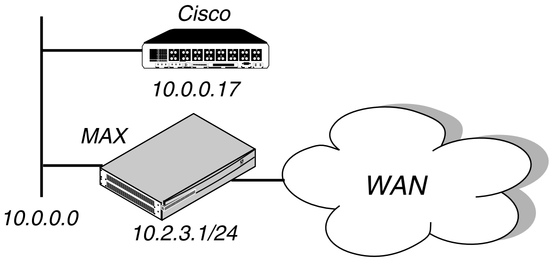


*Figure 9-3. Creating a subnet for the MAX*

You can place the MAX on a subnet of that network by entering a subnet mask in its IP address specification, for example:

**1** Open Ethernet>Mod Config>Ether Options.

**2** Specify the IP subnet address for the MAX on Ethernet. For example:

```
Ethernet
   Mod Config
      Ether options…
         IP Adrs=10.2.3.1/24
```

**3** Configure the MAX to receive RIP updates from the local Cisco router (optional).

```
      RIP=Recv=v2
```

**4** Close the Ethernet profile.

With this subnet address, the MAX requires a static route to the backbone router on the main network; otherwise, it can only communicate with devices on the subnets to which it is directly connected. To create the static route and make the backbone router the default route:

**1** Open the Default IP Route profile.

**2** Specify the IP address of a backbone router in the Gateway parameter. For example:

```
Ethernet
   Static Rtes
      Name=Default
      Active=Yes
      Dest=0.0.0.0/0
      Gateway=10.0.0.17
      Metric=1
      Preference=100
      Private=Yes
```

**3** Close the Default IP Route profile.

See “Configuring IP routes and preferences” on page 9-26 for more information about IP Route profiles. To verify that the MAX is up on the local network, invoke the terminal server interface and enter the Ping command to a local IP address or hostname. For example:

```
ascend% ping 10.1.2.3
```

You can terminate the Ping exchange at any time by typing Ctrl-C.

### Configuring DNS

The DNS configuration enables the MAX to use local DNS or WINS servers for lookups. In this example DNS configuration, client DNS is not in use. Note that you can protect your DNS servers from callers by defining connection-specific (“client”) DNS servers and specifying that Connection profiles use those client servers. To configure the local DNS service:

**1** Open Ethernet>Mod Config>DNS.

**2** Specify the local domain name.

**3** If appropriate, specify a secondary domain name.

**4** Specify the IP addresses of a primary and secondary DNS server, and turn on the DNS list attempt feature.

```
Ethernet
   Mod Config
      DNS...
         Domain Name=abc.com
         Sec Domain Name=
         Pri DNS=10.65.212.10
         Sec DNS=12.20 7.23.51
         Allow As Client DNS=Yes
         Pri WINS=0.0.0.0
         Sec WINS=0.0.0.0
         List Attempt=Yes
         List Size=35
         Client Pri DNS=0.0.0.0
         Client Sec DNS=0.0.0.0
```

**5** Close the Ethernet profile.

## Setting up address pools with route summarization

The address pool parameters enable the MAX to assign an IP address to incoming calls that are configured for dynamic assignment. These addresses are assigned on a first-come first-served basis. After a connection has been terminated, its address is freed up and returned to the pool for reassignment to another connection. Figure 9-4 shows a host using PPP dial-in software to connect to the MAX.

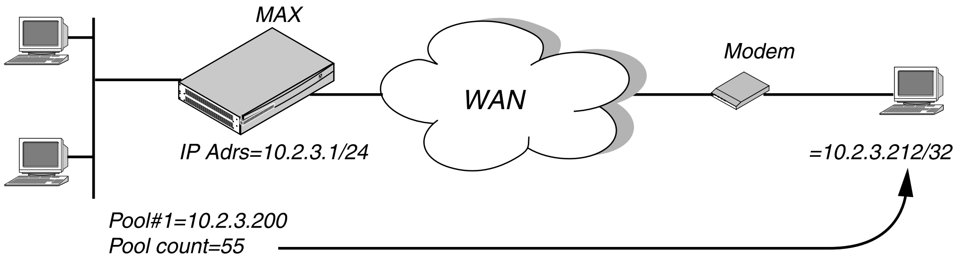


*Figure 9-4. Address assigned dynamically from a pool*

This example shows how to set up network-aligned address pools and use route summarization. It also shows how to enter a static route for the pool subnet and make Connection profile route private, which are requirements when using route summarization.

These are the rules for network-aligned address pools:

- The Pool Count must be two less than the total number of addresses in the pool.

  Add two to Pool Count for the total number of addresses in the subnet, and calculate the netmask for the subnet based on this total.
- The Pool Start address must be the first host address.

  Subtract 1 from the Pool Start address for the base address for the subnet.

For example, the following configuration is network aligned:

```
Ethernet
   Mod Config
      WAN options...
         Pool#1 start=10.12.253.1
         Pool#1 count=62
         Pool Summary=Yes
```

Pool Start is set to 10.12.253.1. When you subtract one from this address, you get 10.12.253.0, which is a valid base address for the 255.255.255.192 netmask. Note that 10.12.253.64, 10.12.253.128, and 10.12.253.192 are also valid zero addresses for the same netmask. The resulting address pool network is 10.12.253.0/26.

Pool Count is set to 62. When you add two to the Pool Count, you get 64. The netmask for 64 addresses is 255.255.255.192 (256–64 = 192). The Ascend subnet notation for a 255.255.255.192 netmask is /26.

After verifying that *every one* of the configured address pools is network-aligned, you must enter a static route for them. These static routes handle all IP address that have not been given to users by routing them to the reject interface or the blackhole interface. (See “MAX IP interfaces” on page 9-5.)

**Note:** The MAX creates a host route for every assigned address from the pools and host routes override subnet routes. So, packets whose destination matches an assigned IP address from the pool are properly routed and not discarded or bounced. Because the MAX advertises the entire pool as a route, and only privately knows which IP addresses in the pool are active, a remote network might improperly send the MAX a packet to an inactive IP address. Depending on the static route specification, these packets are either bounced with an ICMP unreachable or silently discarded.

For example, the following static route specifies the blackhole interface, so it silently discards all packets whose destination falls in the pool's subnet. In addition to the Dest and Gateway parameters that define the pool, be sure you have set the Metric, Preference, Cost, and Private parameters as shown.

```
Ethernet
   Static Rtes
      Name=pool-net
      Active=Yes
      Dest=10.12.253.0/26
      Gateway=127.0.0.3
      Metric=0
      Preference=0
      Cost=0
      Private=No
```

The routing table will contain the following lines:

```
Destination        Gateway    IF      Flg       Pref   Met     Use    Age

10.12.253.0/26      -           bh0     C         0      0       0   172162
127.0.0.1/32        -           lo0     CP        0      0       0   172163
127.0.0.2/32        -           rj0     CP        0      0       0   172163
127.0.0.3/32       -          bh0     CP        0      0       0   172163
```

When you configure Connection profiles that assign IP addresses from the pool, make sure the Private parameter is set to Yes. For example:

```
Ethernet
   Connections
      Ip options...
         LAN Adrs=0.0.0.0/0
         WAN Alias=0.0.0.0
         IF Adrs=0.0.0.0/0
         Preference=100
         Cost=0
         Private=Yes
         RIP=Off
         Pool=1
```

# Configuring IP routing connections

When IP routing is enabled and addresses are specified in a Connection profile, it defines an IP WAN interface. These are the related options:

```
Ethernet
   Answer
      Assign Adrs=Yes
      PPP options...
         Route IP=Yes

      Session options...
         RIP=Off

Ethernet
   Connections
      Station=remote-device
```

```
Route IP=Yes
IP options...
   LAN Adrs=0.0.0.0/0
   WAN Alias=0.0.0.0/0
   IF Adrs=0.0.0.0/0
   Metric=7
   Preference=100
   Private=No
   RIP=Off
   Pool=0
Session options...
   IP Direct=0.0.0.0
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the IP routing connection parameters

This section provides some background information about enabling IP routing in the Answer profile and Connection profiles.

- Enabling dynamic address assignment for answered calls

  Assign Adrs must be set to Yes in the Answer profile to enable the MAX to allocate IP addresses dynamically from a pool of designated addresses on the local network. The caller’s PPP software must be configured to accept an address dynamically. If the Pools Only parameter is set to Yes in the Ethernet profile, the MAX terminates connections that reject the assigned address during PPP negotiation. See “Configuring dynamic address assignment to a dial-in host” on page 9-18 for related information.
- Enabling IP routing for WAN connections

  Route IP in Answer>PPP Options must be set to Yes to enable the MAX to negotiate a routing connection.
- Enabling IP routing for a WAN interface

  To enable IP packets to be routed for this connection, set the Route IP parameter to Yes in the Connection profile. When IP routing is enabled, IP packets are always routed, they are never bridged.
- Configuring the remote IP address

  The LAN parameter specifies the IP address of the remote device. Before accepting a call from the far end, the MAX matches this address to the source IP address presented by the calling device. It may be one of the following values:
  - IP address of a router

    If the remote device is an IP router, specify its address including its netmask modifier. (See “IP addresses and netmasks” on page 9-2 for background information.) If you omit the netmask, the MAX inserts a default netmask which makes the entire far-end network accessible.
  - IP address of a dial-in host

    If the remote device is a dial-in host running PPP software, specify its address including a netmask modifier of /32; for example, 10.2.3.4/32.
  - The null address (0.0.0.0)

    If the remote device is a dial-in host that will accept dynamic address assignment, leave the remote-address parameter blank.

**Note:** The most common cause of trouble in initially establishing an IP connection is incorrect configuration of the IP address or subnet specification for the remote host or calling device.

- A WAN alias

  This is another IP address for the remote device, used for numbered interface routing. The WAN Alias will be listed in the routing table as a gateway (next hop) to the Lan Adrs. The caller must be using a numbered interface, and its interface address must agree with the WAN Alias setting.

- Specifying a local IP interface address

  This is another local IP interface address, to be used as the local numbered interface instead of the default (the Ethernet IP Adrs).

- Metrics and preferences

  Connection profiles often represent switched connections, which have an initial cost that can be avoided if a nailed-up link to the same destination can be used. To favor nailed-up links, you can assign a higher metric to switched connections than any of the nailed-up links that can go to the same place.

  Each connection represents a static route, which has a default preference of 100. (See "Route preferences and metrics" on page 9-5.) For each connection, you can fine-tune the route preference and assign a different preference.

- Private routes

  The Private parameter specifies whether the MAX will disclose the existence of this route when queried by RIP or another routing protocol. Private routes are used internally but are not advertised.

- Assigning the IP address dynamically

  The Pool parameter specifies an IP address pool from which the caller will be assigned an IP address. If the Pool parameter is null but all other configuration settings enable dynamic assignment, the MAX gets IP addresses from the first defined address pool. See "Configuring DNS" on page 9-13.

- IP direct configuration

  An IP Direct configuration bypasses routing and bridging tables for all incoming packets and sends each packet received to the specified IP address. All outgoing packets are treated as normal IP traffic. They are not affected by the IP Direct configuration.

  **Note:** IP Direct connections are typically configured with RIP turned off. If you set the IP Direct configuration with RIP set to receive, all RIP updates will be forwarded to the specified address. This is typically not desirable since RIP updates are designed to be stored locally by the IP router (the MAX, in this case ).

- Configuring RIP on this interface

  You can configure an IP interface to send RIP updates (informing other routers on that interface of its routes), receive RIP updates (learning about distant networks from other routers on that interface), or both.

  Ascend recommends that you run RIP version 2 (RIP-v2) if possible. Ascend does not recommend running RIP-v2 and RIP-v1 on the same network in such a way that the routers receive each other's advertisements. RIP-v1 does not propagate subnet mask information, and the default class network mask is assumed, while RIP-v2 handles subnet masks explicitly. Running the two versions on the same network can result in RIP-v1 "guesses" overriding accurate subnet information obtained via RIP-v2.

# Checking remote host requirements

IP hosts, such as UNIX systems, Windows or OS/2 PCs, or Macintosh systems, must have appropriately configured TCP/IP software. A remote host calling into the local IP network must also have PPP software.

- UNIX

  UNIX systems typically include a TCP/IP stack, DNS software, and other software, files, and utilities used for Internet communication. UNIX network administration documentation describes how to configure these programs and files.

- PC-compatibles

  PCs running Windows or OS/2 need the TCP/IP networking software. The software is included with Windows 95, but the user may need to purchase and install it separately if the computer has a previous version of Windows or OS/2.

- Macintosh

  Macintosh computers need MacTCP or Open Transport software for TCP/IP connectivity. MacTCP is included with all Apple system software including and after Version 7.1. To see if a Macintosh has the software, the user should open the Control Panels folder and look for MacTCP or MacTCP Admin.

For any platform, the TCP/IP software must be configured with the host's IP address and subnet mask. If the host will obtain its IP address dynamically from the MAX, the TCP/IP software must be configured to allow dynamic allocation. If a DNS server is supported on your local network, you should also configure the host software with the DNS server's address.

Typically, the host software is configured with the MAX as its default router.

# Example IP routing connections

This section provides example Connection profile configurations for IP routing. These examples all presume that the Ethernet profile has been configured correctly, as described in "Configuring the local IP network setup" on page 9-7.

## Configuring dynamic address assignment to a dial-in host

In this example, the dial-in host is a PC that will accept an IP address assignment from the MAX dynamically. Figure 9-5 shows an example network.

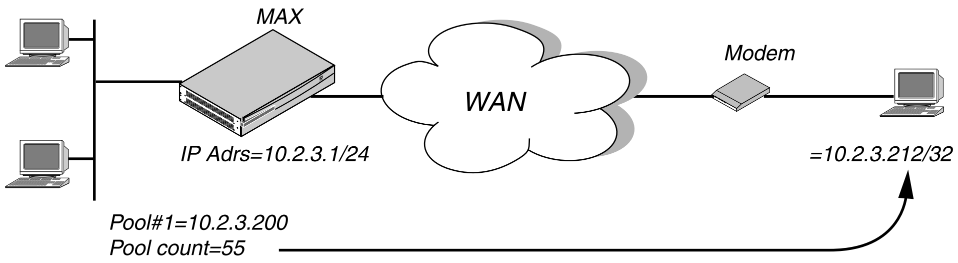


*Figure 9-5. A dial-in user requiring dynamic IP address assignment*

In this example, site A is a backbone network and site B is a single dial-in host with a modem, TCP/IP stack, and PPP software. The PPP software running on the PC at site B must be configured to acquire its IP address dynamically. For example, this example software configuration presumes that the PC has a modem connection to the MAX:

```
Username=victor
Accept Assigned IP=Yes
IP address=Dynamic (or Assigned or N/A)
Netmask=255.255.255.255 (or None or N/A)
Default Gateway=None or N/A
Name Server=10.2.3.55
Domain suffix=abc.com
Baud rate=38400
Hardware handshaking ON
VAN Jacobsen compression ON
```

To configure the MAX to accept dial-in connections from site B and assign an IP address:

**1** Open Ethernet>Mod Config>WAN Options.

**2** Type the start address of the pool and the number of contiguous addresses it includes. For example:

```
Ethernet
   Mod Config
      WAN options…
         Pool Summary=Yes
         Pool#1 start=10.12.253.1
         Pool#1 count=126
         Pool only=Yes
```

**3** Open the Ether Options subprofile and turn on Proxy Mode.

```
      Ether options…
         Proxy Mode=Yes
```

**4** Close the Ethernet profile.

**5** Open the Answer profile and enable both IP routing and dynamic address assignment.

```
Ethernet
   Answer
      Assign Adrs=Yes
      PPP options…
         Route IP=Yes
```

**6** Close the Answer profile.

**7** Open a Connection profile for the dial-in user.

**8** Specify the user’s name, activate the profile, and set encapsulation options.

```
Ethernet
   Connections
      Station=victor
      Active=Yes
      Encaps=PPP
      Encaps options...
         Send Auth=CHAP
         Recv PW=*SECURE*
```

**9** Configure IP routing and address assignment.

```
      Route IP=Yes
      IP options…
         LAN Adrs=0.0.0.0/0
```

```
            RIP=Off
            Pool=1
```

**10** Close the Connection profile.

## Configuring a host connection with a static address

This type of connection enables the dial-in host to keep its own IP address when logging into the MAX IP network. For example, if a PC user telecommutes to one IP network and uses an ISP on another IP network, one of those connections can assign an IP address dynamically and the other can configure a host route to the PC. This example shows how to configure a host connection with a static address. See “IP addresses and netmasks” on page 9-2 for details on the /32 netmask.

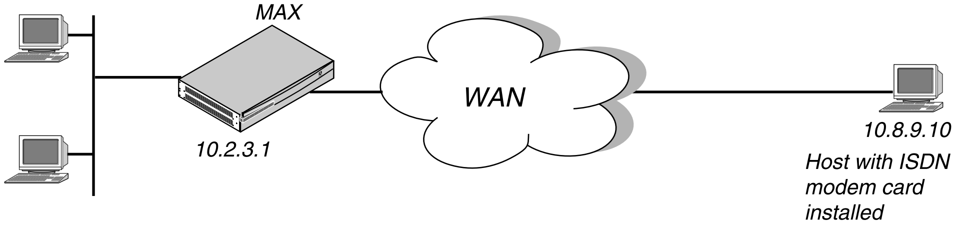


*Figure 9-6. A dial-in user requiring a static IP address (a host route)*

In this example, the PC at site B is running PPP software that includes settings like these:

```
Username=patti
Accept Assigned IP=N/A (or No)
IP address=10.8.9.10
Netmask=255.255.255.255
Default Gateway=N/A (or None)
Name Server=10.7.7.1
Domain suffix=abc.com
VAN Jacobsen compression ON
```

To configure the MAX to accept dial-in connections from site B:

**1** Open the Answer profile and enable IP routing.

```
Ethernet
   Answer
      PPP options…
         Route IP=Yes
```

**2** Close the Answer profile.

**3** Open a Connection profile for the dial-in user.

**4** Specify the user’s name, activate the profile, and set encapsulation options.

```
Ethernet
   Connections
      Station=patti
      Active=Yes
      Encaps=PPP
      Encaps options...
         Send Auth=CHAP
         Recv PW=*SECURE*
```

**5** Configure IP routing.

```
         Route IP=Yes
         IP options…
            LAN Adrs=10.8.9.10/32
            RIP=Off
```

**6** Close the Connection profile.

## Configuring an IP Direct connection

You can configure a Connection profile to automatically redirect incoming IP packets to a specified host on the local IP network without having the packets pass through the routing engine on the MAX.

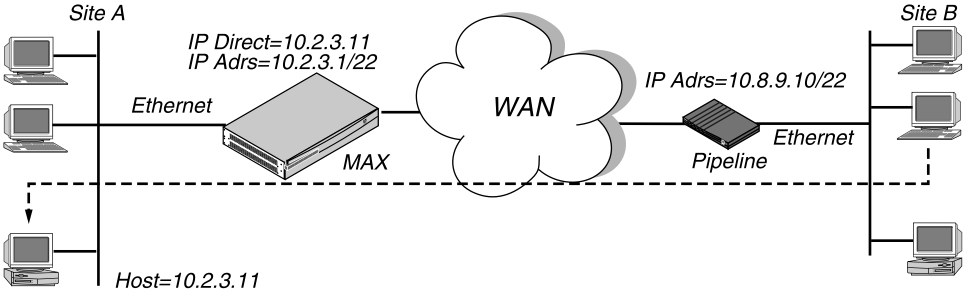


*Figure 9-7. Directing incoming IP packets to one local host*

**Note:** IP Direct connections typically turn off RIP. If the connection is configured to receive RIP, all RIP packets from the far side are kept locally and forwarded to the IP address you specify for IP Direct.

To configure an IP Direct connection:

**1** Open the Answer profile and enable IP routing.

```
Ethernet
   Answer
      PPP options…
         Route IP=Yes
```

**2** Close the Answer profile.

**3** Open a Connection profile for the dial-in connection.

**4** Specify the remote device’s name, activate the profile, and set encapsulation options.

```
Ethernet
   Connections
      Station=Pipeline1
      Active=Yes
      Encaps=MPP
      Encaps options...
         Send Auth=CHAP
         Recv PW=localpw
         Send PW=remotepw
```

**5** Configure IP routing.

```
      Route IP=Yes
      IP options…
         LAN Adrs=10.8.9.10/22
         RIP=Off
```

**6** Open the Session Options subprofile and specify the IP Direct host.

```
      Session options…
         IP Direct=10.2.3.11
```

**7** Close the Connection profile.

**Note:** The IP Direct address you specify in Connections>Session Options is the address to which all incoming packets on this connection will be directed. When you use the IP Direct feature, a user cannot Telnet directly to the MAX from the far side. All incoming IP traffic is directed to the specified address on the local IP network.

## Configuring a router-to-router connection

In this example, the MAX is connected to a corporate IP network and needs a switched connection to another company that has its own IP configuration. Figure 9-8 shows an example network diagram.

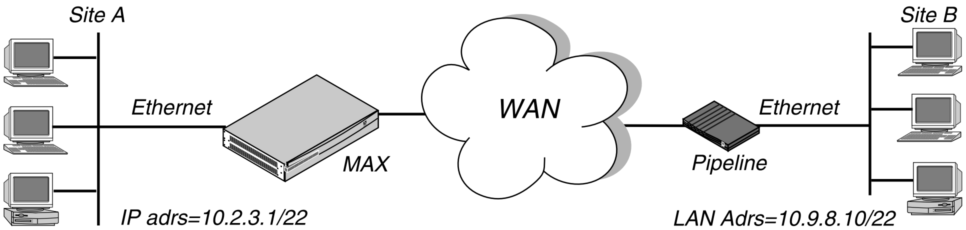


*Figure 9-8. A router-to-router IP connection*

This example assumes that the Answer profile in both devices enable IP routing. To configure the site A MAX for a connection to site B:

**1** Open a Connection profile for the site B device.

**2** Specify the remote device’s name, activate the profile, and set encapsulation options.

```
Ethernet
   Connections
      Station=PipelineB
      Active=Yes
      Encaps=MPP
      Encaps options...
         Send Auth=CHAP
         Recv PW=localpw
         Send PW=remotepw
```

**3** Configure IP routing.

```
      Route IP=Yes
      IP options…
         LAN Adrs=10.9.8.10/22
         RIP=Off
```

**4** Close the Connection profile.

To configure the site B Pipeline:

**5** Open the Connection profile for the site A MAX.

**6** Specify the site A MAX unit’s name, activate the profile, and set encapsulation options.

```
Ethernet
   Connections
```

```
            Station=MAXA
            Active=Yes
            Encaps=MPP
            Encaps options...
               Send Auth=CHAP
               Recv PW=localpw
               Send PW=remotepw
```

**7** Configure IP routing.

```
            Route IP=Yes
            IP options…
               LAN Adrs=10.2.3.1/22
               RIP=Off
```

**8** Close the Connection profile.

## Configuring a router-to-router connection on a subnet

In this example network, the MAX is used to connect telecommuters with their own Ethernet networks to the corporate backbone. The MAX is on a subnet, and assigns subnet addresses to the telecommuters' networks.

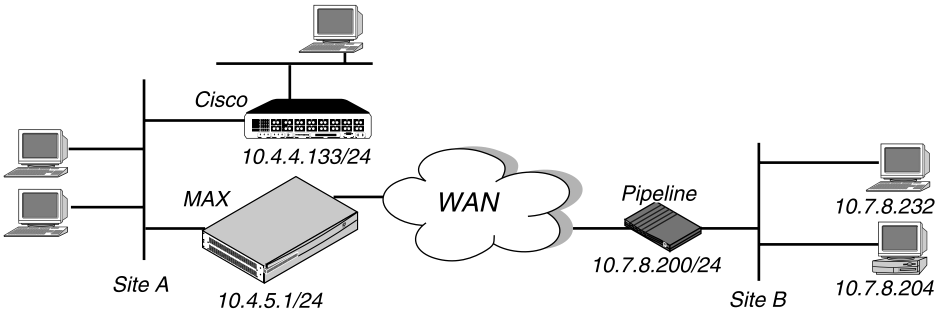


*Figure 9-9. A connection between local and remote subnets*

This example assumes that the Answer profile in both devices enables IP routing. Because the MAX specifies a netmask as part of its own IP address, the MAX must use other routers to reach IP addresses outside that subnet. To forward packets to other parts of the corporate network, the MAX must either have a default route configuration to a router in its own subnet (such as the Cisco router in Figure 5-12) or it must enable RIP on Ethernet.

To configure the MAX at site A with an IP routing connection to site B:

**1** Open a Connection profile for the site B device.

**2** Specify the remote device's name, activate the profile, and set encapsulation options.

```
Ethernet
   Connections
      Station=PipelineB
      Active=Yes
      Encaps=MPP
      Encaps options...
         Send Auth=CHAP
         Recv PW=localpw
         Send PW=remotepw
```

**3** Configure IP routing.

```
      Route IP=Yes
      IP options…
         LAN Adrs=10.7.8.200/24
         RIP=Off
```

4. Close the Connection profile.

To specify the local Cisco router as the MAX unit’s default route:

5. Open the Default IP Route profile.
6. Specify the Cisco router’s address as the gateway address.

```
Ethernet
   Static Rtes
      Name=Default
      Active=Yes
      Dest=0.0.0/0
      Gateway=10.4.4.133
      Metric=1
      Preference=10
      Private=Yes
```

7. Close the IP Route profile.

To configure the site B Pipeline unit for a connection to site A:

8. Open the Connection profile in the Pipeline unit for the site A MAX.
9. Specify the site A MAX unit’s name, activate the profile, and set encapsulation options.

```
Ethernet
   Connections
      Station=MAXA
      Active=Yes
      Encaps=MPP
      Encaps options...
         Send Auth=CHAP
         Recv PW=localpw
         Send PW=remotepw
```

10. Configure IP routing.

```
      Route IP=Yes
      IP options…
         LAN Adrs=10.4.5.1/24
         RIP=Off
```

To make the MAX the default route for the site B Pipeline unit:

11. Open the Default IP Route profile in the site B Pipeline.
12. Specify the MAX unit at the far end of the WAN connection as the gateway address.

```
Ethernet
   Static Rtes
      Name=Default
      Active=Yes
      Dest=0.0.0/0
      Gateway=10.4.5.1
      Metric=1
      Preference=100
      Private=Yes
```

13. Close the IP Route profile.

## Configuring a numbered interface

If you are not familiar with numbered interfaces, see “Numbered interfaces” on page 9-6. In the following example, the MAX is a system-based router but supports a numbered interface for one of its connections. The arrow in Figure 9-10 indicates the numbered interfaces for this connection:

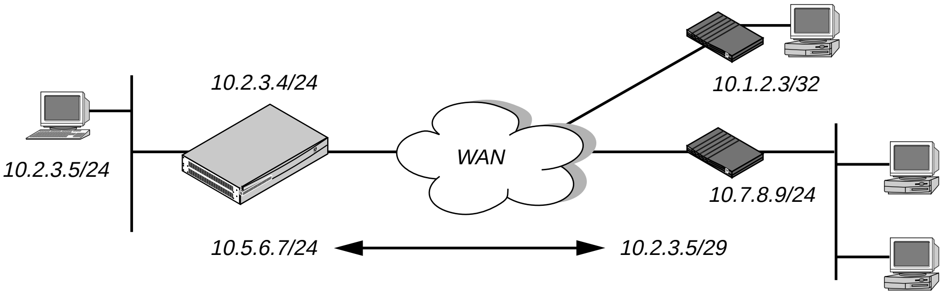


*Figure 9-10. Example numbered interface*

The numbered interface addresses are:

- IF Adrs=10.5.6.7/24
- WAN Alias=10.7.8.9/24

An unnumbered interface is also shown in Figure 9-10. The 10.1.2.3/32 connection uses a single system-based address for both the MAX itself and the dial-in user. To configure the numbered interface:

**1** Open Ethernet>Mod Config>Ether Options and verify that the IP Adrs parameter is set correctly.

```
Ethernet
   Mod Config
      Ether options...
         IP Adrs=10.2.3.4/24
```

**2** Close the Ethernet profile.

**3** Open the Connection profile and configure the required parameters, then open the IP Options subprofile.

**4** Specify the IP address of the remote device in the LAN Adrs parameter.

```
Ethernet
      Connections
      IP options...
         LAN Adrs=10.3.4.5/24
```

**5** Specify the numbered interface address for the remote device in the WAN Alias parameter.

```
      IP options...
         WAN Alias=10.7.8.9/24
```

**6** Specify the numbered interface address for the 42 in the IF Adrs parameter.

```
      IP options...
         IF Adrs=10.5.6.7/24
```

**7** Close the Connection profile.

# Configuring IP routes and preferences

The IP routing table contains routes that are configured (static routes) and routes that are learned dynamically from routing protocols such as RIP or OSPF. These are the parameters for configuring static routes:

```
Ethernet
   Static Rtes
      Name=route-name
      Active=Yes
      Dest=10.2.3.0/24
      Gateway=10.2.3.4
      Metric=2
      Preference=100
      Private=No
      Ospf=Cost=1
      ASE-type=Type1
      ASE=tag=c0000000

Ethernet
   Connections
      Route IP=Yes
      IP options...
         LAN Adrs=10.2.3.4/24
         WAN Alias=10.5.6.7/24
         IF Adrs=10.7.8.9/24
         Metric=7
         Preference=100
         Private=No

Ethernet
   Mod Config
      Ether options…
         IP Adrs=10.2.3.1/24
         2nd Adrs=0.0.0.0/0
         RIP=Off

      Route Pref…
         Static Preference=100
         Rip Preference-100
         RipAseType-Type2
         Rip Tag=c8000000
         OSPF Preference=10
         OSPF ASE Preference=150
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the static route parameters

This section provides some background information on static routes.

- Route names

  IP Route profiles are indexed by name. You can assign any name less than 31 characters.

- Activating a route

  A route must be active to affect packet routing. An inactive route is ignored.

- The route’s destination address

  The destination address of a route is the target network—the destination address in a packet. Packets destined for that host will use this static route to bring up the right connection. The zero address 0.0.0.0 represents the default route (the destination to which packets are forwarded when there is no route to the packet’s destination).

- The route’s gateway address

  The gateway-address parameter specifies the IP address of the router or interface to use to reach the target network.

- Metrics, costs, and preferences

  The metric parameter is a hop count for this route (a number between 1 to 15). When RIP was originally developed, the hop count was a number that showed how many routers needed to be crossed to reach the destination. For example, a destination with a hop count of 10 meant that to get a packet there requires crossing 10 routers. A route with a shorter hop count to a destination is more desirable than one with a larger hop count, since it most likely is a shorter, faster route.

  The hop count can also be manually configured to give a route a "virtual" hop count. In this way you can manually configure which routes are more desirable than others in your environment. The higher the metric, the less likely that the MAX will use a route.

  The cost parameter specifies the cost of an OSPF link. The cost is a configurable metric that can be used to take into account the speed of the link and other issues. The lower the cost, the more likely the interface will be used to forward data traffic. For details, see Chapter 10, “Configuring OSPF Routing.”

  The preference parameter specifies a route preference. Zero is the default for connected routes (such as the Ethernet). When choosing which route to use, the router first compares the preference values, preferring the lower number. If the preference values are equal, the router compares the metric values, using the route with the lower metric. The value of 255 means “Don't use this route.” See “Route preferences and metrics” on page 9-5.

- Tagging routes learned from RIP

  The rip-tag field is “attached” to all routes learned from RIP in OSPF updates. The tag is a hexadecimal number that can be used by border routers to filter the record.

- Type-1 or type-2 metrics for routes learned from RIP

  The rip-ase-type parameter can be set to 1 or 2. Type-1 is a metric expressed in the same units as the link-state metric (the same units as interface cost). Type-2 is considered larger than any link-state path. It assumes that routing between autonomous systems is the major cost of routing a packet, and eliminates the need for conversion of external costs to internal link-state metrics.

- Making a route private

  Private routes are used internally but are not advertised.

- Routes for Connection profile interfaces

  When an IP routing connection is brought up, the MAX activates the route for that WAN interface. The Destination for the route is the remote device’s address (LAN Adrs), and the metric and preference values are specified in the Connection profile. If the profile uses numbered interface, an additional route is created for that interface.

- A connected route for the Ethernet IP interface

  The IP Adrs parameter specifies the MAX unit’s IP address on the local Ethernet. The MAX creates a route for this address at system startup.

- Static route preferences

  By default, static routes and RIP routes have the same preference, so they compete equally. ICMP redirects take precedence over both and OSPF take precedence over everything. If a dynamic route's preference is lower than that of the static route, the dynamic route can overwrite or "hide" a static route to the same network. This can be seen in the IP routing table: there will be two routes to the same destination. The static route has an "h" flag, indicating that it is hidden and inactive. The active, dynamically learned route is also in the routing table. However, dynamic routes age and if no updates are received, they eventually expire. In that case, the hidden static route reappears in the routing table.
- RIP and OSPF preferences

  Because OSPF typically involves a complex environment, its router configuration is described in a separate chapter. See Chapter 10, "Configuring OSPF Routing."
- Tagging routes learned from RIP

  The RIP Tag field is "attached" to all routes learned from RIP in OSPF updates. The tag is a hexadecimal number that can be used by border routers to filter the record.
- Metrics for routes learned from RIP

  The RipAseTag parameter can be type 1 or 2. Type-1 is a metric expressed in the same units as the link-state metric (the same units as interface cost). Type-2 is considered larger than any link-state path. It assumes that routing between autonomous systems is the major cost of routing a packet, and eliminates the need for conversion of external costs to internal link-state metrics.

# Example static route configurations

For example Connection profile configurations, see "Configuring IP routing connections" on page 9-15. Each of these results in a static route. For an example of the Ethernet profile configuration of the MAX unit's local IP interface, see "Configuring the MAX IP interface on a subnet" on page 9-12.

## Configuring the default route

If no routes exist for the destination address of a packet, the MAX forwards the packet to the default route. Most sites use the default route to specify a local IP router (such as a Cisco router or a UNIX host running the route daemon) to offload routing tasks to other devices.

**Note:** If the MAX does not have a default route, it drops packets for which it has no route.

The name of the default IP Route profile is always Default, and its destination is always 0.0.0.0. To configure the default route:

**1** Open the first IP Route profile (the route named Default) and activate it.

```
Ethernet
   Static Rtes
      Name=Default
      Active=Yes
      Dest=0.0.0.0/0
```

**Note:** The name of the first IP Route profile is always Default, and its destination is always 0.0.0.0 (you cannot change these values).

**2** Specify the router to use for packets with unknown destinations; for example:

```
      Gateway=10.9.8.10
```

**3** Specify a metric for this route, the route's preference, and whether the route is private. For example:

```
Metric=1
Preference=100
Private=Yes
```

**4** Close the IP Route profile.

## Defining a static route to a remote subnet

If the connection does not enable RIP, the MAX does not learn about other networks or subnets that are reachable through the remote device, such as the remote network shown in Figure 9-11.

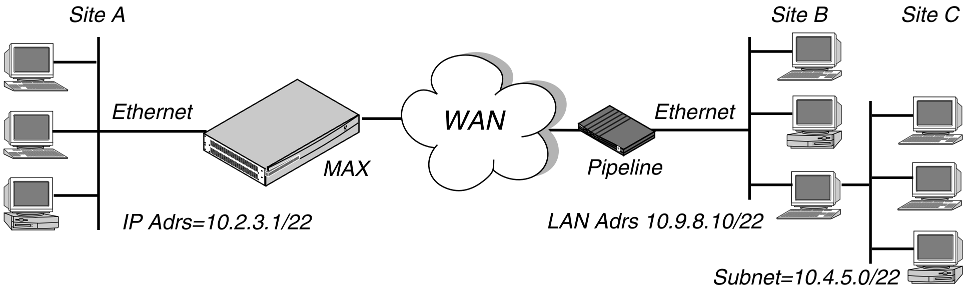


*Figure 9-11. Two-hop connection that requires a static route when RIP is off*

To enable the MAX to route to site C without using RIP, you must configure an IP Route profile like this:

```
Ethernet
   Static Rtes
      Name=SITEBGW
      Active=Yes
      Dest=10.4.5.0/22
      Gateway=10.9.8.10
      Metric=2
      Preference=100
      Private=Yes
      Ospf=Cost=1
      ASE-type=Type1
      ASE=tag=c0000000
```

## Example route preferences configuration

This example increases the preference value of RIP routes, instructing the router to use static routes first if one exists.

**1** Open Ethernet>Mod Config>Route Pref.

**2** Set Rip Preference to 150.

```
Ethernet
   Mod Config
      Route Pref…
         Rip Preference=150
```

**3** Close the Ethernet profile.

# Configuring the MAX for dynamic route updates

Each active interface may be configured to send or receive RIP or OSPF updates. The Ethernet interface can also be configured to accept or ignore ICMP redirects. All of these routing mechanisms modify the IP routing table dynamically.

These are the parameters that enable the MAX to receive updates from RIP or ICMP. (For information on OSPF updates, see Chapter 10, “Configuring OSPF Routing.”)

```
Ethernet
   Mod Config
      Ether options…
         RIP=On
         Ignore Def Rt=Yes
      RIP Policy=Poison Rvrs
      RIP Summary=Yes
      ICMP Redirects=Accept
Ethernet
   Answer
      Session options...
         RIP=On
Ethernet
   Connections
      IP options...
         Private=No
         RIP=On
```

## Understanding the dynamic routing parameters

This section provides some background information about the dynamic routing options.

- RIP (Routing Information Protocol)

  You can configure the router to send or receive RIP updates (or both ) on the Ethernet interface and on each WAN interface. The Answer profile setting applies to Name profiles and profiles retrieved from RADIUS. You can also choose between RIP-v1 and RIP-v2 on any interface. Many sites turn off RIP on WAN connections to keep their routing tables from becoming very large.

  **Note:** The IETF has voted to move RIP-v1 into the “historic” category and its use is no longer recommended. Ascend recommends that you upgrade all routers and hosts to RIP-v2. If you must maintain RIP-v1, Ascend recommends that you create a separate subnet and place all RIP-v1 routers and hosts on that subnet.

- Ignoring the default route

  You can configure the MAX to ignore default routes advertised by routing protocols. This configuration is recommended, because you typically do not want the default route to be changed by a RIP update. The default route specifies a static route to another IP router, which is often a local router such as a Cisco router or another kind of LAN router. When the MAX is configured to ignore the default route, RIP updates will not modify the default route in the MAX routing table.

- RIP policy and RIP summary

  The RIP Policy and RIP Summary parameters have no effect on RIP-v2.

If the MAX is running RIP-v1, the RIP Policy parameter specifies a split horizon or poison reverse policy to handle update packets that include routes that were received on the same interface on which the update is sent. Split-horizon means that the MAX does not propagate routes back to the subnet from which they were received. Poison-reverse means that it propagates routes back to the subnet from which they were received with a metric of 16.

The RIP Summary parameter specifies whether to summarize subnet information when advertising routes. If the MAX summarizes RIP routes, it advertises a route to all the subnets in a network of the same class; for example, the route to 200.5.8.13/28 (a class C address subnetted to 28 bits) would be advertised as a route to 200.5.8.0. When the MAX does not summarize information, it advertises each route in its routing table "as-is;" in our example, the MAX advertises a route only to 200.5.8.13.

- Ignoring ICMP redirects

  ICMP was designed to dynamically find the most efficient IP route to a destination. ICMP redirect packets are one of the oldest route discovery methods on the Internet and one of the least secure, because it is possible to counterfeit ICMP redirects and change the way a device routes packets.

- Private routes

  If you configure a profile with Private=Yes, the router will not disclose its route in response to queries from routing protocols.

## Example RIP and ICMP configurations

This example configuration instructs the router to ignore ICMP redirect packets, to receive (but not send) RIP updates on Ethernet, and to send (but not receive) RIP updates on a WAN connection.

**1** Open Ethernet>Mod Config>Ether Options.

**2** Configure the router to receive (but not send) RIP updates on Ethernet.

```
Ethernet
   Mod Config
      Ether options…
         RIP=Recv-v2
```

Receiving RIP updates on Ethernet means that the router will learn about networks that are reachable via other local routers. However, it will not propagate information about all of its remote connections to the local routers.

**3** Close the Ether Options subprofile, and set ICMP Redirects to Ignore.

```
      ICMP Redirects=Ignore
```

**4** Close the Ethernet profile.

**5** Open Connections>IP Options, and configure the router to send (but not receive) RIP updates on this link.

```
Ethernet
   Connections
      IP options...
         RIP=Send-v2
```

Sending RIP on a WAN connection means that the remote devices will be able to access networks that are reachable via other local routers. However, the MAX will not receive information about networks that are reachable through the remote router.

**6** Close the Connection profile.

# Managing IP routes and connections

This section describes how to monitor TCP/IP/UDP and related information in the terminal server command-line interface. To invoke the terminal-server interface, select System>Sys Diag>Term Serv and press Enter.

## Working with the IP routing table

The terminal-server IProute commands display the routing table and enable you to add or delete routes. The changes you make to the routing table using the IProute command last only until the MAX unit resets. To view the IProute commands:

```
ascend% iproute ?

iproute ?           Display help information
iproute add         iproute add <destination/size> <gateway> [pref] [metric
iproute delete      iproute delete <destination/size> <gateway> [proto]
iproute show        displays IP routes (same as "show ip routes" command)
```

### Displaying the routing table

Note that the IProute Show command and the Show IP Routes command have identical output. To view the IP routing table:

```
ascend% iproute show

Destination        Gateway        IF       Flg Pref  Met   Use   Age
0.0.0.0/0          10.0.0.100     wan0     SG   1     1     0     20887
10.207.76.0/24     10.207.76.1    wanidle0 SG   100   7     0     20887
10.207.77.0/24     10.207.76.1    wanidle0 SG   100   8     0     20887
127.0.0.1/32       -              lo0      CP   0     0     0     20887
10.0.0.0/24        10.0.0.100     wan0     SG   100   1     21387 20887
10.1.2.0/24        -              ie0      C    0     0     19775 20887
10.1.2.1/32        -              lo0      CP   0     0     389   20887
255.255.255.255/32 -              ie0      CP   0     0     0     20887
```

The columns in the table display the following information:

- Destination

  The Destination column indicates the target address of a route. To send a packet to this address, the MAX will use this route. Note that the router will use the most specific route (having the largest netmask) that matches a given destination.

- Gateway

  The Gateway column specifies the address of the next hop router that can forward packets to the given destination. Direct routes (without a gateway) no longer show a gateway address in the gateway column.

- IF

  The Interface column shows the name of the interface through which a packet addressed to this destination will be sent.

  ie0 is the Ethernet interface

  lo0 is the loopback interface

  wanN specifies each of the active WAN interfaces

  wanidle0 is the inactive interface (the special interface for any route whose WAN connection is down).

- Flg

  The Flg column can contain the following flag values:

  - C (A directly connected route such as Ethernet)
  - I (ICMP Redirect dynamic route)
  - N (Placed in the table via SNMP MIB II)
  - O (A route learned from OSPF)
  - R (A route learned from RIP)
  - r (A RADIUS route)
  - S (A static route)
  - ? (A route of unknown origin, which indicates an error)
  - G (An indirect route via a gateway)
  - P (A private route)
  - T (A temporary route)
  - * (A hidden route that will not be used unless another better route to the same destination goes down)

- Pref

  The Preference column contains the preference value of the route. Note that all routes that come from RIP will have a preference value of 100, while the preference value of each individual static route may be set independently.

- Metric

  The Metric column shows the RIP-style metric for the route, with a valid range of 0-16. Routes learned from OSPF show a RIP metric of 10. OSPF Cost infinity routes show a RIP metric of 16.

- Use

  This is a count of the number of times the route was referenced since it was created. (Many of these references are internal, so this is not a count of the number of packets sent using this route.)

- Age

  This is the age of the route in seconds. It is used for troubleshooting, to determine when routes are changing rapidly or flapping.

The first route in the default route (destination 0.0.0.0/0), which is pointing through the active Connection profile.

```
0.0.0.0/0         10.0.0.100     wan0     SG   1     1     0     20887
```

In this example, the IP Route profile for the default route specifies a Preference of 1, so this route is preferred over dynamically learned routes. The next route is specified in a Connection profile that is inactive.

```
10.207.76.0/24    10.207.76.1    wanidle0 SG   100   7     0     20887
```

The next route in the table is a static route that points through an inactive gateway:

```
10.207.77.0/24    10.207.76.1    wanidle0 SG   100   8     0     20887
```

The static route is followed by the loopback route:

```
127.0.0.1/32      -              lo0      CP   0     0     0     20887
```

The loopback route says that packets sent to this special address will be handled internally. The C flag indicates a Connected route, while the P flag indicates that the router will not advertise this route.

The next route is specified in a Connection profile that is currently active:

```
10.0.0.0/24       10.0.0.100     wan0     SG   100   1     21387 20887
```

These are followed by the connection to the Ethernet interface. It is directly connected, with a Preference and Metric of zero.

```
10.1.2.0/24       -             ie0      C    0     0     19775 20887
```

The last two routes are a private loopback route, and a private route to the broadcast address:

```
10.1.2.1/32        -              lo0      CP   0     0     389   20887
255.255.255.255/32 -             ie0      CP   0     0     0     20887
```

The private loopback route is a host route with our Ethernet address. It is private, so it will not be advertised. The private route to the broadcast address is used in cases where the router will want to broadcast a packet but is otherwise unconfigured. It is typically used when trying to locate a server on a client machine to handle challenges for a token security card.

## Adding an IP route

To add a static route to the MAX unit's routing table that will be lost when the MAX resets, use the IProute Add command in this format:

```
iproute add <destination> <gateway> [<metric>]
```

where <destination> is the destination network address, <gateway> is the IP address of the router that can forward packets to that network, and <metric> is the virtual hop count to the destination network (default 8). For example:

```
ascend% iproute add 10.1.2.0/24 10.0.0.3 1
```

The command shown immediately above adds a route to the 10.1.2.0/24 network and all of its subnets through the IP router located at 10.0.0.3. The metric to the route is 1 (it is one hop away).

If you try to add a route to a destination that already exists in the routing table, the MAX replaces the existing route, but only if the existing route has a higher metric. If you get the message "Warning: a better route appears to exist", the MAX rejected your attempt to add a route because the routing table already contained the same route with a lower metric. Note that RIP and OSPF updates can change the metric for the route.

## Deleting an IP route

To remove a route from the MAX unit's routing table, enter the IProute Delete command in this format:

```
iproute delete <destination> <gateway>
```

For example:

```
ascend% iproute delete 10.1.2.0/24 10.0.0.3
```

**Note:** RIP and OSPF updates can add back any route you remove with IProute Delete. Also, the MAX restores all routes listed in the Static Route profile after a system reset.

## Displaying route statistics

The Traceroute command is useful for locating slow routers or diagnosing IP routing problems. It traces the route an IP packet follows by launching UDP probe packets with a low TTL (Time-To-Live) value and then listening for an ICMP “time exceeded” reply from a router. Its syntax is:

```
traceroute [ -n ] [ -v ] [ -m max_ttl ] [ -p port ] [ -q nqueries ]
[ -w waittime ] host [ datasize ]
```

All flags are optional. The only required parameter is the destination hostname or IP address.

- -n

  Prints hop addresses numerically rather than symbolically and numerically (this eliminates a name server address-to-name lookup for each gateway found on the path).
- -v

  Verbose output. Received ICMP packets other than Time Exceeded and ICMP Port Unreachable are listed.
- -m <max_ttl>

  This sets the maximum time-to-live (maximum number of hops) used in outgoing probe packets. The default is 30 hops.
- -p <port>

  Sets the base UDP port number used in probes. Traceroute hopes that nothing is listening on any of the UDP ports from the source to the destination host (so an ICMP Port Unreachable message will be returned to terminate the route tracing). If something is listening on a port in the default range, this option can be used to pick an unused port range. The default is 33434.
- -q <nqueries>

  Sets the maximum number of queries for each hop. The default is 3.
- -w <waittime>

  Sets the time to wait for a response to a query. The default is 3 seconds.
- host

  The destination host by name or IP address.
- datasize

  Sets the size of the data field of the UDP probe datagram sent by Traceroute. The default is 0. This results in a datagram size of 38 bytes (a UDP packet carrying no data).

For example, to trace the route to the host “techpubs”:

```
ascend% traceroute techpubs

traceroute to techpubs (10.65.212.19), 30 hops max, 0 byte packets
 1  techpubs.eng.ascend.com (10.65.212.19)  0 ms  0 ms  0 ms
```

Probes start with a TTL of one and increase by one until of the following conditions occurs:

- The MAX receives an ICMP “port unreachable” message.

  The UDP port in the probe packets is set to an unlikely value, such as 33434, because the target host is not intended to process the packets. A “port unreachable” message indicates that the packets reached the target host and were rejected.
- The TTL value reaches the maximum value.

By default, the maximum TTL is set to 30. You can specify a different TTL by using the –m option; for example:

```
ascend% traceroute -m 60 techpubs
```

```
traceroute to techpubs (10.65.212.19), 60 hops max, 0 byte packets
 1  techpubs.eng.abc.com (10.65.212.19)  0 ms  0 ms  0 ms
```

Three probes are sent at each TTL setting. The second line of command output shows the address of the router and round trip time of each probe. If the probe answers come from different gateways, the address of each responding system will be printed. If there is no response within a 3 second timeout interval, the command output is an asterisk. The following annotations may be included after the time field in a response:

- !H (Host reached. )
- !N (Network unreachable.)
- !P (Protocol unreachable.)
- !S (Source route failed. This may indicate a problem with the associated device. )
- !F (Fragmentation needed. This may indicate a problem with the associated device. )
- !h (Communication with the host is prohibited by filtering.)
- !n (Communication with the network is prohibited by filtering.)
- !c (Communication is otherwise prohibited by filtering.)
- !? (Indicates an ICMP sub-code. This should not occur. )
- !?? (Reply received with inappropriate type. This should not occur.

## Pinging other IP hosts

The terminal-server Ping command is useful for verifying that the transmission path is open between the MAX and another station. It sends an ICMP echo_request packet to the specified station. It the station receives the packet, it returns an ICMP echo_response packet. For example, to ping the host “techpubs”:

```
ascend% ping techpubs
```

```
PING techpubs (10.65.212.19): 56 data bytes
64 bytes from 10.65.212.19: icmp_seq=0 ttl=255 time=0 ms
64 bytes from 10.65.212.19: icmp_seq=3 ttl=255 time=0 ms
^C
--- techpubs ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0/0/0 ms
```

You can terminate the Ping exchange at any time by typing Ctrl-C. When you press Ctrl-C, the command reports the number of packets sent and received, the percentage of packet loss, duplicate or damaged echo_response packets (if any), and round-trip statistics. In some cases, round-trip times cannot be calculated.

During the Ping exchange, the MAX displays information about the packet exchange, including the TTL (Time-To-Live) of each ICMP echo_response packet.

**Note:** The maximum TTL for ICMP Ping is 255 and the maximum TTL for TCP is often 60 or lower, so you might be able to ping a host but not be able to run a TCP application (such as Telnet or FTP) to that station. If you Ping a host running a version of Berkeley UNIX before

4.3BSD-Tahoe, the TTL report is 255 minus the number of routers in the round-trip path. If you Ping a host running the current version of Berkeley UNIX, the TTL report is 255 minus the number of routers in the path from the remote system to the station performing the Ping.

The Ping command sends an ICMP mandatory echo_request datagram, which asks the remote station “Are you there?” If the echo_request reaches the remote station, the station sends back an ICMP echo_response datagram, which tells the sender “Yes, I am alive.” This exchange verifies that the transmission path is open between the MAX and a remote station.

# Displaying information

The following Show commands are useful for monitoring IP routing and related protocols:

```
show arp            Display the Arp Cache
show icmp           Display ICMP information
show if             Display Interface info. Type 'show if ?' for help.
show ip             Display IP information. Type 'show ip ?' for help.
show udp            Display UDP information. Type 'show udp ?' for help.
show tcp            Display TCP information. Type 'show tcp ?' for help.
show pools          Display the assign address pools.
```

## Displaying the ARP cache

To view the ARP cache:

```
ascend% show arp

entry typ ip address      ether addr    if rtr pkt   insert
    0 DYN 10.65.212.199  00C07B605C07   0   0   0   857783
    1 DYN 10.65.212.91   0080C7C4CB80   0   0   0   857866
    2 DYN 10.65.212.22   080020792B4C   0   0   0   857937
    3 DYN 10.65.212.3    0000813DF048   0   0   0   857566
    4 DYN 10.65.212.250  0020AFF80F1D   0   0   0   857883
    5 DYN 10.65.212.16   0020AFEC0AFB   0   0   0   857861
    6 DYN 10.65.212.227  00C07B5F14B6   0   0   0   857479
    7 DYN 10.65.212.36   00C07B5E9AA5   0   0   0   857602
    8 DYN 10.65.212.71   0080C730041F   0   0   0   857721
    9 DYN 10.65.212.5    0003C6010512   0   0   0   857602
   10 DYN 10.65.212.241  0080C72ED212   0   0   0   857781
   11 DYN 10.65.212.120  0080C7152582   0   0   0   857604
   12 DYN 10.65.212.156  0080A30ECE6D   0   0   0   857901
   13 DYN 10.65.212.100  00C07B60E28D   0   0   0   857934
   14 DYN 10.65.212.1    00000C065D27   0   0   0   857854
   15 DYN 10.65.212.102  08000716C449   0   0   0   857724
   16 DYN 10.65.212.33   00A024AA0283   0   0   0   857699
   17 DYN 10.65.212.96   0080C7301792   0   0   0   857757
   18 DYN 10.65.212.121  0080C79BF681   0   0   0   857848
   19 DYN 10.65.212.89   00A024A9FB99   0   0   0   857790
   20 DYN 10.65.212.26   00A024A8122C   0   0   0   857861
   21 DYN 10.65.212.6    0800207956A2   0   0   0   857918
   22 DYN 10.65.212.191  0080C75BE778   0   0   0   857918
   23 DYN 10.65.212.116  0080C72F66CC   0   0   0   857416
   24 DYN 10.65.212.87   0000813606A0   0   0   0   857666
   25 DYN 10.65.212.235  00C07B76D119   0   0   0   857708
   26 DYN 10.65.212.19   08002075806B   0   0   0   857929
```

The ARP table displays this information:

- entry: A unique identifier for each ARP table entry.
- typ: How the address was learned, dynamically (DYN) or statically (STAT).
- ip address: The address contained in ARP requests.
- ether addr: The MAC address of the host with that IP address.
- if: The interface on which the MAX received the ARP request.
- rtr: The next-hop router on the specified interface.

## Displaying ICMP packet statistics

To view the number of ICMP packets received intact, received with errors, and transmitted:

```
   ascend% show icmp

   3857661 packet received.
   20 packets received with errors.
      Input histogram: 15070
   2758129 packets transmitted.
   0 packets transmitted due to lack of resources.
      Output histogram: 15218
```

The Input and Output histograms show the number of ICMP packets received and transmitted in each category.

## Displaying interface statistics

To see the supported commands:

```
   ascend% show if ?

   show if ?           Display help information
   show if stats       Display Interface Statistics
   show if totals      Display Interface Total counts
```

To display the status and packet count of each active WAN link as well as local and loopback interfaces:

```
   ascend% show if stats

Interface    Name    Status  Type     Speed    MTU   InPackets    Outpacket
ie0        ethernet    Up    6     10000000   1500     107385     85384
wan0                 Down    1            0   1500      0         0
wan1                 Down    1            0   1500      0         0
wan2                 Down    1            0   1500      0         0
wanidle0               Up    6     10000000   1500      0         0
lo0       loopback     Up   24     10000000   1500      0         0
```

The output contains these fields:

- Interface: The interface name (see Chapter 9, “Configuring IP Routing.”)
- Name: The name of the profile or a text name for the interface
- Status: Up (the interface is functional) or Down.
- Type: The type of application being used on the interface, as specified in RFC 1213 (MIB-2). For example, 23 indicates PPP and 28 indicates SLIP.
- Speed: The data rate in bits per second.

- MTU: The maximum packet size allowed on the interface. MTU stands for Maximum Transmission Unit.
- InPackets: The number of packets the interface has received.
- OutPackets: The number of packets the interface has transmitted.

To display the packet count at each interface broken down by type of packet:

```
ascend% show if totals
```

```
Name  --Octets----Ucast-- -NonUcast- Discard -Error- Unknown -Same IF-
ie0  i:   7813606   85121     22383       0        0       0        0
     o: 101529978   85306       149       0        0       0        0
wan0 i:         0       0         0       0        0       0        0
     o:         0       0         0       0        0       0        0
wan1 i:         0       0         0       0        0       0        0
     o:         0       0         0       0        0       0        0
wan2 i:         0       0         0       0        0       0        0
     o:         0       0         0       0        0       0        0
wanidle0 i:     0       0         0       0        0       0        0
         o:     0       0         0       0        0       0        0
lo0  i:         0       0         0       0        0       0        0
     o:         0       0         0       0        0       0        0
```

The output contains these fields:

- Name: The interface name (see Chapter 9, "Configuring IP Routing.")
- Octets: The total number of bytes processed by the interface.
- Ucast: Packets with a unicast destination address.
- NonUcast: Packets with a multicast address or a broadcast address.
- Discard: The number of packets that the interface could not process.
- Error: The number of packets with CRC errors, header errors, or collisions.
- Unknown: The number of packets the MAX forwarded across all bridged interfaces because of unknown or unlearned destinations.
- Same IF: The number of bridged packets whose destination is the same as the source.

## Displaying IP statistics and addresses

To see the supported commands:

```
ascend% show ip ?
```

```
show ip ?           Display help information
show ip stats       Display IP Statistics
show ip address     Display IP Address Assignments
show ip routes      Display IP Routes
```

**Note:** For information on the Show IP Routes command, see "Working with the IP routing table" on page 9-32.

To display statistics on IP activity, including the number of IP packets the MAX has received and transmitted:

```
ascend% show ip stats
```

```
107408 packets received.
     0 packets received with header errors.
     0 packets received with address errors.
     0 packets forwarded.
     0 packets received with unknown protocols.
     0 inbound packets discarded.
107408 packets delivered to upper layers.
 85421 transmit requests.
     0 discarded transmit packets.
     1 outbound packets with no route.
     0 reassembly timeouts.
     0 reassemblies required.
     0 reassemblies that went OK.
     0 reassemblies that Failed.
     0 packets fragmented OK.
     0 fragmentations that failed.
     0 fragment packets created.
     0 route discards due to lack of memory.
     64 default ttl.
```

To view IP interface address information:

```
ascend% show ip address
```

```
Interface   IP Address    Dest Address   Netmask         MTU     Status
ie0         10.2.3.4      N/A            255.255.255.224   1500      Up
wan0        0.0.0.0       N/A            0.0.0.0           1500    Down
wan1        13.1.2.0      13.1.2.128     255.255.255.248   1500    Down
wan2        0.0.0.0       N/A            0.0.0.0           1500    Down
wan3        0.0.0.0       N/A            0.0.0.0           1500    Down
lo0         127.0.0.1     N/A            255.255.255.255   1500      Up
rj0         127.0.0.2     N/A            255.255.255.255   1500      Up
bh0        127.0.0.3    N/A           255.255.255.255  1500      Up
```

## Displaying UDP statistics and listen table

To see the supported commands:

```
ascend% show udp ?
```

```
show udp ?          Display help information
show udp stats      Display UDP Statistics
show udp listen     Display UDP Listen Table
```

To display the number of UDP packets received and transmitted:

```
ascend% show udp stats
```

```
22386 packets received.
    0 packets received with no ports.
    0 packets received with errors.
    0 packets dropped
    9 packets transmitted.
```

To view information about the socket number, UDP port number and the number of packets queued for each UDP port on which the MAX is currently listening:

```
ascend% show udp listen
```

```
Socket       Local Port      InQLen
     0              520            0
     1                7            0
```

```
        2              123            0
        3              514            0
        4              161            0
        5              162            0
```

## Displaying TCP statistics and connections

To see the supported commands:

```
ascend% show tcp ?

show tcp ?          Display help information
show tcp stats      Display TCP Statistics
show tcp connection Display TCP Connection Table
```

To display the number of TCP packets received and transmitted:

```
ascend% show tcp stats

     0 active opens.
    11 passive opens.
     1 connect attempts failed.
     1 connections were reset.
     3 connections currently established.
 85262 segments received.
 85598 segments transmitted.
   559 segments re-transmitted.
```

An active open is a TCP session that the MAX initiated, and a passive open is a TCP session that the MAX did not initiate.

To display current TCP sessions:

```
ascend% show tcp connection

Socket       Local              Remote                      State
0            *.23               *.*                        LISTEN
1           10.2.3.23          15.5.248.121.15003      ESTABLISHED
```

## Displaying address pool status

To view the status of the MAX unit's IP address pool:

```
ascend% show pools

Pool #         Base        Count            InUse
1              10.98.1.2     55             27
2              10.5.6.1     128             0
   Number of remaining allocated addresses:    156
```

# Configuring OSPF Routing

# 10

This chapter covers these topics:

# Introduction to OSPF

OSPF (Open Shortest Path First) is the next generation Internet routing protocol. The "Open" in its name refers to the fact that OSPF was developed in the public domain as an open specification. The "Shortest Path First" refers to an algorithm developed by Dijkstra in 1978 for building a self-rooted shortest-path tree from which routing tables can be derived. This algorithm is described in "The link-state routing algorithm" on page 10-7.

## RIP limitations solved by OSPF

The rapid growth of the Internet has pushed RIP (Routing Information Protocol) beyond its capabilities, particularly in these areas:

- Distance-vector metrics

  RIP is a distance-vector protocol, which uses a hop count to select the shortest route to a destination network. RIP always uses the lowest hop count, regardless of the speed or reliability of a link.

  OSPF is a link-state protocol, which means that OSPF can take into account a variety of link conditions, such as the reliability or speed of the link, when determining the best path to a destination network.

- 15-hop limitation

  A destination that requires more than 15 consecutive hops is considered unreachable, which inhibits the maximum size of a network.

  OSPF has no hop limitation—you can add as many routers to a network as you want.

- Excessive routing traffic and slow convergence

  RIP creates a routing table and then propagates it throughout the internet of routers, hop by hop. The time it takes for all routers to receive information about a topology change is called "convergence." A slow convergence can result in routing loops and errors.

  A RIP router broadcasts its entire routing table every 30 seconds. On a 15-hop network, convergence can be as high as 7.5 minutes. In addition, a large table may require multiple broadcasts for each updates, which consumes a lot of bandwidth.

  OSPF uses a topological database of the network and propagates only changes to the database. See "Exchange of routing information" on page 10-4.

## Ascend implementation of OSPF

The primary goal of OSPF at this release is to allow the MAX to communicate with other routers within a single autonomous system (AS).

The MAX acts as an OSPF internal router with limited border router capability. At this release, we do not recommend an area border router (ABR) configuration for the MAX, so the Ethernet interface and all of the MAX WAN links should be configured in the same area.

The MAX does not function as a full AS border router (ASBR) at this release. However, ASBR calculations are performed for external routes such as WAN links that do not support OSPF. The MAX imports external routes into its OSPF database and flags them as ASE (autonomous system external). It redistributes those routes via OSPF ASE advertisements, and propagates its OSPF routes to remote WAN routers running RIP.

The MAX supports null and simple password authentication.

# OSPF features

This section provides a brief overview of OSPF routing to help you configure the MAX properly. For full details about how OSPF works, see RFC 1583, “OSPF Version 2", 03/23/1994, J. Moy.

An AS (autonomous system) is a group of OSPF routers exchanging information, typically under the control of one company. An AS can include a large number of networks, all of which are assigned the same AS number. All information exchanged within the AS is “interior.”

Exterior protocols are used to exchange routing information between autonomous systems. The are referred to by the acronym EGP (exterior gateway protocol). The AS number may be used by border routers to filter out certain EGP routing information. OSPF can make use of EGP data generated by other border routers and added into the OSPF system as ASEs, as well as static routes configured in the MAX or RADIUS.

## Security

All OSPF protocol exchanges are authenticated. This means that only trusted routers can participate in the AS's routing. A variety of authentication schemes can be used; in fact, different authentication types can be configured for each area. In addition, authentication provides added security for the routers that are on the network. Routers that do not have the password will not be able to gain access to the routing information, because authentication failure prevents a router from forming adjacencies.

## Support for variable length subnet masks

OSPF enables the flexible configuration of IP subnets. Each route distributed by OSPF has a destination and mask. Two different subnets of the same IP network number may have different sizes (different masks). This is commonly referred to as variable-length subnet masks (VLSM), or Classless Inter-Domain Routing (CIDR). A packet is routed to the best (longest or most specific) match. Host routes are considered to be subnets whose masks are “all ones” (0XFFFFFFFF).

**Note:** Although OSPF is very useful for networks that use VLSM, we recommend that you attempt to assign subnets that are as contiguous as possible in order to prevent excessive link-state calculations by all OSPF routers on the network.

## Interior gateway protocol (IGP)

OSPF keeps all AS-internal routing information within that AS. All information exchanged within the AS is “interior.”

An AS border router (ASBR) is required to communicate with other autonomous systems by using an external gateway protocol (EGP), as shown in Figure 10-1. An EGP acts as a shuttle service between autonomous systems.

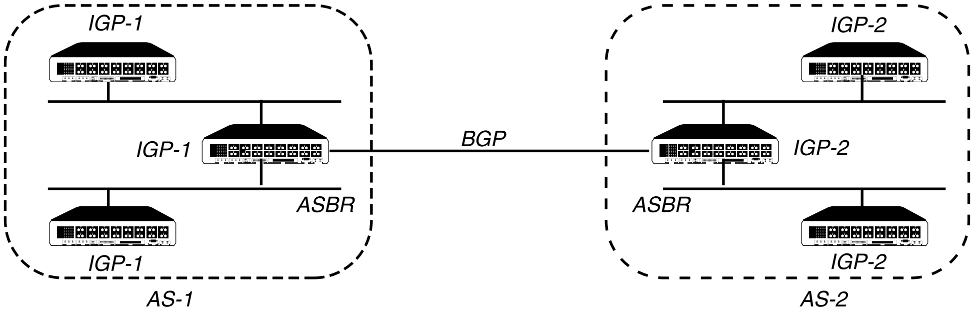


*Figure 10-1. Autonomous system border routers*

ASBRs perform calculations related to external routes. The MAX imports external routes from RIP—for example, when it establishes a WAN link with a caller that does not support OSPF—and the ASBR calculations are always performed.

**Note:** If you must prevent the MAX from performing ASBR calculations, you can disable them in Ethernet>Mod Config>OSPF Global Options.

## Exchange of routing information

OSPF uses a topological database of the network and propagates only changes to the database. Part of the SPF algorithm involves acquiring neighbors, and then forming an adjacency with one neighbor, as shown in Figure 10-2.

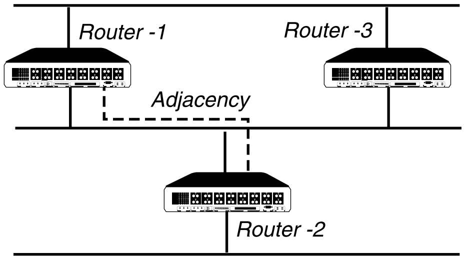


*Figure 10-2. Adjacency between neighboring routers*

An OSPF router dynamically detects its neighboring routers by sending its Hello packets to the multicast address AllSPFRouters. It attempts to form adjacencies with some of its newly acquired neighbors.

Adjacency is a relationship formed between selected neighboring routers for the purpose of exchanging routing information. Not every pair of neighboring routers become adjacent. Adjacencies are established during network initialization in pairs, between two neighbors. As the adjacency is established, the neighbors exchange databases and build a consistent, synchronized database between them.

When an OSPF router detects a change on one of its interfaces, it modifies its topological database and multicasts the change to its adjacent neighbor, which in turn propagates the change to its adjacent neighbor until all routers within an area have synchronized topological databases. This results in quick convergence among routers. OSPF routes can also be summarized in link-state advertisements (LSAs).

## Designated and backup designated routers

In OSPF terminology, a broadcast network is any network that has more than two OSPF routers attached and supports the capability to address a single physical message to all of the attached routers.

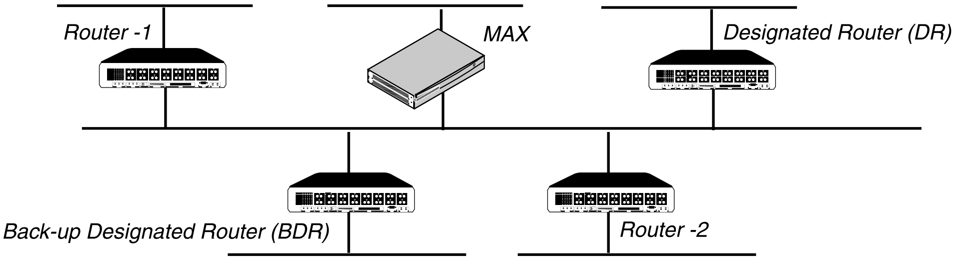


*Figure 10-3. Designated and backup designated routers*

**Note:** The MAX can function as a designated router (DR) or backup designated router (BDR). However, many sites choose to assign a LAN-based router for these roles in order to dedicate the MAX to WAN processing. The administrator chooses a DR and BDR based on the device's processing power and reliability.

To reduce the number of adjacencies each router must form, OSPF calls one of the routers the designated router. A designated router is elected as routers are forming adjacencies, and then all other routers establish adjacencies only with the designated router. This simplifies the routing table update procedure and reduces the number of link-state records in the database. The designated router plays other important roles as well to reduce the overhead of a OSPF link-state procedures. For example, other routers send link-state advertisements it to the designated router only by using the "all-designated-routers" multicast address of 224.0.0.6.

To prevent the designated router from becoming a serious liability to the network if it fails, OSPF also elects a backup designated router at the same time. Other routers maintain adjacencies with both the designated router and its backup router, but the backup router leaves as many of the processing tasks as possible to the designated router. If the designated router fails, the backup immediately becomes the designated router and a new backup is elected.

The administrator chooses which router is to be the designated router based on the processing power, speed, and memory of the system, and then assigns priorities to other routers on the network in case the backup designated router is also down at the same time.

## Configurable metrics

The administrator assigns a cost to the output side of each router interface. The lower the cost, the more likely the interface is to be used to forward data traffic. Costs can also be associated with the externally derived routing data.

The OSPF cost can also be used for preferred path selection. If two paths to a destination have equal costs, you can assign a higher cost to one of the paths to configure it as a backup to be used only when the primary path is not available.

Figure 10-4 shows how costs are used to direct traffic over high-speed links. For example, if Router-2 in Figure 10-4 receives packets destined for Host B, it will route them through Router-1 across two T1 links (Cost=20) rather than across one 56kbps B-channel to Router-3 (Cost=240).

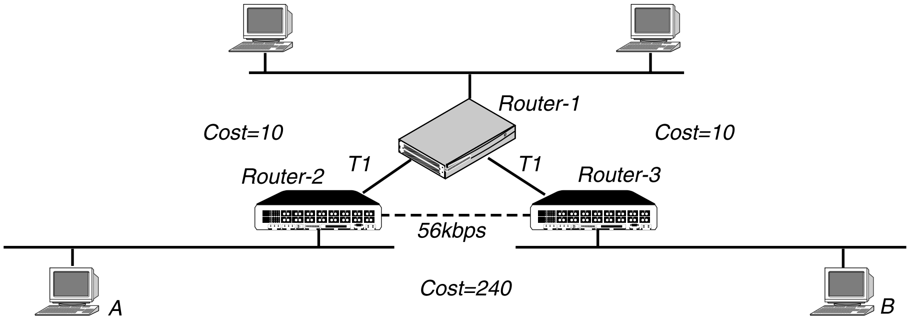


*Figure 10-4. OSPF costs for different types of links*

The MAX has a default cost of 1 for a connected route (Ethernet) and 10 for a WAN link. If you have two paths to the same destination, the one with the lower cost will be used. You may want to reflect the bandwidth of a connection when assigning costs; for example, for a single B-channel connection, the cost would be 24 times greater than a T1 link.

**Note:** Be careful when assigning costs. Incorrect cost metrics can cause delays and congestion on the network.

## Hierarchical routing (areas)

If a network is large, the size of the database, time required for route computation, and related network traffic become excessive. An administrator can partition an AS into areas to provide hierarchical routing connected by a backbone.

**Note:** The backbone area is special and always has the area number 0.0.0.0. Other areas are assigned area numbers that are unique within the autonomous system.

Each areas acts like its own network: all area-specific routing information stays within the area, and all routers within an area must have a synchronized topological database. To tie the areas together, some routers belong to an area and to the backbone area. These routers are area border routers (ABRs). In Figure 10-5, all of the routers are ABRs.

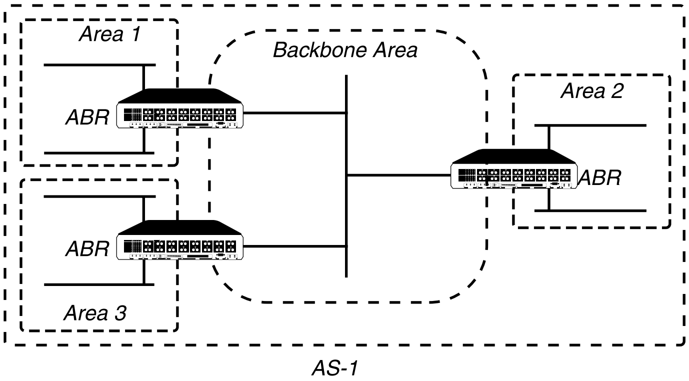


*Figure 10-5. Dividing an AS into areas*

If the ABRs and area boundaries are set up correctly, link-state databases are unique to an area.

**Note:** At this release, we recommend that you do not configure the MAX as an ABR. We currently recommend that you use the same area number for the Ethernet interface of the MAX and each of its WAN links. That are number does not have to be the backbone; the MAX can reside in any OSPF area.

## Stub areas

For areas that are connected only to the backbone by one ABR (that is, the area has one exit point), there is no need to maintain information about external routes. To reduce the cost of routing, OSPF supports sub areas, in which all external routes are summarized by a default route. Stub areas are similar to regular areas except that the routers do not enter external routes in the area's databases.

To prevent external routes from being flooded throughout the AS, you can configure areas as a stub when there is a single exit point from the area, or when the choice of exit point need not be made on a per-external-destination basis. You may need to specify a stub area with no default cost (StubNoDefault) if the area has more than one exit point.

In a stub area, routing to AS-external destinations is based on a per-area default cost. The per-area default cost is advertised to all routers within the stub area by a border router, and is used for all external destinations.

**Note:** If the MAX supports external routes across its WAN links, you should not configure it in a stub area . Because an ABR configuration is not currently recommended for the MAX, the area in which it resides should not be a stub area if any of its links are AS-external.

## The link-state routing algorithm

Link-state routing algorithms require that all routers within a domain maintain synchronized (identical) topological databases, and that the databases describe the complete topology of the domain. An OSPF router's domain may be an AS or an area within an AS.

Based on the exchange of information among routers, OSPF routers create a link-state database, which is updated based on packet exchanges among the routers. Link-state databases are synchronized between pairs of adjacent routers (see "Exchange of routing information" on page 10-4). In addition, each OSPF router uses its link-state database to calculate a self-rooted tree of shortest paths to all destinations. The routing table is built from these calculated shortest-path trees.

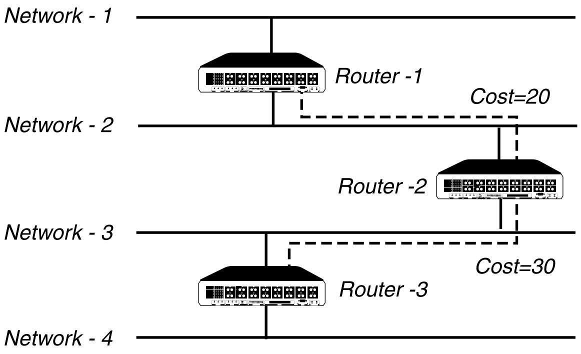


*Figure 10-6. Sample network topology*

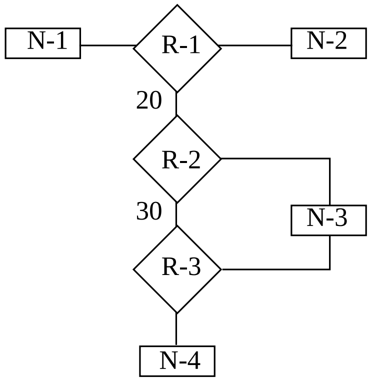
For example, the link-state databases of the three routers shown in Table 10-1, next.

*Table 10-1. Link state databases for network topology in Figure 10-6*

| **Router-1** | **Router-2** | **Router-3** |
|---|---|---|
| Network-1/Cost 0 | Network-2/Cost0 | Network-3/Cost 0 |
| Network-2/Cost 0 | Network-3/Cost0 | Network-4/Cost 0 |
| Router-2/Cost 20 | Router-1/Cost 20 | Router-2/Cost 30 |
|  | Router-3/Cost 30 |  |

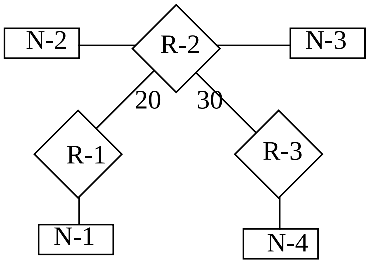
From the link-state database, each router builds a self-rooted shortest-path tree, and then calculates a routing table stating the shortest path to each destination in the AS as well as externally derived routing information. All of the routers calculate a routing table of shortest paths based on the link-state database. Externally derived routing data is advertised throughout the AS but is kept separate from the link-state data. Each external route can also be tagged by the advertising router, enabling the passing of additional information between routers on the boundary of the AS.

*Table 10-2. Shortest-path tree and resulting routing table for Router-1*



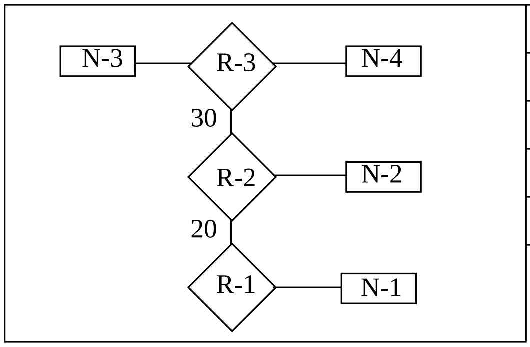
| *Destination* | *Next Hop* | *Metric* |
|---|---|---|
| Network-1 | Direct | 0 |
| Network-2 | Direct | 0 |
| Network-3 | Router-2 | 20 |
| Network-4 | Router-2 | 50 |

*Table 10-3. Shortest-path tree and resulting routing table for Router-2*



| *Destination* | *Next Hop* | *Metric* |
|---|---|---|
| Network-1 | Router-1 | 20 |
| Network-2 | Direct | 0 |
| Network-3 | Direct | 0 |
| Network-4 | Router-2 | 30 |

*Table 10-4. Shortest-path tree and resulting routing table for Router-3*



| *Destination* | *Next Hop* | *Metric* |
|---|---|---|
| Network-1 | Router-2 | 50 |
| Network-2 | Router-2 | 30 |
| Network-3 | Direct | 0 |
| Network-4 | Direct | 0 |

# Configuring OSPF routing in the MAX

These are the parameters related to OSPF routing in the MAX:

```
Ethernet
   Mod Config
      OSPF options...
         RunOSPF=Yes
         Area=0.0.0.0
         AreaType=Normal
         StubAreaDefaultCost=N/A
         HelloInterval=10
         DeadInterval=40
         Priority=5
         AuthType=Simple
         AuthKey=ascend0
         Cost=1
         ASE-type=N/A
         ASE-tag=N/A
         TransitDelay=1
         RetransmitInterval=5

      OSPF global options...
         Enable ASBR=Yes

Ethernet
   Connections
      OSPF options…
         RunOSPF=Yes
         Area=0.0.0.0
         AreaType=Normal
         StubAreaDefaultCost=N/A
         HelloInterval=40
         DeadInterval=120
         Priority=5
         AuthType=Simple
         AuthKey=ascend0
         Cost=10
         ASE-type=N/A
         ASE-tag=N/A
         TransitDelay=5
         RetransmitInterval=20
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the OSPF routing parameters

This section provides some background information about the OSPF parameters. Notice that the same configuration parameters appear Ethernet>Mod Config>OSPF Options and Ethernet>Connections>OSPF Options. The parameters are the same, but some of the default values are different.

- Enabling OSPF on an interface

  OSPF is turned off by default. To enable it on an interface, set RunOSPF to Yes.

- Specifying an area number and type

  Area sets the area ID for the interface. The format for this ID is dotted decimal, but it is not an IP address. See “Hierarchical routing (areas)” on page 10-6.

  AreaType specifies the type of area: Normal, Stub, or StubNoDefault. See “Stub areas” on page 10-7.

- Intervals for communicating with an adjacent router

  HelloInterval specifies how frequently in seconds the MAX sends out Hello packets on the. OSPF router use Hello packets to dynamically detect neighboring routers in order to form adjacencies.

  DeadInterval specifies how many seconds the MAX will wait before declaring its neighboring routers down after it stops receiving the router's Hello packets.

  See “Exchange of routing information” on page 10-4.

- Priority

  The Priority value is used to elect a designated router (DR) and backup designated router (BDR). Assigning a priority of 1 would place the MAX near the top of the list of possible designated routers. Acting as a DR or BDR significantly increases the amount of OSPF overhead for the router. See “Designated and backup designated routers” on page 10-5.

- Authentication type and key

  You can specify that the MAX supports OSPF router authentication and the key it will look for in packets to support that authentication. See “Security” on page 10-3.

- Cost of the route on this interface

  This parameter specifies the link state or output cost of a route. Be careful to assign realistic costs for each interface that supports OSPF. The lower the cost, the higher the likelihood of using that route to forward traffic. See “Configurable metrics” on page 10-5.

- ASE (autonomous system external route) type and tag

  ASEs are used only when OSPF is turned off on a particular interface. When OSPF is enabled, the ASE parameters are not applicable.

  ASE-type specifies he type of metric that the MAX advertises for external routes. A Type 1 external metric is expressed in the same units as the link-state metric (the same units as interface cost). A Type 2 external metric is considered larger than any link state path. Use of Type 2 external metrics assumes that routing between autonomous systems is the major cost of routing a packet, and eliminates the need for conversion of external costs to internal link-state metrics.

  ASE-tag is a hexadecimal number used to tag external routes for filtering by other routers.

- Transit delay

  This specifies the estimated number of seconds it takes to transmit a Link State Update Packet over this interface, taking into account transmission and propagation delays. On a connected route, you can leave the default 1.

- Retransmit interval

  This specifies the number of seconds between retransmissions of Link-State Advertisements, Database Description and Link State Request Packets.

- OSPF global option for disabling ASBR calculations

  ASBRs (autonomous system border routers) perform calculations related to external routes. The MAX imports external routes from RIP—for example, when it establishes a WAN link with a caller that does not support OSPF—and the ASBR calculations are always performed . If you must prevent the MAX from performing ASBR calculations, you can disable them in Ethernet>Mod Config>OSPF Global Options.

## Example configurations adding the MAX to an OSPF network

This section describes how to add a MAX to your OSPF network. It assumes that you know how to configure the MAX with an appropriate IP address. See Chapter 9, “Configuring IP Routing.” The examples in this section use the network diagram in Figure 10-7 to configure the unit labeled MAX-1.

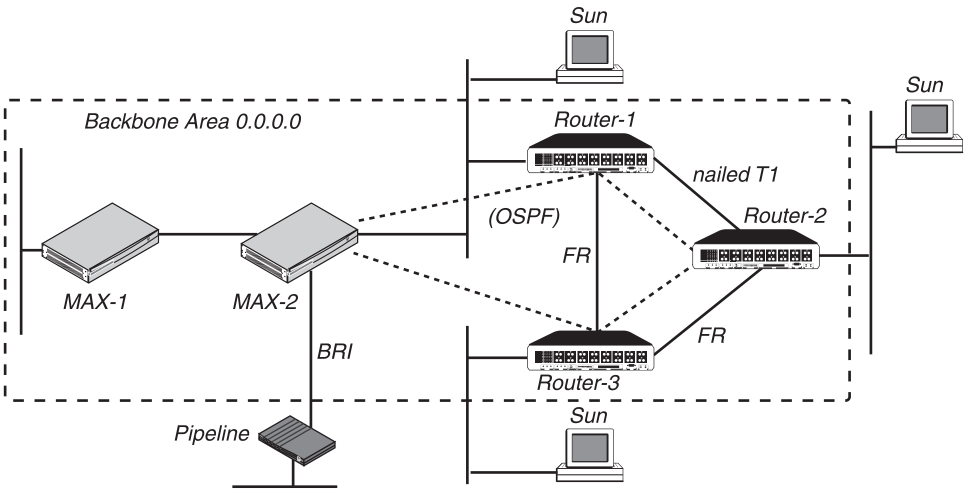


*Figure 10-7. An example OSPF setup*

In Figure 10-7, all OSPF routers are in the same area (the backbone area), so the units will all form adjacencies and synchronize their databases together.

**Note:** All OSPF routers in Figure 10-7 have RIP turned off. OSPF can learn routes from RIP without the added overhead of running RIP.

### Configuring OSPF on the Ethernet interface

The MAX Ethernet interface in the example network diagram is in the OSPF backbone area. Although there is no limitation stated in the RFC about the number of routers in the backbone area, it is recommended that you keep the number of routers relatively small, because changes that occur in area zero are propagated throughout the AS.

Another way to configure the same units would be to create a second area (such as 0.0.0.1) in one of the existing OSPF routers, and add the MAX to that area. You can then assign the same area number (0.0.0.1) to all OSPF routers reached through the MAX across a WAN link.

After you configure the MAX as an IP host on that interface, you can configure it as an OSPF router in the backbone area in the Ethernet profile. To configure the MAX as an OSPF router on Ethernet:

**1** Open Ethernet>Mod Config>Ether Options, and make sure the MAX is configured as an IP host. For example:

```
Ethernet
   Mod Config
      Ether options...
         IP Adrs=10.168.8.17/24
         2nd Adrs=0.0.0.0
         RIP=Off
         Ignore Def Rt=Yes
         Proxy Mode=Always
         Filter=0
         IPX Frame=N/A
```

Note that RIP is turned off. It isn’t necessary to run both RIP and OSPF, and it reduces processor overhead to turn RIP off. OSPF can learn routes from RIP, incorporate them in the routing table, assign them an external metric, and tag them as external routes. See Chapter 9, “Configuring IP Routing.”

**2** Open Ethernet>Mod Config>OSPF Options and turn on RunOSPF.

```
      OSPF options...
         RunOSPF=Yes
```

**3** Specify the area number and area type for the Ethernet.

```
         Area=0.0.0.0
         AreaType=Normal
         StubAreaDefaultCost=N/A
```

In this case, the Ethernet is in the backbone area. (The backbone area number is always 0.0.0.0.) The backbone area is not a stub area, so leave the setting at its default. See “Stub areas” on page 10-7 for background information.

**4** Leave the Hello interval, Dead interval, and Priority values set to their defaults.

```
         HelloInterval=10
         DeadInterval=40
         Priority=5
```

**5** If authentication is required to get into the backbone area, specify the password.

For example:

```
         AuthType=Simple
         AuthKey=ascend0
```

If authentication is not required, set AuthType=None.

**6** Configure the cost for the MAX to route into the backbone area. For example:

```
         Cost=1
```

Then type a number greater than zero and less than 16777215. By default the cost of a Ethernet connected route is 1.

**7** Set the expected transit delay for Link State Update packets. For example:

```
         TransitDelay=1
```

**8** Specify the retransmit interval for OSPF packets.

```
         RetransmitInterval=5
```

This specifies the number of seconds between retransmissions of Link-State Advertisements, Database Description and Link State Request Packets.

**9** Close the Ethernet profile.

When you close the Ethernet profile, the MAX comes up as an OSPF router on that interface. It forms adjacencies and begins building its routing table.

## Configuring OSPF across the WAN

The WAN interface of the MAX is a point-to-point network. A point-to-point network is any network that joins a single pair of routers. These networks typically do not provide a broadcasting or multicasting service, so all advertisements are sent point to point.

An OSPF WAN link has a default cost of 10. You can assign higher costs to reflect a slower connection or lower costs to set up a preferred route to a certain destination. If the cost of one route is lower than another to the same destination, the higher-cost route will not be used unless route preferences change that equation (see “Route preferences” on page 10-18).

OSPF on the WAN link is configured in a Connection profile. In this example, the MAX is connecting to another MAX unit across a T1 link (see Figure 10-7 on page 10-11). To configure this interface:

**1** Open the Connection profile for the remote MAX unit.

**2** Turn on Route IP and configure the IP routing connection. For example:

```
Ethernet
   Connections
      IP options…
         LAN Adrs=10.2.3.4/24
         WAN Alias=0.0.0.0
         IF Adrs=0.0.0.0
         Metric=7
         Preference=N/A
         Private=No
         RIP=Off
        Pool=0
```

See Chapter 9, “Configuring IP Routing.”

**3** Open Connections>OSPF Options and turn on RunOSPF.

```
      OSPF options…
         RunOSPF=Yes
```

**4** Specify the area number for the remote device and the area type.

The area number must always be specified in dotted-quad format similar to an IP address. For example:

```
         Area=0.0.0.0
         AreaType=Normal
         StubAreaDefaultCost=N/A
```

At this release, we recommend that you use the same area number for the Ethernet interface of the MAX and each of its WAN links. In this example, the Ethernet interface is in the backbone area (0.0.0.0). You can use any area numbering scheme that is consistent throughout the AS and uses this format.

**5** Leave the Hello interval, Dead interval, and Priority values set to their defaults.

```
HelloInterval=40
DeadInterval=120
Priority=5
```

The Priority value is used to configure the MAX as a DR or BDR.

**6** If authentication is required to get into the backbone area, specify the password.

For example:

```
AuthType=Simple
AuthKey=ascend0
```

If authentication is not required, set AuthType=None.

**7** Configure the cost for the route to MAX-2.

For example, for a T1 link the cost should be at least 10.

```
Cost=10
```

**8** Close the Connection profile.

**Note:** Of course, the remote MAX unit must also have a comparable Connection profile to connect to MAX-1.

## Configuring a WAN link that doesn't support OSPF

In this example, the MAX has a Connection profile to a remote Pipeline unit across a BRI link (see Figure 10-7 on page 10-11). The remote Pipeline is an IP router that transmits routes using RIP-v2. The route to this network, as well as any routes the MAX learns about from the remote Pipeline, are ASEs (external to the OSPF system).

**Note:** To enable OSPF to add the RIP-v2 routes to its routing table, configure RIP-v2 normally in this Connection profile. OSPF will import all RIP routes as Type-2 ASEs.

In this example, RIP is turned off on the link and ASE information is configured explicitly.

**1** Open the Connection profile for the remote Pipeline unit.

**2** Turn on Route IP and configure the IP routing connection. For example:

```
Ethernet
   Connections
      IP options…
         LAN Adrs=10.2.3.4/24
         WAN Alias=0.0.0.0
         IF Adrs=0.0.0.0
         Metric=7
         Preference=N/A
         Private=No
         RIP=Off
         Pool=0
```

See Chapter 9, "Configuring IP Routing." Note that Connections>OSPF Options includes two ASE parameters that are active only when OSPF is *not* running on a link. When you configure these parameters, the Connection profile route will be advertised whenever the MAX is up.

**3** Open the OSPF Options subprofile.

**4** Leave RunOSPF set to No.

```
OSPF options…
   RunOSPF=No
```

**5** Configure the cost for the route to the remote Pipeline.

For example, for a single-channel BRI link could have a cost approximately 24 times the cost of a dedicated T1 link:

```
Cost=240
```

**6** Specify the ASE-type metric for this route.

```
ASE-type=Type 2
```

`ASE-type=Type 2`

This specifies the type of metric to be advertised for an external route.

A Type 1 external metric is expressed in the same units as the link state metric (the same units as interface cost). Type 1 is the default.

A Type 2 external metric is considered larger than any link state path. Use of Type 2 external metrics assumes that routing outside the AS is the major cost of routing a packet, and eliminates the need for conversion of external costs to internal link state metrics.

**7** Enter an ASE-tag for this route.

The ASE-tag is a hexadecimal number that shows up in management utilities and “flags” this route as external. It may also be used by border routers to filter this record. For example:

```
ASE-tag=cfff8000
```

**8** Close the Connection profile.

**Note:** Of course, the remote MAX unit must also have a comparable Connection profile to connect to MAX-1.

# Administering OSPF

This section describes how to work with OSPF information in the routing table and how to monitor OSPF activity in the terminal server command-line interface.

To invoke the terminal-server interface, select System>Sys Diag>Term Serv and press Enter.

## Working with the routing table

The OSPF routing table includes routes built from the router’s link-state database as well as those added by external routing protocols such as RIP. You can also add routes statically, for example, to direct traffic destined for a remote site through one of several possible border routers. For details on adding static routes, for example, if you want to force the use of one route over those learned from OSPF, see Chapter 9, “Configuring IP Routing.”.

To view the IP routing table with added OSPF information, invoke the terminal-server (System>Sys Diag>Term Serv) and use the Iproute Show command with the –l option:

```
ascend% iproute show -l
```

In addition to the standard routing-table fields, which are described in Chapter 9, “Configuring IP Routing,” the following three columns are specific to OSPF and are displayed only when you use the –l option. These OSPF-specific columns are displayed on the far right of each entry in the routing table:

```
    ...     Cost        T           Tag
    ...     1           0           0xc0000000
    ...     9           1           0xc8000000
    ...     10          0           0xc0000000
    ...     9           1           0xc8000000
    ...     1           1           0xc0000000
    ...     3           1           0xc8000000
    ...     9           1           0xc8000000
    ...     4           1           0xc8000000
    ...     5           1           0xc8000000
    ...     3           1           0xc8000000
    ...     3           1           0xc8000000
    ...     3           1           0xc8000000
```

- Cost

  The cost of an OSPF route. The interpretation of this cost depends on type of external metric type, displayed in the next column. If the MAX is advertising Type 1 metrics, OSPF can use the specified number as the cost of the route. Type 2 external metrics are an order of magnitude larger.

- T

  The ASE-type of metric to be advertised for an external route. 0 in this column means that it is an external-type-1 or an OSPF internal route. If this column shows a 1, it means that the route is an external-type-2 route.

- Tag

  This column specifies a 32-bit hexadecimal number attached to each external route to “tag” it as external to the AS. This number may be used by border routers to filter this record.

## Multipath routing

A MAX running OSPF can alternate between two equal cost gateways.  When OSPF detects more than one equally good gateway, in terms of routing costs, each equal-cost gateway is put on an equal-cost list. The router will alternate between all the gateways on the list. This is called equal-cost multipath routing.

For example, if a router A has two equal-cost routes to example.com, one via router B and the other via router C, the routing table could look like this:

```
Destination       Gateway        IF       Flg   Pref Met    Use     Age

10.174.88.0/25    10.174.88.12    wan2     OGM     10  10      52      19
10.174.88.0/25    10.174.88.13    wan3     OGM     10  10      52      19
10.174.88.12/32   10.174.88.12    wan2     OG      10  10       0      28
10.174.88.13/32   10.174.88.13    wan3     OG      10  10       0      28
192.168.253.0/24   -              ie0      C        0   0       1      49
192.168.253.6/32   -              lo0      CP       0   0      53      49
223.1.1.0/24       10.174.88.12   wan2     OG      10  10       0      19
223.5.1.0/24       10.174.88.12   wan2     OG      10  10       0      19
223.12.9.0/24      10.174.88.12   wan2     OG      10  10       0      19
255.255.255.255/32 -             ie0      CP      0   0      0      49
```

Note that the “M” in the Flags column indicates an equal-cost multipath. A Traceroute from A to example.com would look like this:

```
ascend% traceroute -q 10 example.com
```

```
traceroute to example.com (10.174.88.1), 30 hops max, 0 byte packets
```

```
1 C.example.com (10.174.88.13) 20 ms B .example.com (10.174.88.12) 20
ms C.example.com (10.174.88.13) 20 ms B .example.com (10.174.88.12) 20
ms  20 ms C.example.com (10.174.88.13)  60 ms  20 ms B .example.com
(10.174.88.12) 20 ms C.example.com (10.174.88.13) 20 ms B .example.com
(10.174.88.12)  20 ms
```

```
2 example.com (10.174.88.1) 20 ms 20 ms 20 ms 20 ms 30 ms 20 ms 20
ms  30 ms  20 ms  30 ms
```

**Note:** Notice the alternating replies. The replies are statistically dispatched to B and C, with roughly 50% of the packets sent through each gateway. For background information on the routing table and on the Traceroute command, see Chapter 9, “Configuring IP Routing.”

## Third-party routing

A MAX running OSPF can advertise routes to external destinations on behalf of another gateway (a “third-party”). This is commonly known as advertising a forwarding address. Depending on the exact topology of the network, it may be possible for other routers to use this type of LSA and route directly to the forwarding address without involving the advertising MAX, increasing the total network throughput.

Third-party routing requires that all OSPF routers know how to route to the forwarding address. This will usually mean that the forwarding address must be on an Ethernet that has an OSPF router acting as the forwarding router, or that designated router is sending LSAs for that Ethernet to any area that sees the static route's forwarding address LSAs. To configure a static route for OSPF to advertise a third-party gateway:

**1** Open a static route in Ethernet>Static Rtes.

**2** Set Third-Party to Yes.

**3** Set the Gateway to the forwarding address.

```
Ethernet
   Static Rtes
      Name=third-party
      Silent=No
      Active=Yes
      Dest=10.212.65.0/24
      Gateway=101.2.3.4
      Metric=3
      Preference=100
      Private=No
      Ospf-Cost=1
      ASE-Type=Type1
      ASE-tag=c00000000
      Third-Party=Yes
```

**4** Close the static route.

## How OSPF adds RIP routes

When the MAX establishes an IP routing connection with a caller that does not support OSPF, it imports the AS-external route from the Connection profile and adds it to the routing table. The MAX does not have to run RIP to learn these routes. RIP should be turned off when the MAX is running OSPF.

To enable OSPF to add the RIP-v2 routes to its routing table, configure RIP-v2 normally in this Connection profile. OSPF will import all RIP routes as Type-2 ASEs. The reason why RIP routes are imported with Type-2 metrics by default is that RIP metrics are not directly comparable to OSPF metrics. To prevent OSPF from interpreting RIP metrics, we assign the imported ASE route a Type-2 metric, which means that it is so large compared to OSPF costs that the metric can be ignored.

## Route preferences

Route preferences provide additional control over which types of routes take precedence over others. They are necessary in a router which speaks multiple routing protocols, largely because RIP metrics are not comparable with OSPF metrics.

For each IP address and netmask pair, the routing table holds one route per protocol, where the protocols are defined as follows:

- Connected routes, such as Ethernet, have a Preference=0.
- Routes learned from ICMP Redirects have a Preference=30.
- Routes placed in the table by SNMP MIB II have a Preference=100.
- Routes learned from OSPF have a default Preference=10.
  You can modify the default in Ethernet>Mod Config>Route Pref.
- Routes learned from RIP have a default Preference=100.
  You can modify the default in Ethernet>Mod Config>Route Pref.
- A statically configured IP Route or Connection profile has a default Preference=100.
  You can modify the default in the Connection or IP Route profile.

When choosing which routes should be put in the routing table, the router first compares the Preference value, preferring the lower number. If the Preference values are equal, the router then compares the Metric field, using the route with the lower Metric.

If multiple routes exist for a given address and netmask pair, the route with the lower Preference is better. If two routes have the same Preference, then the lower Metric is better. The best route by these criteria is actually used by the router. The others remain latent or “hidden”, and are used in case the best route was removed.

To assign a WAN link the same preference as a route learned from OSPF:

**1** Open Connections>IP Options.

**2** Specify a preference value of 10 (the default value for OSPF routes). For example:

```
Ethernet
   Connections
      IP options…
         LAN Adrs=10.9.8.10/22
         WAN Alias=0.0.0.0
         IF Adrs=0.0.0.0
         Metric=5
         Preference=10
         Private=No
         RIP=Off
         Pool=0
```

**3** Close the Connection profile.

On Ethernet, the route preferences also include ASE type and ASE tag information for routes learned from RIP. These values affect all RIP information learned across the Ethernet. To change the route preferences on Ethernet:

**1** Open Ethernet>Mod Config>Route Pref.

**2** Modify the parameters to adjust preference values. For example, to assign static routes the same preference value as those learned from OSPF:

```
Ethernet
   Mod Config
      Route prefs...
         Static Preference=10
         Rip Preference=100
         RipAseType=Type2
         Rip Tag=c8000000
         OSPF Preference=10
```

Or, to change RIP metrics to Type 1:

```
Ethernet
   Mod Config
      Route prefs...
         Static Preference=100
         Rip Preference=100
         RipAseType=Type1
         Rip Tag=c8000000
         OSPF Preference=10
```

**3** Close the Ethernet profile.

# Monitoring OSPF

The terminal server command-line interface provides commands for monitoring OSPF in the MAX. To see the options, invoke the terminal server interface (System>Sys Diag>Term Serv) and use the Show OSPF command; for example:

```
ascend% show ospf ?

show ospf ?              Display help information
show ospf errors         Display OSPF errors
show ospf areas          Display OSPF areas
show ospf general        Display OSPF general info
show ospf interfaces     Display OSPF interfaces
show ospf lsdb           Display OSPF link-state DB
show ospf lsa            Display OSPF link-state advertisements
show ospf nbrs           Display OSPF neighbors
show ospf rtab           Display OSPF routing tab
show ospf io             Display OSPF io
```

## Viewing OSPF errors

To see OSPF errors, type:

```
   ascend% show ospf errors
```

```
ERRORS from:                       boot
   0: IP: Bad OSPF pkt type             0: IP: Bad IP Dest
   0: IP: Bad IP proto id               1: IP: Pkt src = my IP addr
   0: OSPF: Bad OSPF version            0: OSPF: Bad OSPF checksum
   0: OSPF: Bad intf area id            0: OSPF: Area mismatch
   0: OSPF: Bad virt link info          0: OSPF: Auth type != area type
   0: OSPF: Auth key != area key        0: OSPF: Packet is too small
   0: OSPF: Packet size > IP length     0: OSPF: Transmit bad
   0: OSPF: Received on down IF         0: Hello: IF mask mismatch
   0: Hello: IF hello timer mismatch    0: Hello: IF dead timer mismatch
   0: Hello: Extern option mismatch     0: Hello: Nbr Id/IP addr confusion
   0: Hello: Unknown Virt nbr           0: Hello: Unknown NBMA nbr
   0: DD: Unknown nbr                   0: DD: Nbr state low
   0: DD: Nbr's rtr = my rtrid          0: DD: Extern option mismatch
   0: Ack: Unknown nbr                  0: Ack: Nbr state low
   0: Ls Req: Nbr state low             0: Ls Req: Unknown nbr
   0: Ls Req: Empty request             0: LS Req: Bad pkt
   0: LS Update: Nbr state low          0: Ls Update: Unknown nbr
   0: Ls Update: Newer self-gen LSA     0: Ls Update: Bad LS chksum
   0: Ls Update: less recent rx         0: Ls Update: Unknown type
```

The output lists all error messages related to OSPF, with each message preceded by the number of times it has been generated since the MAX powered up. Immediately following the number is a field indicating the packet type:

- IP (IP packets)
- OSPF (OSPF packets)
- Hello (Hello packets)
- DD (Database Description packets, which are exchanged periodically between neighbors)
- Ack (every DD packet must be acknowledged)
- LS Req (Link-state request— a request for an updated database)
- LS Update (An exchange to update databases)

## Viewing OSPF areas

To view information about OSPF areas, type:

```
   ascend% show ospf areas

   Area ID: 0.0.0.0
   Auth Type: Simple Passwd  Import ASE: On  Spf Runs: 23
   Local ABRs: 0  Local ASBRs: 5  Inter LSAs: 7  Inter Cksum sum: 0x2ee0e
```

- Area ID specifies the area number in dotted-decimal format.
- The Auth Type field states the type of authentication, simple or null.
- Import ASE relates to the way routes are calculated, in effect, it specifies whether the router is an ABR or not. This functionality is always ON in the MAX.

- Spf Runs show how many times the SPF calculation was run. The calculation is performed every time the router notes a topology change or receives an update from another router.
- Local ABRs shows the number of ABRs the router knows about and the number of areas. The number 0 means that the router knows about the backbone area only.
- Local ASBRs shows the number of ASBRs the router knows about.
- Inter LSAs shows the number of entries in the link-state database.
- Inter Cksum sum shows the checksum that is used to note that a database has changed.

## Viewing OSPF general info

To see general information about OSPF, type:

```
ascend% show ospf general

Rtr ID: 10.5.2.154
    Status: Enabled Version: 2 ABR: Off ASBR: On
    LS ASE Count: 8 ASE Cksum sum: 0x4c303 Tos Support: TOS 0 Only
    New LSA Originate Count: 13  Rx New LSA Count: 498
```

- The Rtr ID field contains the MAX IP address (the IP address assigned to the MAX Ethernet interface).
- Status shows whether OSPF is enabled or disabled.
- Version is the version of the OSPF protocols running.
- ABR can be on or off, depending on where the MAX is situated on the network. If ABR is on, the MAX performs additional calculations related to external routes.
- ASBR is always on in the MAX. Although the MAX cannot function as an IGP gateway, it does import external routes— for example, when it establishes a WAN link with a caller that does not support OSPF—and the ASBR calculations are always performed.
- LS ASE count specifies the number of link-state database entries that are external.
- ASE Cksum sum specifies a checksum that is used to note that ASE routes in the database have changed.
- TOS Support shows the level of TOS support in the router.
- New LSA Originate Count shows the number of LSAs this router created.
- Rx New LSA Count shows the number of LSAs this router received from other OSPF routers.

To display the OSPF interfaces, type:

```
    ascend% show ospf interfaces

Area      IP Address   Type   State    Cost   Pri  DR           BDR
---------------------------------------------------------------------------
0.0.0.0   10.5.2.154   Bcast  BackupDR   1    5    10.5.2.155   10.5.2.154
0.0.0.0   10.5.2.154   PtoP   P To P     10   5    None         None
0.0.0.0   10.5.2.154   PtoP   P To P     10   5    None         None
```

- The Area field shows the area ID (0.0.0.0 is the backbone).
- IP Address shows the address assigned to the interface. In the MAX, the IP address is always the address assigned to the Ethernet interface. To identify WAN links, use the Type and Cost fields.
- Type can be broadcast or point-to-point. WAN links are point-to-point.

- State shows how far along the router is in the election process of a DR or BDR. The state may be 1-way (indicating that the election process has begun), 2-way (indicating that the router has received notification), BackupDR, or DR.
- Cost is the metric assigned to the link. The default cost for Ethernet is 1.
- Pri shows the designated router election priority assigned to the MAX.
- DR identifies the designated router.
- BDR identifies the backup designated router.

## Viewing the OSPF link-state database

To view the router’s link-state database, type:

```
ascend% show ospf lsdb
```

**Note:** You can expand each entry in the link-state database to view additional information about a particular LSA. See “Viewing OSPF link-state advertisements” on page 10-23.

```
LS Data Base:
Area         LS Type Link ID       Adv Rtr       Age  Len Seq #    Metric
-----------------------------------------------------------------------
0.0.0.0      STUB    10.5.2.146    10.5.2.146    3600 24  0        0
0.0.0.0      STUB    10.5.2.154    10.5.2.154    3600 24  0        0
0.0.0.0      STUB    10.5.2.155    10.5.2.155    3600 24  0        0
0.0.0.0      STUB    10.5.2.162    10.5.2.162    3600 24  0        0
0.0.0.0      STUB    10.5.2.163    10.5.2.163    3600 24  0        0
0.0.0.0      RTR     10.5.2.146    10.5.2.146    659  72  8000003e 0
0.0.0.0      RTR     10.5.2.154    10.5.2.154    950  84  8000000a 0
0.0.0.0      RTR     10.5.2.155    10.5.2.155    940  60  80000005 0
0.0.0.0      RTR     10.5.2.162    10.5.2.162    980  84  8000003b 0
0.0.0.0      RTR     10.5.2.163    10.5.2.163    961  60  80000005 0
0.0.0.0      NET     10.5.2.155    10.5.2.155    940  32  80000003 0
0.0.0.0      NET     10.5.2.163    10.5.2.163    961  32  80000003 0
0.0.0.0      ASE     10.5.2.16     10.5.2.163    18   36  80000098 3
0.0.0.0      ASE     10.5.2.18     10.5.2.163    546  36  80000004 10
0.0.0.0      ASE     10.5.2.144    10.5.2.146    245  36  80000037 1
0.0.0.0      ASE     10.5.2.152    10.5.2.154    536  36  80000006 1
0.0.0.0      ASE     10.5.2.152    10.5.2.155    526  36  80000004 1
0.0.0.0      ASE     10.5.2.152    10.5.2.163    18   36  80000097 9
0.0.0.0      ASE     10.5.2.155    10.5.2.163    17   36  80000097 9
0.0.0.0      ASE     10.5.2.160    10.5.2.162    568  36  80000037 1
```

- The Area field shows the area ID.
- The LS Type shows the type of link as defined in RFC 1583:

  Type 1 (RTR) are router-LSAs that describe the collected states of the router's interfaces.

  Type 2 (NET) are network-LSAs that describe the set of routers attached to the network.

  Types 3 and 4 (STUB) are summary-LSAs that describe point-to-point routes to networks or AS boundary routers.

  Type 5 (ASE) are AS-external-LSAs that describe routes to destinations external to the Autonomous System. A default route for the Autonomous System can also be described by an AS-external-LSA.
- Link ID is the target address of the route.

- Adv Rtr is the address of the advertising router.
- Age is the age of the route in seconds.
- Len is the length of the LSA.
- Seq # is a number that begins with 80000000 and increments by one for each LSA received.
- Metric is the cost of the link, not of a route. The cost of a route is the sum of all intervening links, including the cost of the connected route.

## Viewing OSPF link-state advertisements

To view additional information about an LSA in the link-state database, first display the database as described in the preceding section. You can specify an LSA to expand using this format:

```
show ospf lsa area ls-type ls-id adv-rtr
```

This command requires that you include the first four fields of the LSA as listed in the database. You can select the first four fields and paste them in after typing the command, for example, to see an expanded view of the last entry in the link-state database shown in the previous section:

```
ascend% show ospf lsa 0.0.0.0 ase 10.5.2.160 10.5.2.162
```

```
LSA  type: ASE ls id: 10.5.2.160 adv rtr: 110.5.2.162 age: 568
          len: 36 seq #: 80000037 cksum: 0xfffa
          Net mask: 255.255.255.255 Tos 0 metric: 10 E type: 1
          Forwarding Address: 0.0.0.0 Tag: c0000000
```

## Viewing OSPF neighbors

To view adjacencies, type:

```
ascend% show ospf nbrs
```

```
Area       Interface     Router Id     Nbr IP Addr   State      Mode   Pri
---------------------------------------------------------------------------
0.0.0.0    10.5.2.154    10.5.2.155    10.5.2.155    Full       Slave  5
0.0.0.0    10.5.2.154    10.5.2.146    10.5.2.146    Full       Master 5
0.0.0.0   10.5.2.154    10.5.2.162   10.5.2.162   Full      Slave  5
```

- Area is the area ID.
- Interface shows the address assigned to the interface. In the MAX, the IP address is always the address assigned to the Ethernet interface.
- Router Id is the IP address of the router used to reach a neighbor. This is often the same address as the neighbor itself.
- Nbr IP Addr is the IP address of the neighbor.
- State indicates the state of the link-state database exchange. Full means that the databases are fully aligned between the MAX and its neighbor.
- Mode indicates whether the neighbor is functioning in master or slave mode. The master sends Database Description packets (polls) which are acknowledged by Database Description packets sent by the slave (responses).
- Pri shows the designated router election priority assigned to the MAX.

## Viewing the OSPF routing table

To view the OSPF routing table, type:

```
   ascend% show ospf rtab
```

```
SPF algorithm run 24 times since                       boot
Dest          D_mask          Area    Cost E Path Nexthop AdvRtr      L
---------------------------------------------------------------------------
Nets:
10.5.2.163   255.255.255.248  0.0.0.0  10  3 EXT  10.5.2.163 10.5.2.163 0
10.5.2.163   255.255.255.255  0.0.0.0  20  0 EXT  10.5.2.163 10.5.2.163 0
10.5.2.146   255.255.255.248  0.0.0.0  20  1 EXT  10.5.2.154 10.5.2.146 0
10.5.2.146   255.255.255.255  0.0.0.0  20  0 STUB 10.5.2.154 10.5.2.146 0
10.5.2.155   255.255.255.248  0.0.0.0  10  0 INT  10.5.2.154 10.5.2.155 1
10.5.2.154   255.255.255.255  0.0.0.0  21  0 STUB 10.5.2.163 10.5.2.154 0
10.5.2.155   255.255.255.255  0.0.0.0  20  9 STUB 10.5.2.155 10.5.2.155 1
10.5.2.163   255.255.255.248  0.0.0.0  11  1 INT  10.5.2.163 10.5.2.163 0
10.5.2.162   255.255.255.255  0.0.0.0  20  0 STUB 10.5.2.163 10.5.2.162 0
10.5.2.163  255.255.255.255 0.0.0.0  10  0 STUB 10.5.2.163 10.5.2.163 0
```

- The Dest field shows the destination address.
- D_mask is the destination netmask.
- Area is the area ID.
- Cost is the cost of the route.
- E is the cost of the link. (The cost of a route is the sum of the cost of each intervening link, including the cost to the connected route.)
- Path specifies the type of link: EXT (exterior), INT (interior), or STUB (a default).
- Next hop specifies the target address from this router.
- Adv Rtr is the advertising router. Sometimes a router will advertise routes for which it is not the gateway.

## Viewing OSPF protocol i/o

To display information about packets sent and received by the OSPF protocol, type:

```
   ascend% show ospf io
```

```
   IO stats from:                       boot
   >> RECEIVED:
          0: Monitor request
        785: Hello
         13: DB Description
          6: Link-State Req
       1387: Link-State Update
         64: Link-State Ack
   >> SENT:
        794: Hello
         15: DB Description
          6: Link-State Req
       1017: Link-State Update
        212: Link-State Ack
```

# Setting Up IP Multicast Forwarding

# 11

This chapter covers these topics:

# Configuring multicast forwarding

The multicast backbone (MBONE) is a virtual network layered on top of the Internet to support IP multicast routing across point-to-point links. It is used for transmitting audio and video on the Internet in real-time, because multicasting is a much cheaper and faster way to communicate the same information to multiple hosts.

To the MBONE, the MAX looks like a multicast client. It responds as a client to IGMP (Internet Group Membership Protocol) packets it receives from MBONE routers, which may be IGMP version-1 or version-2, including IGMP MTRACE (multicast trace) packets.

To multicast clients on a WAN or Ethernet interface, the MAX looks like a multicast router. Like a router, it sends those clients IGMP queries, receives responses, and forwards multicast traffic. In this implementation, multicast clients are not allowed to source multicast packets—if they do, the MAX discards the packets.

These are the parameters for configuring multicast forwarding:

```
Ethernet
   Mod Config
      Multicast...
         Forwarding=Yes
         Mbone Profile=
         Client=No
         Rate Limit=5
         HeartBeat Addr=224.0.1.1
         HeartBeat Udp Port=123
         HeartBeat Slot Time=10
         HeartBeat Slot Count=10
         Alarm threshold=3
         Source Addr=128.232.0.0
         Source Mask=0.0.0.0
Ethernet
   Connections
       Ip options...
         Multicast Client=No
         Multicast Rate Limit=5
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the multicast parameters

This section provides some background information about multicast parameters.

- Enabling multicast forwarding

  The Forwarding parameter turns on multicast forwarding in the MAX.

  **Note:** When you change the Forwarding parameter from No to Yes, the multicast subsystem reads the values in the Ethernet profile and initiates the forwarding function. If you modify a multicast value in the Ethernet profile, you must set this parameter to No and then set it to Yes again to force a read of the new value.

- Specifying the MBONE interface

  The MBONE interface is where the multicast router resides. If it resides across the WAN, the Mbone Profile parameter must specify the name of a resident Connection profile to that router. If the Mbone Profile name is null and Multicast Forwarding is turned on, the MAX assumes that its Ethernet is the MBONE interface.

- Monitoring the multicast heartbeat

  When it is running as a multicast forwarder, the MAX is continually receiving multicast traffic. The heartbeat-monitoring feature enables the administrator to monitor possible connectivity problems by continuously polling for this traffic and generating an SNMP alarm trap if there is a traffic breakdown. This is the SNMP alarm trap:

```
Trap type: TRAP_ENTERPRISE
Code: TRAP_MULTICAST_TREE_BROKEN (19)
Arguments:
1) Multicast group address being monitored (4 bytes),
2) Source address of last heartbeat packet received (4 bytes)
3) Slot time interval configured in seconds (4 bytes),
4) Number of slots configured (4 bytes).
5) Total number of heartbeat packets received before the MAX
started sending SNMP Alarms (4bytes).
```

  **Note:** Heartbeat monitoring is optional. It is not required for multicast forwarding.

  To set up heartbeat monitoring, you configure several parameters that define what packets will be monitored, how often and for how long to poll for multicast packets, and the threshold for generating an alarm. These are the related parameters:

  – What packets will be monitored

    HeartBeat Addr specifies a multicast address. If specified, the MAX listens for packets to and from this group.

    HeartBeat Udp Port specifies a UDP port number. If specified, the MAX listens only to packets received on that port.

    Source Addr and Source Mask specify an IP address and netmask. If specified, the MAX ignores packets from that source for monitoring purposes.

  – How often and for how long to poll for multicast packets

    HeartBeat Slot Time specifies an interval (in seconds). The MAX polls for multicast traffic, waits for this interval, and then polls again.

    HeartBeat Slot Count specifies how many times to poll before comparing the number of heartbeat packets received to the Alarm Threshold.

  – The threshold for generating an alarm

    Alarm Threshold specifies a number. If the number of monitored packets falls below this number, the SNMP alarm trap is sent.

- Configuring multicast forwarding on a client interface

  Each local or WAN interface that supports multicast clients must set the Client (or Multicast Client) parameter to Yes. With this setting, the MAX begins handling IGMP requests and responses on the interface. It does not begin forwarding multicast traffic until the rate limit is set.

  The Rate Limit specifies the rate at which the MAX accepts multicast packets from its clients. It does not affect the MBONE interface.

  **Note:** By default, the Rate Limit parameter is set to 100. This disables multicast forwarding on the interface. The forwarder handles IGMP packets, but does not accept packets from clients or forward multicast packets from the MBONE router.

To begin forwarding multicast traffic on the interface, you must set the Rate Limit parameter to a number less than 100. For example if you set it to 5, the MAX accepts a packet from multicast clients on the interface every 5 seconds. Any subsequent packets received in that 5-second window are discarded.

- An implicit priority setting for dropping multicast packets

  For high-bandwidth data, voice, and audio multicast applications, the MAX supports both multicast rate limiting (described immediately above) and prioritized packet dropping. If the MAX is the receiving device under extremely high loads, it drops packets according to a priority ranking, which is determined by these UDP port ranges:

  – Traffic on ports 0–16384 (unclassified traffic) has the lowest priority (50).

  – Traffic on ports 16385–32768 (Audio traffic) has the highest priority (70).

  – Traffic on ports 32769–49152 (Whiteboard traffic) has medium priority (60).

  – Traffic on ports 49153–65536 (Video traffic) has low priority (55).

## Multicast forwarding from an MBONE router on Ethernet

Figure 11-1 shows a local multicast router on one of the MAX unit's Ethernet interfaces and dial-in multicast clients.

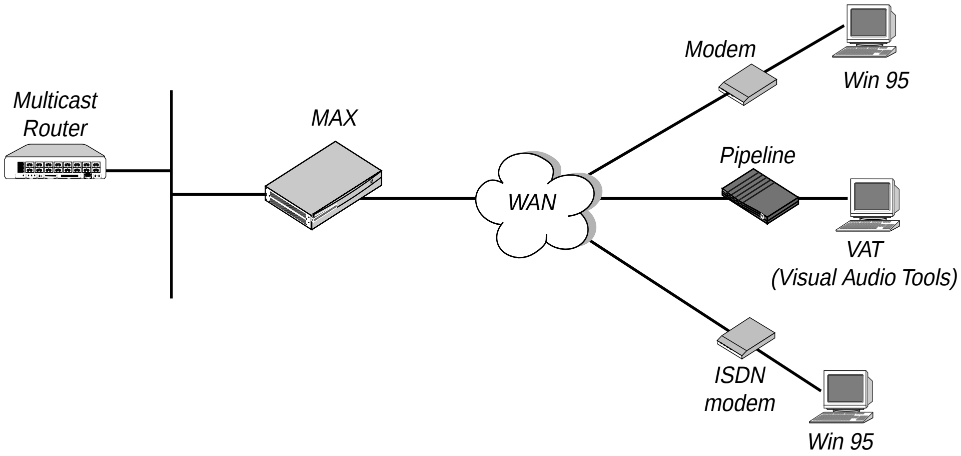


*Figure 11-1. MAX forwarding multicast traffic to dial-in multicast clients*

**Note:** Heartbeat monitoring is an optional feature. You can operate multicast forwarding without it if you prefer.

This sample profile specifies the MBONE interface as the Ethernet port, and uses the heartbeat group address of 224.1.1.1:

1. Open Ethernet>Mod Config>Multicast.
2. Enable multicast forwarding, and leave the default values for the Mbone profile, Client, and Rate Limit parameters.

```
Ethernet
   Mod Config
      Multicast...
         Forwarding=Yes
```

```
Mbone Profile=
Client=No
Rate Limit=5
```

3 Specify a heartbeat group address and UDP port for monitoring heartbeat packets.

```
HeartBeat Addr=224.1.1.1
HeartBeat Udp Port=16387
```

4 Specify the time, count, and alarm threshold parameters.

```
HeartBeat Slot Time=10
HeartBeat Slot Count=10
Alarm threshold=3
Source Addr=0.0.0.0
Source Mask=0.0.0.0
```

5 Close the Ethernet profile.

To enable multicasting on WAN interfaces:

1 Open the Connection profile for a multicast client site.

2 Open the IP options subprofile and set Multicast Client to Yes. If appropriate, specify a rate limit other than the default 5.

```
Ethernet
   Connections
      Ip options...
         Multicast Client=Yes
         Multicast Rate Limit=5
```

3 Close the Connection profile.

## Multicast forwarding from an MBONE router on a WAN link

Figure 11-2 shows a multicast router on the WAN with local and dial-in multicast clients.

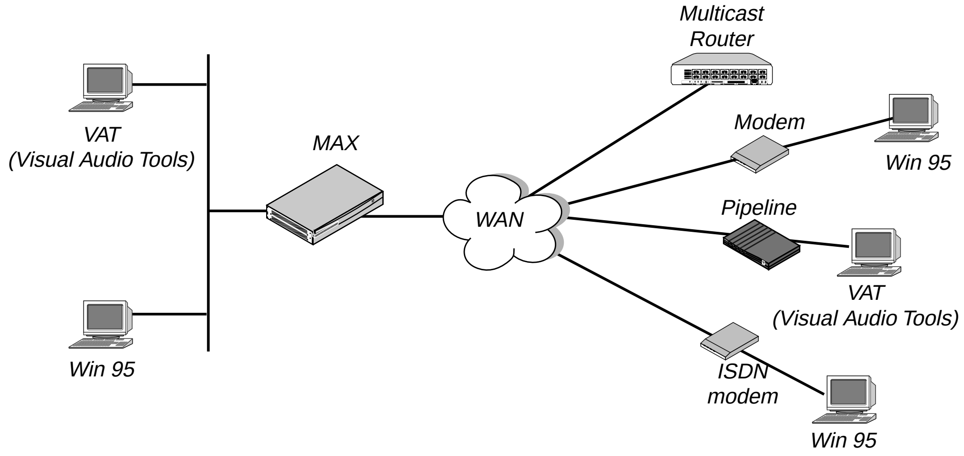


*Figure 11-2. MAX acting as a multicast forwarder on Ethernet and WAN interfaces*

**Note:** This example does not use heartbeat monitoring. If you want to configure the MAX for heartbeat monitoring, see the example settings in "Multicast forwarding from an MBONE router on Ethernet" on page 11-4.

This sample profile specifies the MBONE interface as a WAN link accessed through a Connection profile #20. To configure the MAX for to respond to multicast clients on Ethernet:

**1** Open Ethernet>Mod Config>Multicast.

**2** Enable multicast forwarding, specify the number of the Connection profile for the MBONE interface, and set Client to Yes.

**3** Set Multicast Rate Limit to a number lower than the default 100.

```
Ethernet
   Mod Config
      Multicast...
         Forwarding=Yes
         Mbone Profile=20
         Client=Yes
         Rate Limit=5
```

**4** Close the Ethernet profile.

To configure the MBONE interface:

**1** Open the Connection profile for a MBONE interface (in this example, profile #20).

**2** Open the IP options subprofile and set Multicast Rate Limit to a number lower than the default 100.

```
Ethernet
   Connections
      profile #20...
         Ip options...
            Multicast Client=No
            Multicast Rate Limit=5
```

**3** Close the Connection profile.

To enable multicasting on WAN interfaces:

**1** Open the Connection profile for a multicast client site.

**2** Open the IP options subprofile and set Multicast Client to Yes.

**3** Set Multicast Rate Limit to a number lower than the default 100.

```
Ethernet
   Connections
      Ip options...
         Multicast Client=Yes
         Multicast Rate Limit=5
```

**4** Close the Connection profile.

# Administering multicast interfaces

The terminal server command-line interface provides commands to support IP multicast functionality. To see the options, invoke the terminal server interface (System>Sys Diag>Term Serv) and type:

```
ascend% show igmp ?
```

```
show igmp ?         Display help information
show igmp stats     Display IGMP Statistics
show igmp groups    Display IGMP groups Table
show igmp clients   Display IGMP clients
```

and:

```
ascend% show mrouting ?
```

```
show mrouting ?     Display help information
show mrouting stats Display MROUTING Statistics
```

## Displaying the multicast forwarding table

To display active multicast group addresses and clients (interfaces) registered for each group:

```
ascend% show igmp groups
```

```
IGMP Group address Routing Table Up Time: 0:0:22:17
 Hash      Group Address    Members    Expire time   Counts
  10       224.0.2.250
                             2           0:3:24       3211 :: 0 S5
                             1           0:3:21       145 :: 0 S5
                             0(Mbone)    ......      31901 :: 0 S5
```

The output contains these fields:

- Hash is an index to a hash table (displayed for debugging purposes only).
- Group address is the IP multicast address used in this packet.

  **Note:** The IP multicast address being monitored is marked with an asterisk, meaning that this address is joined by local application.
- Members is the interface ID on which the membership resides. 0 represents the Ethernet interface. Other numbers represent WAN interfaces, numbered according to when they became active. The interface labeled "Mbone" is the interface on which the multicast router resides.
- Expire time indicates when this membership expires. The MAX sends out IGMP queries every 60 seconds, so the expiration time is usually renewed. If the expiration time is reached, the entry is removed from the table. When this field contains periods, it means that this membership never expires.
- Counts shows the number of packets forwarded to the client, the number of packets dropped due to lack of resources, and the state of the membership (the state is displayed for debugging purposes).

## Listing multicast clients

To display a list of multicast clients, type:

```
ascend% show igmp clients
```

```
IGMP Clients

Client      Version  RecvCount  CLU      ALU
  0(Mbone)      1       0          0       0
  2             1      39         68      67
  1             1   33310         65      65
```

The output contains these fields:

- Client indicates the interface ID on which the client resides. 0 represents the Ethernet. Other numbers are WAN interfaces, numbered according to when they became active. The interface labeled "Mbone" is the interface on which the multicast router resides.

- Version is the version of IGMP being used.
- RecvCount is the number of IGMP messages received on that interface.
- CLU (current line utilization) and ALU (average line utilization) show the percentage of bandwidth utilized across this interface. If bandwidth utilization is high, some IGMP packet types will not be forwarded.

## Displaying multicast activity

To display the number of IGMP packet types sent and received:

```
ascend% show igmp stats

      46 packets received.
        0 bad checksum packets received.
        0 bad version packets received.
        0 query packets received.
       46 response packets received.
        0 leave packets received.
       51 packets transmitted.
       47 query packets sent.
        4 response packets sent.
        0 leave packets sent.
```

To display the number of multicast packets received and forwarded:

```
ascend% show mrouting stats

34988 packets received.
    57040 packets forwarded.
        0 packets in error.
       91 packets dropped.
        0 packets transmitted.
```

In many cases, the number of packets forwarded will be greater than the number of packets received, because packets may be duplicated and forwarded across multiple links.

# Setting Up Virtual Private Networks

12

This chapter covers these topics:

# Introduction to virtual private networks

Virtual private networks provide low-cost remote access to private LANs via the Internet. The tunnel to the private corporate network may be from an ISP, enabling mobile nodes to dial-in to a corporate network, or between two corporate networks that use a low-cost Internet connection to access each other. Ascend currently supports these virtual private networking schemes:

- Ascend Tunnel Management Protocol (ATMP)

  An ATMP session occurs between two MAX units via UDP/IP. All packets passing through the tunnel are encapsulated in standard GRE (Generic Routing Encapsulation) as described in RFC 1701. ATMP creates and tears down a cross-Internet tunnel between the two MAX units. In effect, the tunnel collapses the Internet cloud and provides what looks like direct access to a home network. Bridging is not supported through the tunnels. Al packets must be routed using IP or IPX.
- Point-to-Point Tunneling Protocol (PPTP)

  Point-to-Point-Tunneling Protocol (PPTP) was developed by Microsoft Corporation to enable Windows 95 and Windows NT Workstation users to dial into a local ISP to connect to a private corporate network across the Internet.

# Configuring ATMP tunnels

This section describes how ATMP tunnels work between two MAX units. One of the units acts as a “foreign” agent (typically a local ISP) and one as a “home” agent (which can access the home network). A mobile node dials into the foreign agent, which establishes a cross-Internet IP connection to the home agent. The foreign agent then requests an ATMP tunnel on top of the IP connection. The foreign agent must use RADIUS to authenticate mobile nodes dial-ins.

The home agent is the terminating part of the tunnel, where most of the ATMP intelligence takes place. It must be able to communicate with the home network (the destination network for mobile nodes) through a direct connection, another router, or across a nailed connection.

For example, in Figure 12-1, the mobile node might be a sales person who logs into an ISP to access his or her home network. The ISP is the foreign agent. The home agent has access to the home network.

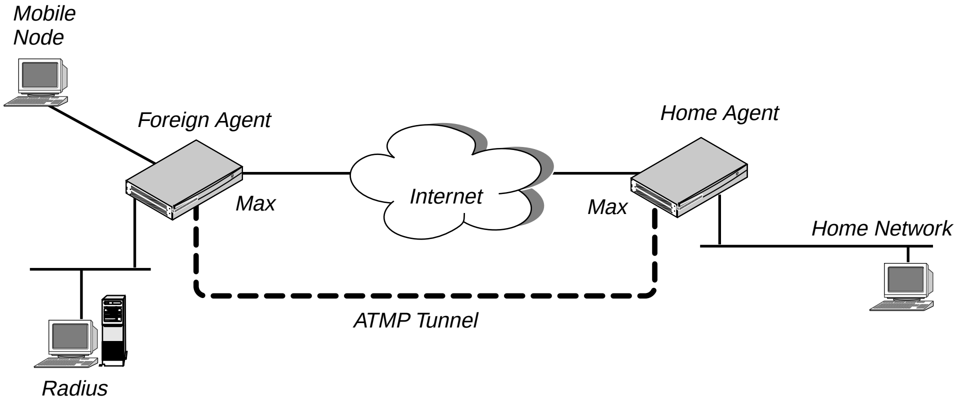


*Figure 12-1. ATMP tunnel across the Internet*

## How the MAX creates ATMP tunnels

This is how an ATMP tunnel connection is established:

**1** A mobile node dials a connection to the foreign agent.

**2** The foreign agent authenticates the mobile node using a RADIUS profile.

RADIUS authentication of the mobile node is required, because the required attributes are supported only in RADIUS.

**3** The foreign agent uses the Ascend-Home-Agent-IP-Addr attribute in the mobile node’s RADIUS profile to locate a Connection profile (or RADIUS profile) for the home agent.

**4** The foreign agent dials the home agent, and an IP connection is authenticated and established in the usual way.

**5** The foreign agent informs the home agent that the mobile node is connected, and requests a tunnel. It sends up to 10 RegisterRequest messages at 2-second intervals, timing out and logging a message if it receives no response to those requests.

**6** The home agent requests a password before it creates the tunnel.

**7** The foreign agent returns an encrypted version of the Ascend-Home-Agent-Password found in the mobile node’s RADIUS profile. This password must match the home agent’s Password parameter in the ATMP configuration in the Ethernet Profile.

**8** The home agent returns a RegisterReply with a number that identifies the tunnel. If registration fails, a message is logged and the foreign agent disconnects the mobile node. If registration succeeds, the tunnel is created between the foreign agent and the home agent.

**9** When the mobile node disconnects from the foreign agent, the foreign agent sends a DeregisterRequest to the home agent to close down the tunnel.

The foreign agent can send its request a maximum of ten times, or until it receives a DeregisterReply. If the foreign agent receives packets for a mobile node whose connection has been terminated, the foreign agent silently discards the packets.

## Router and gateway mode

The home agent may communicate with the home network through a direct connection, another router, or across a nailed connection. When it relies on packet routing to reach the home network, it operates in router mode. It is in gateway mode when it has a nailed connection to the home network.

## Configuring the foreign agent

These are the parameters related to foreign agent configuration:

```
Ethernet
   Mod Config
      ATMP options...
         ATMP Mode=Foreign
         Type=N/A
         Password=N/A
         SAP Reply=N/A
         UDP Port=5150
```

For the IP routing connection to the home agent:

```
Ethernet
   Mod Config
      Ether options...
         IP Adrs=10.65.212.226/24
Ethernet
   Connections
      Station=home-agent
      Active=Yes
      Dial #=555-1212
      Route IP=Yes
      IP options...
         LAN Adrs=10.1.2.3/24
```

To use RADIUS for authentication:

```
Ethernet
   Mod Config
      Auth...
         Auth=RADIUS
         Auth Host #1=10.23.45.11/24
         Auth Host #2=0.0.0.0/0
         Auth Host #3=0.0.0.0/0
         Auth Port=1645
         Auth Timeout=1
         Auth Key-=[]
         Auth Pool=No
         Auth Req=Yes
         Password Server=No
         Password Port=N/A
         Local Profile First=No
         Sess Timer=0
         Auth Src Port=0
         Auth Send Attr 6,7=Yes
```

RADIUS user profiles for mobile nodes running TCP/IP:

```
node1 Password="top-secret"
   Ascend-Metric=2,
   Framed-Protocol=PPP,
   Ascend-IP-Route=Route-IP-Yes,
   Framed-Address=200.1.1.2,
   Framed-Netmask=255.255.255.0,
   Ascend-Primary-Home-Agent=10.1.2.3,
   Ascend-Home-Agent-Password="private"
   Ascend-Home-Agent-UDP-Port = 5150
```

RADIUS user profiles for mobile nodes running NetWare:

```
node2 Password="ipx-unit"
   User-Service=Framed-User,
   Ascend-Route-IPX=Route-IPX-Yes,
   Framed-Protocol=PPP,
   Ascend-IPX-Peer-Mode=IPX-Peer-Dialin,
   Framed-IPX-Network=40000000,
   Ascend-IPX-Node-Addr=123456789012,
   Ascend-Primary-Home-Agent=10.1.2.3,
   Ascend-Home-Agent-Password="private"
```

For details on the parameters, see the *MAX Reference Guide*. For details on attributes and configuring external authentication, see the *MAX RADIUS Configuration Guide*.

## Understanding the foreign agent parameters and attributes

This section provides some background information on configuring a foreign agent to initiate an ATMP request to the home agent MAX.

- ATMP mode

  For the foreign agent, the mode is Foreign, which makes the type, password, and SAP Reply fields not applicable.

- UDP port

  ATMP uses UDP port 5150 for ATMP messages between the foreign and home agents. If you specify a different UDP port number, make sure that the entire ATMP configuration agrees.

- IP configuration and Connection profile

  The cross-Internet connection to the home agent is an IP routing connection, which is authenticated and established in the usual way. For details, see Chapter 9, “Configuring IP Routing.”

- Configuring the foreign agent to authenticate using RADIUS

  The foreign agent must use RADIUS to authenticate mobile nodes, and the RADIUS server must be running a version of the daemon that includes the ATMP attributes. For details, see the *MAX RADIUS Configuration Guide*.

- Creating a RADIUS user profile for a mobile node running TCP/IP

  The RADIUS user profiles for mobile nodes must set ATMP attributes. The required attributes differ slightly depending on whether the mobile node and home network run IP or IPX and whether the home agent MAX operates in router mode or gateway mode. These are required attributes when the mobile node and home network are routing IP:

*Table 12-1. Required RADIUS attributes to reach an IP home network*

| **Home agent in router mode** | **Home agent in gateway mode** |
|---|---|
| `Ascend-Primary-Home-Agent` | `Ascend-Primary-Home-Agent` |
| `Ascend-Home-Agent-Password` | `Ascend-Home-Agent-Password` |
| `Ascend-Home-Agent-UDP-Port` | `Ascend-Home-Agent-UDP-Port` |
| | `Ascend-Home-Network-Name` |

These are required attributes when the mobile node and home network are routing IPX:

*Table 12-2. Required RADIUS attributes to reach an IPX home network*

| **Home agent in router mode** | **Home agent in gateway mode** |
|---|---|
| `Ascend-IPX-Peer-Mode` | `Ascend-IPX-Peer-Mode` |
| `Framed-IPX-Network` | `Framed-IPX-Network` |
| `Ascend-IPX-Node-Addr` | `Ascend-IPX-Node-Addr` |
| `Ascend-Primary-Home-Agent` | `Ascend-Primary-Home-Agent` |
| `Ascend-Home-Agent-Password` | `Ascend-Home-Agent-Password` |
| `Ascend-Home-Agent-UDP-Port` | `Ascend-Home-Agent-UDP-Port` |
| | `Ascend-Home-Network-Name` |

- Ascend-Primary-Home-Agent

  This is the IP address of the home agent, used to locate the Connection profile (or RADIUS profile) for the IP connection to the home agent.

- Ascend-Home-Agent-Password

  This is the password used to authenticate the ATMP tunnel itself, which must match the password specified in the home agent’s Ethernet>Mod Config>ATMP Options. All mobile nodes use the *same* ATMP-Home-Agent-Password.

- Ascend-Home-Agent-UDP-Port

  This must match the UDP port configuration in Ethernet>Mod Config>ATMP Options. It is required only for a port number other than the default 5150.

- Ascend-Home-Network-Name

  This is the name of the home agent’s local Connection profile to the home network. It is required only when the home agent is operating in gateway mode (when it has a nailed WAN link to the home network). See “Configuring a home agent in gateway mode” on page 12-11.

- Ascend-IPX-Peer-Mode

  Dial-in NetWare clients must specify IPX-Peer-Dialin. This enables the foreign agent to handle RIP and SAP advertisements and assign the mobile node a virtual IPX network number.

- Framed-IPX-Network

  This is a virtual IPX network number. It is assigned to dial-in NetWare clients (mobile nodes) to enable the home agent to route back to the mobile node.

  This IPX network number must be represented in decimal, not hexadecimal, and it must be unique in the IPX routing domain. (Note that IPX network numbers are typically specified in hexadecimal.) All mobile nodes logging into an IPX home network through the same foreign agent typically use the same virtual IPX network number.

- Ascend-IPX-Node-Addr

  This is a node address to represent the mobile node on the virtual IPX network. The node address is represented as a 12-digit string, which must be enclosed in double-quotes.

## Example foreign agent configuration (IP)

To configure the foreign agent and create a mobile node profile to access a home IP network:

**1** Open Ethernet>Mod Config>Ether Options and verify that the LAN interface has an IP address. For example:

```
Ethernet
   Mod Config
      Ether options...
         IP Adrs=10.65.212.226/24
```

**2** Open the ATMP Options subprofile and set ATMP Mode to Foreign.

```
      ATMP options...
         ATMP Mode=Foreign
         Type=N/A
         Password=N/A
         SAP Reply=N/A
         UDP Port=5150
```

**3** Open the Auth subprofile and configure the foreign agent to authenticate using RADIUS. For example:

```
      Auth...
         Auth=RADIUS
         Auth Host #1=10.23.45.11/24
         Auth Host #2=0.0.0.0/0
         Auth Host #3=0.0.0.0/0
         Auth Port=1645
         Auth Timeout=1
         Auth Key-=[]
         Auth Pool=No
         Auth Req=Yes
         Password Server=No
         Password Port=N/A
         Local Profile First=No
         Sess Timer=0
         Auth Src Port=0
         Auth Send Attr 6,7=Yes
```

For details, see the *MAX RADIUS Configuration Guide*.

**4** Close the Ethernet profile.

**5** Open a Connection profile and configure an IP routing connection to the home agent. For example:

```
Ethernet
   Connections
      Station=home-agent
      Active=Yes
      Encaps=MPP
      Dial #=555-1212
      Route IP=Yes

      Encaps options...
         Send Auth=CHAP
         Recv PW=home-pw
         Send PW=foreign-pw

      IP options...
         LAN Adrs=10.1.2.3/24
```

**6** Close the Connection profile.

**7** On the RADIUS server, open the RADIUS user profile and create an entry for a mobile node. For example:

```
node1 Password="top-secret"
   Ascend-Metric=2,
   Framed-Protocol=PPP,
   Ascend-IP-Route=Route-IP-Yes,
   Framed-Address=200.1.1.2,
   Framed-Netmask=255.255.255.0,
   Ascend-Primary-Home-Agent=10.1.2.3,
   Ascend-Home-Agent-Password="private"
   Ascend-Home-Agent-UDP-Port = 5150
```

**8** Close the user profile.

When the mobile node logs into the foreign agent with the password “top-secret”, the foreign agent authenticates the mobile node using RADIUS. It then looks for a profile with an IP address that matches the Ascend-Home-Agent-IP-Addr value, so it can bring up an IP connection to the home agent.

### Example foreign agent configuration (IPX)

The foreign agent configuration to support IPX connections via ATMP is the same as the one shown in the previous section. The only difference is in the mobile node's user profile. For example:

```
node2 Password="ipx-unit"
   User-Service=Framed-User,
   Ascend-Route-IPX=Route-IPX-Yes,
   Framed-Protocol=PPP,
   Ascend-IPX-Peer-Mode=IPX-Peer-Dialin,
   Framed-IPX-Network=40000000,
   Ascend-IPX-Node-Addr=123456789012,
   Ascend-Primary-Home-Agent=10.1.2.3,
   Ascend-Home-Agent-Password="private"
```

When the mobile node logs into the foreign agent with the password "ipx-unit", the foreign agent authenticates the mobile node using RADIUS. It then looks for a profile with an IP address that matches the Ascend-Home-Agent-IP-Addr value, so it can bring up an IP connection to the home agent.

## Configuring a home agent in router mode

When the ATMP tunnel has been established between the home agent and foreign agent, the home agent in router mode receives IP packets through the tunnel, removes the GRE encapsulation, and passes the packets to its bridge/router software. It also adds a host route to the mobile node to its routing table.

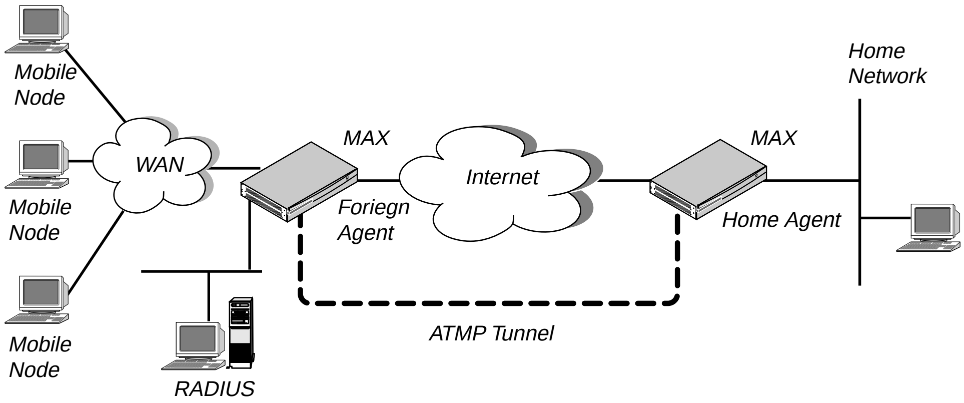


*Figure 12-2. Home agent routing to the home network*

The IPX routing parameters in the Ethernet profile are required only if the MAX is routing IPX. These are the parameters for configuring a home agent in router mode:

```
Ethernet
   Mod Config
      IPX Routing=Yes
      Ether options…
         IP Adrs=10.1.2.3/24
```

```
            IPX Frame=802.2
            IPX Enet #=00000000
         ATMP options...
            ATMP Mode=Home
            Type=Router
            Password=private
            SAP Reply=No
            UDP Port=5150
```

For the IP routing connection to the foreign agent:

```
Ethernet
   Connections
      Station=foreign-agent
      Active=Yes
      Encaps=MPP
      Dial #=555-1213
      Route IP=Yes
      Encaps options...
         Send Auth=CHAP
         Recv PW=foreign-pw
         Send PW=home-pw
      IP options...
         LAN Adrs=10.65.212.226/24
```

For details on each of these parameters, see the *MAX Reference Guide*.

## Understanding the ATMP router mode parameters

This section provides some background information on configuring a home agent in router mode:

- ATMP mode and type

  For the home agent, the mode is Home. When the ATMP Type is set to Router, the home agent relies on routing (not a WAN connection) to pass packets received through the tunnel to the home network.
- Password

  This is the password used to authenticate the ATMP tunnel itself, which must match the password specified in the Ascend-Home-Agent-Password attribute of mobile nodes' RADIUS profiles. (All mobile nodes use the same password for that attribute.)
- SAP Reply

  This enables a home agent to reply to the mobile node's IPX Nearest Server Query if it knows about a server on the home network. If set to No, the home agent simply tunnels the mobile node's request to the home network.
- UDP port

  ATMP uses UDP port 5150 for ATMP messages between the foreign and home agents. If you specify a different UDP port number, make sure that the entire ATMP configuration agrees.
- IP configuration and Connection profile

  The cross-Internet connection to the foreign agent is an IP routing connection, which is authenticated and established in the usual way. For details, see Chapter 9, "Configuring IP Routing."

## Notes about routing to the mobile node

When the home agent receives IP packets through the ATMP tunnel, it adds a host route for the mobile node to its IP routing table. It then handles routing in the usual way. When the home agent receives IPX packets through the tunnel, it adds a route to the mobile node based on the virtual IPX network number assigned in the RADIUS user profile.

For IP routes, you can enable RIP on the home agent's Ethernet to enable other hosts and networks to route to the mobile node. Enabling RIP is particularly useful if the home network is one or more hops away from the home agent's Ethernet. If RIP is turned off, other routers require static routes that specify the home agent as the route to the mobile node.

**Note:** If the home agent's Ethernet is the home network (a direct connection), you should turn on proxy ARP in the home agent to enable local hosts to ARP for the mobile node.

For details on IP routes, see "Configuring IP Routing" on page 9-1. For information about IPX routes, see "Configuring IPX Routing" on page 8-1.

## Example home agent in router mode (IP)

To configure the home agent in router mode to reach an IP home network:

**1** Open Ethernet>Mod Config>Ether Options and verify that the LAN interface has an IP address. You may also set routing options, for example:

```
Ethernet
   Mod Config
      Ether options...
         IP Adrs=10.1.2.3/24
         RIP=On
```

**2** Open the ATMP Options subprofile, set ATMP Mode to Home, and ATMP Type to Router.

**3** Specify the password used to authenticate the tunnel (Ascend-Home-Agent-Password).

```
      ATMP options...
         ATMP Mode=Home
         Type=Router
         Password=private
         SAP Reply=No
         UDP Port=5150
```

**4** Close the Ethernet profile.

**5** Open a Connection profile and configure an IP routing connection to the foreign agent. For example:

```
Ethernet
   Connections
      Station=foreign-agent
      Active=Yes
      Encaps=MPP
      Dial #=555-1213
      Route IP=Yes

      Encaps options...
         Send Auth=CHAP
         Recv PW=foreign-pw
         Send PW=home-pw
      IP options...
         LAN Adrs=10.65.212.226/24
```

6 Close the Connection profile.

### Example home agent in router mode (IPX)

To configure the home agent in router mode to reach an IPX network:

1 Open Ethernet>Mod Config>Ether Options and verify that the LAN interface has an IP address (needed to communicate with the foreign agent) and can route IPX.

```
Ethernet
   Mod Config
      IPX Routing=Yes
      Ether options…
         IP Adrs=10.1.2.3/24
         IPX Frame=802.2
         IPX Enet #=00000000
```

For details, see Chapter 8, "Configuring IPX Routing."

2 Open the ATMP Options subprofile and set ATMP Mode to Home and Type to Router.

3 Specify the password used to authenticate the tunnel (Ascend-Home-Agent-Password).

4 Set SAP Reply to Yes.

```
      ATMP options...
         ATMP Mode=Home
         Type=Gateway
         Password=private
         SAP Reply=Yes
         UDP Port=5150
```

5 Close the Ethernet profile.

6 Open a Connection profile and configure an IP routing connection to the foreign agent. For example:

```
Ethernet
   Connections
      Station=foreign-agent
      Active=Yes
      Encaps=MPP
      Dial #=555-1213
      Route IP=Yes

      Encaps options...
         Send Auth=CHAP
         Recv PW=foreign-pw
         Send PW=home-pw

      IP options...
         LAN Adrs=10.65.212.226/24
```

7 Close the Connection profile.

## Configuring a home agent in gateway mode

When the home agent is configured in gateway mode, it receives GRE-encapsulated IP packets from the foreign agent, strips off the encapsulation, and passes the packets across a nailed WAN connection to the home network.

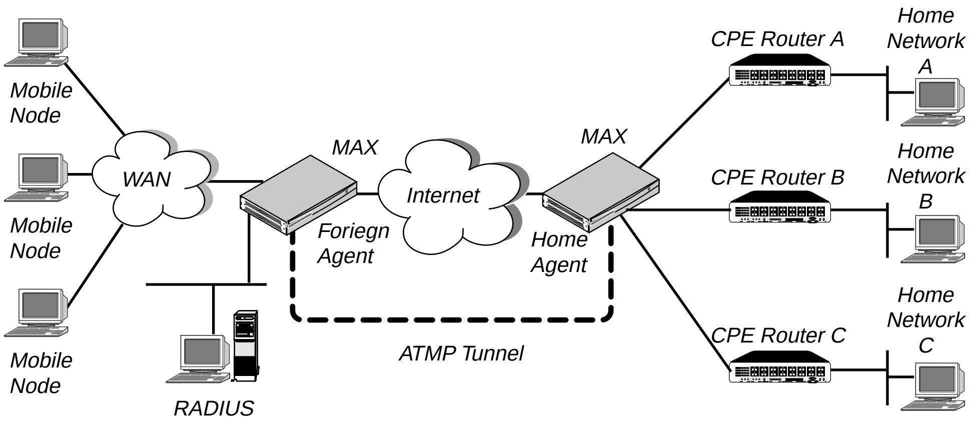


*Figure 12-3. Home agent in gateway mode*

**Note:** To enable hosts and routers on the home network to reach the mobile node, you must configure a static route in the CPE (customer premise equipment) router on the home network (not in the home agent). The static route must specify the home agent as the route to the mobile node; that is, the route's destination address specifies the Framed-Address of the mobile node, and its gateway address specifies the IP address of the home agent.

These are the parameters for configuring a home agent in gateway mode:

```
Ethernet
   Mod Config
      IPX Routing=Yes
      Ether options…
         IP Adrs=10.1.2.3/24
         IPX Frame=802.2
         IPX Enet #=00000000
      ATMP options...
         ATMP Mode=Home
         Type=Gateway
         Password=private
         SAP Reply=No
         UDP Port=5150
```

For the IP routing connection to the foreign agent:

```
Ethernet
   Connections
      Station=foreign-agent
      Active=Yes
      Encaps=MPP
      Dial #=555-1213
      Route IP=Yes
      Encaps options...
         Send Auth=CHAP
         Recv PW=foreign-pw
         Send PW=home-pw
      IP options...
         LAN Adrs=10.65.212.226/24
```

For the nailed connection to the home network:

```
Ethernet
   Connections
      Station=homenet
      Active=Yes
      Encaps=MPP
      Dial #=N/A
      Calling #=N/A
      Route IP=Yes
      Route IPX=Yes
      IP options...
         LAN Adrs=5.9.8.2/24
      Telco options...
         Call Type=Nailed
         Group=1,2
      Session options...
         ATMP Gateway=Yes
```

The IPX routing parameters are required only if the MAX is routing IPX. For details on each of these and the other parameters listed above, see the *MAX Reference Guide*.

## Understanding the ATMP gateway mode parameters

This section provides some background information on configuring a home agent in gateway mode.

- ATMP mode and type

  For the home agent, the mode is Home. When the ATMP Type is set to Gateway, the home agent forwards packets received through the tunnel to the home network across a nailed WAN connection.

- Password

  This is the password used to authenticate the ATMP tunnel itself, which must match the password specified in the Ascend-Home-Agent-Password attribute of mobile nodes' RADIUS profiles. (All mobile nodes use the same password for that attribute.)

- SAP Reply

  This enables a home agent to reply to the mobile node's IPX Nearest Server Query if it knows about a server on the home network. If set to No, the home agent simply tunnels the mobile node's request to the home network.

- UDP port

  ATMP uses UDP port 5150 for ATMP messages between the foreign and home agents. If you specify a different UDP port number, make sure that the entire ATMP configuration agrees.

- IP configuration and Connection profile

  The cross-Internet connection to the foreign agent is an IP routing connection, which is authenticated and established in the usual way. For details, see Chapter 9, "Configuring IP Routing."

- Connection profile to the home network

  The Connection profile to the home network must be a local profile, it cannot be specified in RADIUS. The name of this Connection profile must match the name in the Ascend-Home-Network-Name attribute in the mobile node's RADIUS profile. In addition, the Connection profile to the home network must specify these values:

– Nailed call type

  The home agent must have a nailed connection to the home network, because it will not dial the WAN connection based on packets received through the tunnel.

– ATMP Gateway session option

  The ATMP Gateway parameter must be set to Yes. This parameter instructs the home agent to send data it receives back from the home network on this connection to the mobile node.

## Example home agent in gateway mode (IP)

To configure the home agent in gateway mode to reach an IP home network:

1 Open Ethernet>Mod Config>Ether Options and verify that the LAN interface has an IP address. For example:

```
Ethernet
   Mod Config
      Ether options...
         IP Adrs=10.1.2.3/24
```

2 Open the ATMP Options subprofile and set ATMP Mode to Home and Type to Gateway.

3 Specify the password used to authenticate the tunnel. This must match the Ascend-Home-Agent-Password attribute of mobile nodes' RADIUS profiles.

```
      ATMP options...
         ATMP Mode=Home
         Type=Gateway
         Password=private
         SAP Reply=No
         UDP Port=5150
```

4 Close the Ethernet profile.

5 Open a Connection profile and configure an IP routing connection to the foreign agent. For example:

```
Ethernet
   Connections
      Station=foreign-agent
      Active=Yes
      Encaps=MPP
      Dial #=555-1213
      Route IP=Yes

      Encaps options...
         Send Auth=CHAP
         Recv PW=foreign-pw
         Send PW=home-pw

      IP options...
         LAN Adrs=10.65.212.226/24
```

6 Open a Connection profile and configure a nailed WAN link to the home network.

```
Ethernet
   Connections
      Station=homenet
      Active=Yes
      Encaps=MPP
      Dial #=N/A
      Calling #=N/A
      Route IP=Yes

      IP options...
         LAN Adrs=5.9.8.2/24

      Telco options...
         Call Type=Nailed
         Group=1,2

      Session options...
         ATMP Gateway=Yes
```

7 Close the Connection profile.

## Example home agent in gateway mode (IPX)

To configure the home agent in gateway mode to reach an IPX home network:

1 Open Ethernet>Mod Config>Ether Options and verify that the LAN interface has an IP address (required to communicate with the foreign agent) and can route IPX. For example:

```
Ethernet
   Mod Config
      IPX Routing=Yes
      Ether options…
         IP Adrs=10.1.2.3/24
         IPX Frame=802.2
         IPX Enet #=00000000
```

For details, see Chapter 8, "Configuring IPX Routing."

2 Open the ATMP Options subprofile and set ATMP Mode to Home and Type to Gateway.

3 Specify the password used to authenticate the tunnel. This must match the Ascend-Home-Agent-Password attribute of mobile nodes' RADIUS profiles.

4 Set SAP Reply to Yes.

```
      ATMP options...
         ATMP Mode=Home
         Type=Gateway
         Password=private
         SAP Reply=Yes
         UDP Port=5150
```

5 Close the Ethernet profile.

6 Open a Connection profile and configure an IP routing connection to the foreign agent. For example:

```
Ethernet
   Connections
      Station=foreign-agent
      Active=Yes
      Encaps=MPP
      Dial #=555-1213
      Route IP=Yes

      Encaps options...
         Send Auth=CHAP
         Recv PW=foreign-pw
         Send PW=home-pw

      IP options...
         LAN Adrs=10.65.212.226/24
```

7 Open a Connection profile and configure a nailed WAN link that routes IPX to the home network.

```
Ethernet
   Connections
      profile 5...
         Station=homenet
         Active=Yes
         Encaps=MPP
         Dial #=555-1212
         Route IPX=Yes

         Encaps options...
            Send Auth=CHAP
            Recv PW=homenet-pw
            Send PW=my-pw

         IPX options...
            IPX RIP=None
            IPX SAP=Both
            NetWare t/o=30

         Telco options...
            Call Type=Nailed
            Group=1,2

         Session options...
            ATMP Gateway=Yes
```

8 Close the Connection profile.

## Configuring the MAX as an ATMP multi-mode agent

You can configure the MAX to act as both a home agent and foreign agent on a tunnel-by-tunnel basis. Figure 12-4 shows an example network topology with a MAX acting as a home agent for Network B and a foreign agent for Network A.

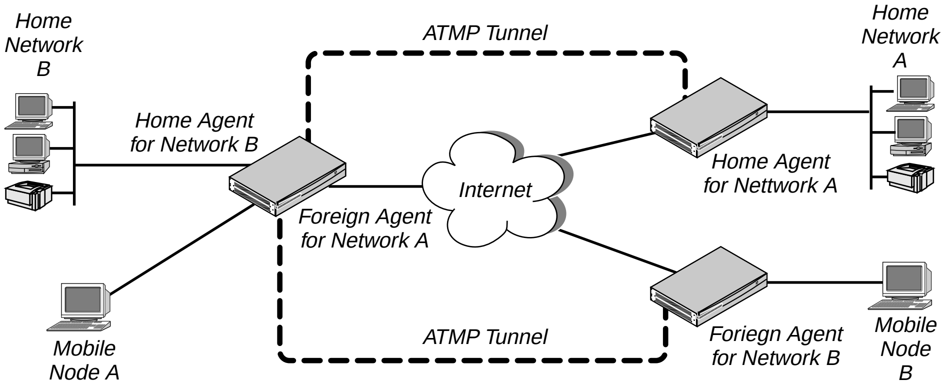


*Figure 12-4. MAX acting as both home agent and foreign agent*

To configure the MAX as a multi-mode agent, set ATMP Mode to Both and complete both the foreign and home agent requirements. Setting ATMP Mode to Both indicates that the MAX will function as both a home agent and foreign agent on a tunnel-by-tunnel basis.

For example, to configure the MAX to operate as both a home agent and foreign agent:

**1** Open Ethernet>Mod Config>Ether Options and verify that the LAN interface has an IP address. For example:

```
Ethernet
   Mod Config
      Ether options...
         IP Adrs=10.65.212.226/24
```

**2** Open the ATMP Options subprofile and set ATMP Mode to Both.

**3** Configure the other home-agent settings as appropriate; for example, to use Gateway mode and a password of “private”:

```
      ATMP options...
         ATMP Mode=Both
         Type=Gateway
         Password=private
         SAP Reply=No
         UDP Port=5150
```

To configure the foreign-agent aspect of the multi-mode configuration:

**4** Open the Auth subprofile and configure RADIUS authentication. For example:

```
      Auth...
         Auth=RADIUS
         Auth Host #1=10.23.45.11/24
         Auth Host #2=0.0.0.0/0
         Auth Host #3=0.0.0.0/0
         Auth Port=1645
         Auth Timeout=1
         Auth Key-=[]
         Auth Pool=No
         Auth Req=Yes
         Password Server=No
         Password Port=N/A
         Local Profile First=No
         Sess Timer=0
         Auth Src Port=0
         Auth Send Attr 6,7=Yes
```

For details, see the *MAX RADIUS Configuration Guide*.

**5** Close the Ethernet profile.

**6** On the RADIUS server, open the RADIUS user profile and create an entry for a mobile node. For example:

```
node1 Password="top-secret"
   Ascend-Metric=2,
   Framed-Protocol=PPP,
   Ascend-IP-Route=Route-IP-Yes,
   Framed-Address=200.1.1.2,
   Framed-Netmask=255.255.255.0,
   Ascend-Primary-Home-Agent=10.1.2.3,
   Ascend-Home-Agent-Password="private"
   Ascend-Home-Agent-UDP-Port = 5150
   Ascend-Home-Network-Name=home-agent
```

**7** Close the user profile.

**8** Open a Connection profile and configure an IP routing connection to the Network A home agent. For example:

```
Ethernet
   Connections
      Station=home-agent
      Active=Yes
      Encaps=MPP
      Dial #=555-1212
      Route IP=Yes

      Encaps options...
         Send Auth=CHAP
         Recv PW=home-pw
         Send PW=foreign-pw

      IP options...
         LAN Adrs=10.1.2.3/24
```

**9** Close the Connection profile.

To configure the home-agent aspect of the multi-mode configuration:

**10** Open a Connection profile and configure an IP routing connection to the Network B foreign agent. For example:

```
Ethernet
   Connections
      Station=foreign-agent
      Active=Yes
      Encaps=MPP
      Dial #=555-1213
      Route IP=Yes

      Encaps options...
         Send Auth=CHAP
         Recv PW=foreign-pw
         Send PW=home-pw

      IP options...
         LAN Adrs=10.65.212.226/24
```

**11** Open a Connection profile and configure a nailed WAN link to the Network B home network.

```
Ethernet
   Connections
      Station=homenet
      Active=Yes
      Encaps=MPP
      Dial #=N/A
      Calling #=N/A
      Route IP=Yes

      IP options...
         LAN Adrs=5.9.8.2/24

      Telco options...
         Call Type=Nailed
         Group=1,2

      Session options...
         ATMP Gateway=Yes
```

**12** Close the Connection profile.

## Supporting mobile node routers (IP only)

To enable an IP router to connect as a mobile node, the foreign agent’s RADIUS entry for the mobile node must specify *the same netmask as the home network*. For example, to connect to a home network whose router has this address:

```
10.1.2.3/28
```

The foreign agent’s RADIUS entry for the remote router would contain lines like this:

```
node1 Password="top-secret"
   Ascend-Metric=2,
   Framed-Protocol=PPP,
   Ascend-IP-Route=Route-IP-Yes,
   Framed-Address=10.168.6.21,
   Framed-Netmask=255.255.255.240,
   Ascend-Primary-Home-Agent=10.1.2.3,
   Ascend-Home-Agent-Password="private"
```

With this Framed-Address for the mobile node router (10.168.6.21/28), the connecting LAN can support up to 14 hosts.

- 10.168.6.16

  The network address (or base address) for this subnet is 10.168.6.16. This address represents the network itself, because the host portion of the IP address is all zeros.

- 10.168.6.31

  The broadcast address for this subnet is 10.168.6.31. The broadcast address of any subnet is specified by setting the host portion of the IP address to all ones.

- 10.168.6.17—10.168.6.30

  This is the valid host address range (14 host addresses) for the LAN.

Routes to and from the mobile node’s LAN are handled differently, depending on whether the home agent is configured in router mode or gateway mode.

- Home agent in router mode

  If the home agent is directly connected to the home network, it should be configured to respond to ARP requests for the mobile node by setting Proxy ARP=Always.

  If the home agent is not directly connected to the home network, the situation is the same as for any remote network: routes to the mobile node’s LAN must either be learned dynamically from a routing protocol or configured statically.

  The mobile node always requires static routes to the home agent as well as to other networks reached through the home agent. (It cannot learn routes from the home agent.)

- Home agent in gateway mode

  If the home agent forwards packets from the mobile node across a nailed WAN link to the home IP network, the answering unit on the home network must have a static route to the mobile node's LAN.

  In addition, because no routing information is passed on the connection between the mobile node and the home agent, the mobile node’s LAN can only support local subnets that fall within the network specified in the RADIUS entry.

  For example, using the example RADIUS entry shown above, the mobile node could support two subnets with a netmask of 255.255.255.248: one on the 10.168.6.16 subnet and the other on the 10.168.6.24 subnet. The answering unit on the home network would have only one route to the router itself (10.168.6.21/28).

## ATMP connections that bypass a foreign agent

If a home agent MAX has the appropriate RADIUS entry for a mobile node, the mobile node can connect directly to the home agent. An ATMP-based RADIUS entry that is local to the home agent enables the mobile node to bypass a foreign agent connection, but it does not preclude a foreign agent. If both the home agent and the foreign agent have local RADIUS entries for the mobile node, the node can choose between a direct connection or a tunneled connection through the foreign agent.

For example, the following RADIUS entry authenticates a mobile NetWare client that will connect directly to the home agent. In this example, the home agent is configured in gateway mode (it forwards packets from the mobile node across a nailed WAN link to the home IPX network):

```
mobile-ipx Password = "unit"
   User-Service = Framed-User,
   Ascend-Route-IPX = Route-IPX-Yes,
   Framed-Protocol = PPP,
   Ascend-IPX-Peer-Mode = IPX-Peer-Dialin,
   Framed-IPX-Network = 40000000,
   Ascend-IPX-Node-Addr = 12345678,
   Ascend-Home-Agent-IP-Addr = 192.168.6.18,
   Ascend-Home-Network-Name = "homenet",
   Ascend-Home-Agent-Password = "pipeline"
```

**Note:** If the home agent is configured in router mode (in which it forwards packets from the mobile node to its internal routing module), the Ascend-Home-Network-Name line is not included in the user entry. The Ascend-Home-Network-Name attribute specifies the name of the answering unit across the WAN on the home IPX network.

# Configuring PPTP tunnels for dial-in clients

PPTP enables Windows 95 and Windows NT Workstation users to dial into a local ISP to connect to a private corporate network across the Internet. To the user dialing the call, the connection looks like a regular login to an NT server, which may support TCP/IP, IPX, or other protocols.

The MAX acts as a PAC (PPTP Access Controller), which functions as a front-end processor to offload the overhead of communications processing. At the other end of the tunnel, the NT server acts as a PNS (PPTP Network Server). All authentication is negotiated between the Windows 95 or NT client and the PNS. The NT server's account information remain the same as if the client dialed in directly; no changes needed.

## How the MAX works as a PAC

Currently, PPTP does not support per-channel call routing and routing to the NT server by PPP-authenticated connection. For each destination PNS address, you must dedicate an entire BRI line. For details on configuring WAN lines and assigning phone numbers, see Chapter 2, "Configuring the MAX for WAN Access."

In the PPTP configuration, you specify the destination IP address of the PNS (the NT server), to which all calls that come in on the PPTP-routed line will be forwarded. When the MAX receives a call on that line, it passes the call directly to the specified IP address end-point, creating the PPTP tunnel to that address if one is not already up. The PNS destination IP address must be accessible via IP routing.

**Note:** PPTP calls are handled differently than regular calls in the MAX. No Connection profiles are used for these calls, and the Answer profile is not consulted. They are routed through the PPTP tunnel based solely upon the phone number dialed.

These are the parameters related to a PPTP PAC configuration:

```
Ethernet
   Mod Config
      PPTP options...
         PPTP Enabled=Yes
         Route line 1=10.65.212.11
         Route line 2=0.0.0.0
         Route line 3=0.0.0.0
         Route line 4=0.0.0.0
         Route line 5=0.0.0.0
         Route line 6=0.0.0.0
         Route line 7=0.0.0.0
         Route line 8=0.0.0.0

For details on each parameter, see the MAX Reference Guide.
```

## Understanding the PPTP PAC parameters

This section provides some background information about configuring PPTP.

- Enabling PPTP

  When PPTP is enabled, the MAX can bring up a PPTP tunnel with a PNS and respond to a request for a PPTP tunnel from a PNS. You must specify the IP address of the PNS in one or more of the Route Line parameters.

- Specifying a PRI line for PPTP calls and the PNS IP address

  The PPTP parameters include eight Route Line parameters, one for each of the MAX unit’s BRI lines. If you specify the IP address of a PNS in one of these parameters, that WAN line is dedicated to receiving PPTP connections and forwarding them to that destination address.

  The IP address you specify must be accessible via IP, but there are no other restrictions on it. It can be across the WAN or on the local network. If you leave the default null address, that WAN line handles calls normally.

## Example PAC configuration

Figure 12-6 shows an ISP POP MAX unit communicating across the WAN with an NT Server at a customer premise. Windows 95 or NT clients dial into the local ISP and are routed directly across the Internet to the corporate server.

In this example, the MAX unit supports eight BRI lines and the fourth line is dedicated to PPTP connections to that server.

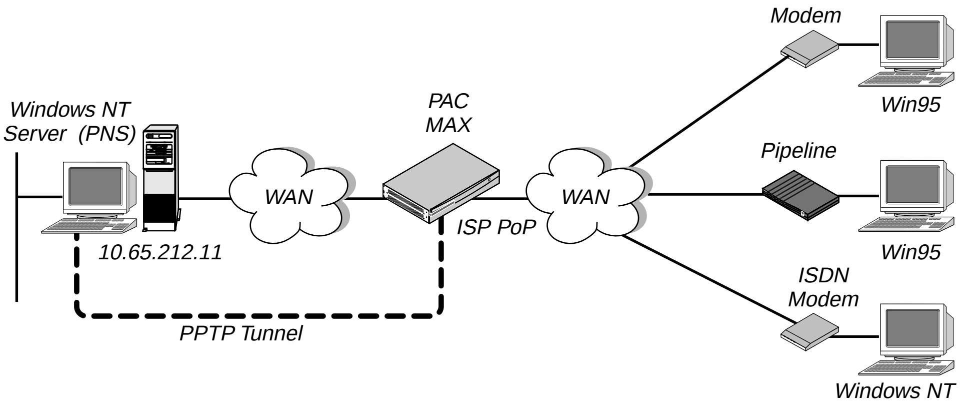


*Figure 12-5. PPTP tunnel*

To configure this MAX for PPTP:

**1** Open Ethernet>Mod Config>PPTP Options.

**2** Turn on PPTP, and specify the PNS IP address next to Route Line 4.

```
Ethernet
   Mod Config
      PPTP options...
         PPTP Enabled=Yes
         Route line 1=0.0.0.0
         Route line 2=0.0.0.0
         Route line 3=0.0.0.0
         Route line 4=10.65.212.11
         Route line 5=0.0.0.0
         Route line 6=0.0.0.0
         Route line 7=0.0.0.0
         Route line 8=0.0.0.0
```

**3** Close the Ethernet Profile.

## Example PPTP tunnel across multiple POPs

Figure 12-5 shows an ISP POP MAX communicating through an intervening router to the PNS that is the end-point of its PPTP tunnel. The packets are routed in the usual way to reach the end-point IP address.

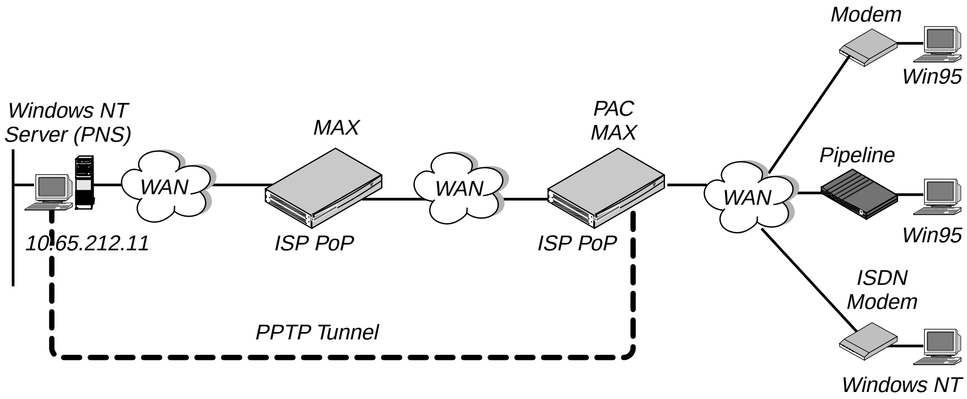


*Figure 12-6. PPTP tunnel across multiple POPs*

In this example, the MAX at ISP POP #1 dedicates its second BRI line to PPTP connections to the PNS at 10.65.212.11. To configure this MAX as a PAC:

**1** Open Ethernet>Mod Config>PPTP Options.

**2** Turn on PPTP, and specify the PNS IP address next to Route Line 2.

```
Ethernet
   Mod Config
      PPTP options...
         PPTP Enabled=Yes
         Route line 1=0.0.0.0
         Route line 2=10.65.212.11
         Route line 3=0.0.0.0
         Route line 4=0.0.0.0
         Route line 5=0.0.0.0
         Route line 6=0.0.0.0
         Route line 7=0.0.0.0
         Route line 8=0.0.0.0
Close the Ethernet Profile.
```

The PAC must have a route to the destination address, in this case a route through the ISP POP #2. This does not have to be a static route, it can be learned dynamically via routing protocols. This example shows a static route to ISP POP #2:

**3** Open an unused IP Route profile and activate it.

```
Ethernet
   Static Rtes
      Name=pop2
      Active=Yes
```

**4** Specify the PNS destination address.

```
      Dest=10.65.212.11
```

**5** Specify the address of the next-hop router (ISP POP #2), for example:

```
      Gateway=10.1.2.4
```

**6** Specify a metric for this route, the route’s preference, and whether the route is private. For example:

```
      Metric=1
      Preference=100
      Private=Yes
```

7. Close the IP Route profile.

# MAX System Administration

# 13

This chapter covers these topics:

# Introduction to MAX administration

This chapter describes the following administration tasks:

- Administrative configurations

  Some system- or network-wide configurations are related to the unit itself. These are described in "System and Ethernet profile configurations" on page 13-3.

- Administrative commands

  The terminal server provides commands related to managing the system, its networks, and its calls. This chapter focuses on those related to the system itself, and tells you where to find information about the network and connection-oriented commands.

- SNMP administration

  MAX configurations control which classes of events will generate traps to be sent to an SNMP manager, which SNMP managers may access the unit, and community strings to protect that access. This chapter shows you how to set up the unit to work with SNMP.

**Note:** You can manage the MAX from your workstation by establishing a Telnet session and logging in with sufficient administrative privileges. You can also use Telnet to manage remote Ascend units, such as Pipeline or MAX units.

## Where to find additional administrative information

The following administrative topics are documented in a separate guide or supplement.

- Security profiles

  For details on Security profiles, see the *MAX Security Supplement.*

- RADIUS authentication and accounting

  For details, see the *MAX RADIUS Configuration Guide.*

- MIF (Machine Interface Format) interface

  MIF is an Ascend-specific language that provides an alternative configuration interface for Ascend units. You can use a command-line or write a MIF program that sets Ascend parameters rather than use the configuration menus to change one parameter after another. MIF programs provide a batch-processing method of changing a configuration or performing a series of actions. For details on using it, see the *MAX MIF Supplement*.

- Sys Diag and Line Diag commands

  The Sys Diag commands enable you to reset the device, save or restore configuration information, and perform other administrative functions. The Line Diag commands enable loopbacks and other diagnostics on WAN lines. For details, see the *MAX Reference Guide*.

- DO commands

  Pressing Ctrl-D in the vt100 interface displays the DO menu, which contains commands for changing security levels in the MAX, or manually dialing or clearing a call. For details, see the *MAX Reference Guide*.

- Status windows

  The status windows in the vt100 interface provide information about what is currently happening in the MAX. You can also perform DO commands, for example, clear an active connection, using the status windows. For details, see the *MAX Reference Guide*.

- Troubleshooting

  For troubleshooting tips, see Appendix A, "Troubleshooting."

## Activating administrative permissions

Before you can use the administrative commands and profiles, you must login as super-user by activating a Security profile that has sufficient permissions, such as the Full Access profile. To do so:

**1** Press Ctrl-D to open the DO menu, and then press P (or select P=Password).

```
00-300 Security
DO...
>0=ESC
 P=Password
```

**2** In the list of Security profiles that opens, select Full Access.

The MAX prompts you for the Full Access password:

```
00-300 Security
Enter Password:
 []

 Press > to accept
```

**3** Type the password assigned to the profile and press Enter.

When you enter the correct password, the MAX displays a message informing you that the password was accepted and that the MAX is using the new security level.

```
Message #119
Password accepted.
Using new security level.
```

If the password you enter is incorrect, the MAX prompts you again for the password.

**Note:** The default password for the Full Access login is “Ascend.” The first task you should perform after logging in as the super-user is to assign a new password to the profile. See the *MAX Security Supplement* for details.

# System and Ethernet profile configurations

This section describes the following system administration configurations:

```
System
   Sys Config
      Name=gateway-1
      Location=east-bay
      Contact=thf
      Date=2/20/97
      Time=10:00:29
      Term Rate=9600
      Console=Standard
      Remote Mgmt=Yes
      Parallel Dial=5
      Single Answer=Yes
      Auto Logout=No
      Idle Logout=0
      DS0 Min Rst=Off
      Max DS0 Mins=N/A
      High BER=10 ** -3
      High BER Alarm=No
      No Trunk Alarm=No
      Edit=00-000
      Status 1=10-100
      Status 2=10-200
      Status 3=90-100
      Status 4=00-200
      Status 5=90-300
      Status 6=90-400
      Status 7=20-100
      Status 8=20-200
Ethernet
   Mod Config
      Log...
         Syslog=Yes
         Log Host=10.65.212.12
         Log Facility=Local0
```

For details on these parameters, see the *MAX Reference Guide*. For background information on additional parameters that appear in the System profile, see Chapter 2, “Configuring the MAX for WAN Access.”

## Understanding the administrative parameters

This section provides some background information on the administration options.

- The system name

  The system name can contain up to 16 characters. It’s a good idea to keep the name simple (don’t include special characters), because it is used in negotiating bridged PPP, AIM, and BONDING connections.

- Specifying who to contact about problems and the location of the unit

  The contact and location fields are SNMP readable and settable, and should indicate the person to contact about this unit, and its location. You can enter up to 80 characters.

- Setting the system date and time

  The date and time parameters set the system date and time. If you are using SNTP (Simple Network Time Protocol), the MAX can maintain its date and time by accessing the SNTP server. See Chapter 9, “Configuring IP Routing.”

- Console and term rate

  The Console parameter lets you change the configuration interface, for example, you can change it from Standard to MIF. If you set it to MIF, the Machine Interface Format interface comes up when you power up the MAX. “Limited” brings up simplified menus for operation with the serial host ports (but not for bridging and routing). See the *MAX MIF Supplement* for details.

  You should also verify that the data rate of your terminal emulation program is set to 9600 baud or lower and that the term-rate parameter in the System profile is also set to 9600. Higher speeds might cause transmission errors.

- Allowing remote management

  You can set Remote Mgmt to Yes to enable management of the MAX from a WAN link.

- Dial-in and dial-out parameters

  The Parallel Dial parameter specifies the number of channels that the MAX can dial simultaneously over the T1 PRI line, or that the MAX can disconnect simultaneously.

Although you can specify any number of channels, the initial number of channels in a connection never exceeds the value of the Base Ch Count parameter.

The Single Answer parameter specifies whether the MAX completes the answering and routing of one call before answering and routing the next call.

- Logging out the console port

  The Auto Logout parameter specifies whether to log out and go back to default privileges on loss of DTR from the serial port. Idle Logout specifies the number of minutes an administrative login can remain inactive before the MAX logs out and hangs up.

- DS0 minimum and maximum resets

  A DS0 minute is the online usage of a single 56-kbps or 64-kbps switched channel for one minute. For example, a 5-minute, 6-channel call uses 30 DS0 minutes.

  The DSO Min Rst parameter specifies when the MAX should reset accumulated DS0 minutes to 0 (zero). You can also use this parameter to specify that the MAX should disable the timer altogether.

  The Max DS0 Mins parameter specifies the maximum number of DS0 minutes a call can be online. When the usage exceeds the maximum specified by the Max DS0 Mins parameter, the MAX cannot place any more calls, and takes any existing calls offline.

- Setting a high-bit-error alarm

  High BER specifies the maximum bit-error rate for any PRI line. The bit-error rate consists of the number of bit errors that occur per second. The number that comes after the double asterisks specifies the power of 10 for the current ratio of error bits to total bits.

  High BER alarm specifies whether the back panel alarm relay closes when the bit-error rate exceeds the value specified by the High BER parameter.

- Setting an alarm when no trunks are available

  No Trunk Alarm specifies whether the back panel alarm relay closes when all T1 PRI lines (or trunks) go out of service.

- Customizing the vt100 interface

  The Edit and Status parameters customize the status windows in the vt100 interface so that particular screens appear at startup. For details, see the *MAX Reference Guide*.

- Interacting with the syslog daemon to save ASCII log files

  The sylog-enabled, host, and facility parameters are related to sending log messages to syslogd running on a UNIX host. To maintain a permanent log of MAX system events and send Call Detail Reporting (CDR) reports to a host that can record and process them, configure the MAX to report events to a syslog host on the local IP network. The host running a syslog daemon is typically a UNIX host, but it may also be a Windows system. If the log host is not on the same subnet as the MAX, the MAX must have a route to that host, either via RIP or a static route.

  **Note:** Do not configure the MAX to send reports to a syslog host that can only be reached by a dial-up connection. That would cause the MAX to dial the log host for every logged action, including hang ups.

  The facility parameter is used to flag messages from the MAX. After you set a log facility number, you need to configure the syslog daemon to write all messages containing that facility number to a particular log file. (That will be the MAX log file.)

# Example administrative configurations

This section shows some sample configurations.

## Setting basic system parameters

To configure the system name and other basic parameters in the System profile:

**1** Open the System profile.

**2** Specify a system name up to 16 characters long, enter the physical location of the MAX unit, and indicate a person to contact in case of problems.

```
System
   Sys Config
      Name=gateway-1
      Location=east-bay
      Contact=thf
```

**3** If necessary, set the system date and time.

```
      Date=2/20/97
      Time=10:00:29
```

**4** Specify the data transfer rate of the MAX Control port.

```
      Term Rate=9600
```

**5** Close the System profile.

## Configuring the MAX to interact with syslog

To maintain a permanent log of MAX system events and send Call Detail Reporting (CDR) reports to a host that can record and process them, configure the MAX to report events to a syslog host on the local IP network. Note that syslog reports are only sent out through the Ethernet interface. To configure the MAX to send messages to a Syslog daemon:

**1** Open Ethernet>Mod Config>Log.

**2** Turn on Syslog.

**3** Specify the IP address of the host running the Syslog daemon.

**4** Set the log facility level.

```
Ethernet
   Mod Config
      Log...
         Syslog=Yes
         Log Host=10.65.212.12
         Log Facility=Local0
```

**5** Close the Ethernet profile.

To configure the Syslog daemon, you need to modify /etc/syslog.conf on the log host. This file specifies which action the daemon will perform when it receives messages from a particular log facility number (which represents the MAX). For example, if you set Log Facility to Local5 in the MAX, and you want to log its messages in /var/log/MAX, add this line to /etc/syslog.conf:

```
local5.info<tab>/var/log/MAX
```

**Note:** The Syslog daemon must reread /etc/syslog.conf after it has been changed.

# Terminal server commands

This section describes the commands that are available in the terminal server command-line interface. To invoke the terminal server command-line interface, you must have administrative privileges. See “Activating administrative permissions” on page 13-3.

You can open the terminal server command-line interface using any of these methods:

- Select System>Sys Diag>Term Serv, and press Enter.
- Press Ctrl-D to open the DO menu in the Main Edit menu and select E=Termsrv.
- Enter the following keystroke sequence (Escape key, left square bracket, Escape key, zero) in rapid succession:

```
<Esc> [ <Esc> 0
```

If you have sufficient privileges to invoke the command line, you’ll see the command-line prompt; for example:

```
** Ascend Terminal Server **
ascend%
```

## Displaying terminal-server commands

To display the list of terminal server commands:

```
ascend% ?
```

Or:

```
ascend% help
```

```
?                   Display help information
help                   "     "        "
quit                Closes terminal server session
hangup                 "      "       "       "
test                test <number> frame-count> ] [ <optional fields> ]
local               Go to local mode
remote              remote <station>
set                 Set various items. Type 'set ?' for help
show                Show various tables. Type 'show ?' for help
iproute             Manage IP routes.  Type 'iproute ?' for help
slip                SLIP command
cslip               Compressed SLIP command
ppp                 PPP command
menu                Host menu interface
telnet              telnet [ -a|-b|-t ] <host-name> [ <port-number> ]
tcp                 tcp <host-name> <port-number>
ping                ping <host-name>
ipxping             ipxping <host-name>
traceroute          Trace route to host.  Type 'traceroute -?' for help
rlogin              rlogin [ -l user -ec ] <host-name>
```

```
open                open < modem-number | slot:modem-on-slot >
resume              resume virtual connect session
close               close virtual connect session
kill                terminate session
```

## Returning to the vt100 menus

The following commands close the terminal server command-line interface and return the cursor to the vt100 menus.

```
quit                Closes terminal server session
hangup                 "      "       "       "
local               Go to local mode
For example:
```

```
   ascend% quit
```

When a dial-in user enters the Local command, a Telnet session begins.

## Commands for monitoring networks

The following commands are specific to IP or IPX routing connections, and are described in the chapter that explains those connections:

```
iproute             Manage IP routes.  Type 'iproute ?' for help
ping                ping <host-name>
ipxping             ipxping <host-name>
traceroute         Trace route to host.  Type 'traceroute -?' for help
```

For information about IPXping, see Chapter 8, “Configuring IPX Routing.”

For details on IProute, Ping, and Traceroute, see Chapter 9, “Configuring IP Routing.”

## Commands for use by terminal-server users

The following commands must be enabled for use in Ethernet>Mod Config>TServ Options. If they are enabled, login users can initiate a session by invoking the commands in the terminal-server interface.

```
slip                SLIP command
cslip               Compressed SLIP command
ppp                 PPP command
menu                Host menu interface
telnet              telnet [ -a|-b|-t ] <host-name> [ <port-number> ]
rlogin              rlogin [ -l user -ec ] <host-name>
tcp                 tcp <hostname> <port-number>
open                open < modem-number | slot:modem-on-slot >
resume              resume virtual connect session
close               close virtual connect session
```

These commands initiate a session with a host or modem, or toggle to a different interface that displays a menu selection of Telnet hosts. For details on enabling these commands, see Chapter 3, “Configuring WAN Links.”

## SLIP, CSLIP, and PPP commands

These commands initiate SLIP (Serial Line IP), CSLIP (Compressed SLIP), and PPP sessions from the terminal-server command line.

## Menu command

The Menu command invokes the terminal-server menu mode, which lists up to four Telnet hosts as configured in Ethernet>Mod Config>TServ Options. For example:

```
Up to 16 lines of up to 80 characters each
will be accepted. Long lines will be truncated.
Additional lines will be ignored



         1. host1.abc.com
         2. host2.abc.com
         3. host3.abc.com
         4. host4.abc.com

           Enter Selection (1-4, q)
```

To return to the command-line, press 0. Terminal-server security must be set up to allow the operator to “toggle” between the command line and menu mode, or the Menu command has no effect.

## Telnet command

The Telnet command initiates a login session to a remote host. It uses this format:

```
telnet [-a|-b|–t] <hostname> [<port-number>]
```

If DNS is configured in the Ethernet profile, you can specify a hostname:

```
ascend% telnet myhost
```

If DNS is not configured, you must specify the host’s IP address instead. There are also several options in Ethernet>Mod Config>TServ Options that affect Telnet; for example, if Def Telnet is set to Yes, you can just type a hostname to open a Telnet session to that host.

```
ascend% myhost
```

Another way to open a session is to invoke Telnet first, followed by the Open command at the Telnet prompt, for example:

```
ascend% telnet
telnet> open myhost
```

The Telnet prompt is “telnet>”. When you see that prompt, you can enter any of the Telnet commands described in “Telnet session commands” on page 13-10. You can quit the Telnet session at any time by typing quit at the Telnet prompt:

```
telnet> quit
```

**Note:** During an open Telnet connection, type Ctrl-] to display the telnet> prompt and the Telnet command-line interface. Any valid Telnet command returns you to the open session. Note that Ctrl-] does not function in binary mode Telnet. If you log into the MAX by Telnet, you might want to change its escape sequence from Ctrl-] to a different setting.

### Telnet command arguments

The arguments to the Telnet command are as follows:

- <hostname>

  If DNS is configured, you can specify the remote system's hostname. Otherwise, hostname must be the IP address of the remote station.
- –a | –b | –t

  (Optional.) You can specify -a, -b, or -t on the Telnet command line to indicate ASCII, Binary, or Transparent mode. A specification on the command line overrides the setting of the Telnet Mode parameter.
  - In ASCII mode, the MAX uses standard 7-bit mode.
  - In Binary mode, the MAX tries to negotiate 8-bit Binary mode with the server at the remote end of the connection.
  - In Transparent mode, the user can send and receive binary files, and use 8-bit file transfer protocols, without having to be in Binary mode.
- <port-number>

  (Optional.) You can specifies the port to use for the session. The default is 23, the well-known port for Telnet.

### Telnet session commands

The commands in this section can be typed at the Telnet prompt during an open session. To display the Telnet prompt during an active login to the specified host, press Ctrl-] (hold down the Control key and type a right-bracket). To display information about Telnet session commands, use the Help or ? command. For example:

```
telnet> ?
```

To open a Telnet connection after invoking Telnet, use the Open command; for example:

```
telnet> open myhost
```

To send standard Telnet commands such as “Are You There” or “Suspend Process,” use the Send command. For example:

```
telnet> send susp
```

For a list of Send commands and their syntax, type:

```
telnet> send ?
```

To set special characters for use during the Telnet session, use the SET command. For example:

```
telnet> set eof ^D
```

To display current settings, type:

```
telnet> set all
```

To see a list of Set commands, type:

```
telnet> set ?
```

To quit the Telnet session and close the connection, use the Close or Quit command. For example:

```
telnet> close
```

### Telnet error messages

The MAX generates an error message for any condition that causes the Telnet session to fail or terminate abnormally. These error messages may appear:

- no connection: host reset (The destination host reset the connection.)
- no connection: host unreachable (The destination host is unreachable.)
- no connection: net unreachable (The destination network is unreachable.)
- Unit busy. Try again later. (The host already has open the maximum number of concurrent Telnet sessions.)

## Rlogin command

The Rlogin command initiates a login session to a remote host. It uses this format:

```
rlogin [-e<char>] [-l <username>] <hostname>
```

If DNS is configured, you can specify a hostname such as:

```
ascend% rlogin myhost
```

If DNS has not been configured, you must specify the host's IP address instead. Rlogin must also be enabled in Ethernet>Mod Config>TServ Options. The arguments to the Rlogin command are as follows:

- <hostname>

  If DNS is configured, you can specify the remote system's hostname. Otherwise, hostname must be the IP address of the remote station.
- -e<char>

  (Optional.) This argument sets the escape character to <char>; for example:

  ```
  rlogin -e$ 10.2.3.4
  ```

  The default for <char> is a tilde (~).
- -l <username>

  (Optional.) This argument specifies that you log into the remote host as <username>, rather than as the name you used to log into the terminal server. For example:

  ```
  rlogin -l jim 10.2.3.4
  ```

  If you did not log into the terminal server using RADIUS or TACACS, you can use this option on the command-line instead of being prompted for it by the remote host.

To terminate the remote login, use the Exit command at the remote system's prompt. Or, you can use the following escape sequence:

```
<CR><ESC-CHAR><PERIOD>
```

For example, to terminate a remote login that was initiated with the default escape character (a tilde), press Return and then type a tilde followed by a period.

```
~.
```

## TCP command

The TCP command initiates a login session to a remote host. It uses this format:

```
tcp <hostname> <port-number>
```

For example:

```
ascend% tcp myhost
```

The arguments to the TCP command are as follows:

- <hostname>

  If DNS is configured, you can specify the remote system's hostname. Otherwise, hostname must be the IP address of the remote station.
- [<port-number>]

  (Optional.) You can specifies the port to use for the session. The port number typically indicates a custom application that runs on top of the TCP session. For example, port number 23 starts a Telnet session. However, terminating the Telnet session does not terminate the raw TCP session.

When the raw TCP session starts running, the MAX displays the word "connected." You can now use the TCP session to transport data by running an application on top of TCP. You can hang up the device at either end to terminate the raw TCP session. If you are using a remote terminal server session, ending the connection also terminates raw TCP.

If a raw TCP connection fails, the MAX returns one of the following error messages:

```
Can't open session: <hostname> <port-number>
```

You entered an invalid or unknown value for <hostname>, you entered an invalid value for <port-number>, or you failed to enter a port number.

- no connection: host reset (The destination host reset the connection.)
- no connection: host unreachable (The destination host is unreachable.)
- no connection: net unreachable (The destination network is unreachable.)

## Open, Resume, and Close commands

If the MAX has V.34 digital modems installed and Modem Dialout is enabled in the TServ Options submenu, a local user can issue AT commands to the modem as if connected locally to the modem's asynchronous port. To set up a virtual connection to a V.34 mode, a user can enter the Open command in this format:

```
open [<modem number> | <slot>:<modemOnSlot>]
```

For example:

```
ascend% open 7:1
```

If the user is not sure which slot or item number to specify, the Show Modems command displays the possible choices. If the user enters the Open command without specifying any of the optional arguments, the MAX opens a virtual connection to the first available V.34 modem.

Once the user is connected to the V.34 modem, he or she can issue AT commands to the modem and receive responses from it.

To temporarily suspend a virtual connection, the user can press Ctrl-C three times. This control sequence causes the MAX to display the terminals server interface again. To resume a virtual connection suspended with Ctrl-C, the user can enter this command at the terminal server prompt:

```
ascend% resume
```

To terminate a virtual connection, the user enters this command at the terminal server prompt:

```
ascend% close
```

## Administrative commands

The following commands are related to system administration:

```
test                test <number> frame-count> ] [ <optional fields> ]
remote              remote <station>
set                 Set various items. Type 'set ?' for help
show                Show various tables. Type 'show ?' for help
kill                terminate session
```

### Test command

To run a self-test in which the MAX calls itself, the MAX must have two open channels: one for the placing the call, and the other for receiving it. The TEST command has this format:

```
test <phonenumber> [<frame-count>] [<optional fields>]
```

- <phonenumber>

  The phone number of the channel receiving the test call. This can include the numbers 0 through 9 and the characters ()[]-, but cannot include spaces.

- [<frame-count>]

  (Optional.) The number of frames to send during the test (a number from 1 to 65535.) The default is 100.

- [data-svc=<data-svc>]

  For data-svc, enter a data service identical to any of the values available for the Data Svc parameter of the Connection profile. For a list of valid values, see the *MAX Reference Guide*. If you do not specify a value, the default value is the one specified for the Data Svc parameter.

- [call-by-call=<T1-PRI-service>]

  For PRI-service, enter any value available to the Call-by-Call parameter of the Connection profile. The Call-by-Call parameter specifies the PRI service that the MAX uses when placing a PPP call. For a list of valid values, see the *MAX Reference Guide*. If you do not specify a value, the default is as specified for the Call-by-Call parameter.

- [primary-number-type=<AT&T-switch>]

  For AT&T-switch, specify any value available to the PRI # Type parameter of the Connection profile. The PRI # Type parameter specifies an AT&T switch. For a list of valid values, see the *MAX Reference Guide*. If you do not specify a value, the default value is the one specified for the PRI # Type parameter.

- [transit-number=<IEC>]

  For IEC, specify any value available to the Transit # parameter of the Connection profile. The Transit # parameter specifies the U.S. Interexchange Carrier (IEC) you use for long distance calls over a PRI line. For a list of valid values, see the *MAX Reference Guide*. If you do not specify a value, the default is as specified for the Transit # parameter.

For example:

```
ascend% test 555-1212
```

You can enter Ctrl-C at any time to terminate the test. While the test is running, the MAX displays the status, for example:

```
calling...answering...testing...end
200 packets sent, 200 packets received
```

If you enable trunk groups on the MAX, you can specify the outgoing lines used in the self test; if you do not, the MAX uses the first available T1 (or E1) line. For example, if you assign the trunk group 7 to line 1 on a Net/BRI module and a preceding “9” is required by your PBX to make an outgoing call, the following command places the outgoing call on line 1 of the Net/BRI module:

```
ascend% test 7-9-555-1212
```

The MAX generates an error message for any condition that causes the test to terminate before sending the full number of packets. These error messages may appear:

- bad digits in phone number

  The phone number you specified contained a character other than the numbers 0 through 9 and the characters ()[]-.
- call failed

  The MAX did not answer the outgoing call. This error can indicate a wrong phone number or a busy phone number. Use the Show ISDN command to determine the nature of the failure.
- call terminated <N1> packets sent <N2> packets received

  This message indicates the number of packets sent (<N1>) and received (<N2>).
- can’t handshake

  The MAX answered the outgoing call, but the two sides did not properly identify themselves. This error can indicate that the call was routed to the wrong MAX module, or that the phone number was incorrect.
- frame-count must be in the range 1-65535

  The number of frames requested exceeded 65535.
- no phone number

  You did not specify a phone number on the command-line.
- test aborted

  The test was terminated (Ctrl-C).
- unit busy

  You attempted to start another self-test when one was already in progress. You can run only a single self-test at a time.
- unknown items on command-line

  The command-line contained unknown items. Inserting one or more spaces in the telephone number can generate this error.
- unknown option <option>

  The command-line contained the option specified by <option>, which is invalid.

- unknown value <value>

  The command-line contained the value specified by <value>, which is invalid.
- wrong phone number

  A device other than the MAX answered the call; therefore, the phone number you specified was incorrect.

## Remote command

After an MP+ connection has been established with a remote station (for example, by using the DO DIAL command), you can start a remote management session with that station by entering the Remote command in this format:

```
remote <station>
```

For example:

```
ascend% remote lab17gw
```

During the remote management session, the user interface of the remote device replaces your local user interface, as if you had opened a Telnet connection to the device. You can enter Ctrl-\ at any time to terminate the Remote session. Note that either end of an MP+ link can terminate the session by hanging up all channels of the connection.

The argument to the Remote command is the name of the remote station, which must match the value of a Station parameter in a Connection profile that allows outgoing MP+ calls, or the user-id at the start of a RADIUS profile set up for outgoing calls.

**Note:** A remote management session can time out because the traffic it generates does not reset the idle timer. Therefore, the Idle parameter in the Connection profile at both the calling and answering ends of the connection should be disabled during a remote management session, and restored just before exiting. Remote management works best at higher terminal speeds.

At the beginning of a remote management session, you have privileges set by the default Security profile at the remote end of the connection. To activate administrative privileges on the remote station, activate the appropriate remote Security profile by using the DO Password command (see “Activating administrative permissions” on page 13-3.)

The MAX generates an error message for any condition that causes the test to terminate before sending the full number of packets. These error messages may appear:

- not authorized

  Your current security privileges are insufficient for beginning a remote management session. To assign yourself the required privileges, log in with the DO PASSWORD command to a Security profile whose Edit System parameter is set to Yes.
- can’t find profile for <station>

  The MAX could not locate a local Connection profile containing a Station parameter whose value matched <station>.
- profile for <station> doesn’t specify MPP

  The local Connection profile containing a Station value equal to <station> did not contain Encaps=MPP.
- can’t establish connection for <station>

  The MAX located a local Connection profile containing the proper Station and Encaps settings, but it could not complete the connection to the remote station.

- <station> didn't negotiate MPP

  The remote station did not negotiate an MP+ connection. This error occurs most often when the remote station does not support MP+, but does support PPP.
- far end doesn't support remote management

  The remote station is running a version of MP+ that does not support remote management.
- management session failed

  A temporary condition, such as premature termination of the connection, caused the management session to fail.
- far end rejected session

  The remote station was configured to reject remote management; its Remote Mgmt parameter was set to No in the System profile.

## Set command

The Set command takes several arguments. To see the Set commands:

```
ascend% set ?

set ?               Display help information
set all             Display current settings
set term            Sets the telnet/rlogin terminal type
set password        Enable dynamic password serving
set fr              Frame Relay datalink control
set circuit         Frame Relay Circuit control
```

The Set All command displays current settings.

```
ascend% set all

term = vt100
dynamic password serving = disabled
```

To specify a terminal type other than the default vt100, use the Set Term command.

The Set Password command puts the terminal server in password mode, where a third-party ACE or SAFEWORD server at a secure site can display password challenges dynamically in the terminal server interface. This command applies only when using security card authentication. To enter password mode:

```
ascend% set password

Entering Password Mode...

[^C to exit] Password Mode>
```

This command puts the terminal server in password mode, where it passively waits for password challenges from a remote ACE or SAFEWORD server. To return to normal terminal server operations and thereby disable password mode, press Ctrl-C.

**Note:** Note that each channel of a connection to a secure site requires a separate password challenge, so for multichannel connections to a secure site, you must leave the terminal server in password mode until all channels have been established. The APP Server utility is an alternative way to allow users to respond to dynamic password challenges obtained from hand-held security cards. For details on dynamic password serving, see the *MAX Security Supplement*.

The Set FR commands enable you to bring down the nailed connection specified in the named Frame Relay profile. The connection will be reestablished within a few seconds. The Set

Circuit commands let you activate or deactivate a frame relay circuit. For details, see Chapter 4, “Configuring Frame Relay.”

## Show command

The Show command takes several arguments. To see the Show commands:

```
   ascend% show ?
show ?              Display help information
show arp            Display the Arp Cache
show icmp           Display ICMP information
show if             Display Interface info. Type 'show if ?' for help.
show ip             Display IP information. Type 'show ip ?' for help.
show udp            Display UDP information. Type 'show udp ?' for help.
show ospf           Display OSPF information. Type 'show ospf ?' for help.
show tcp            Display TCP information. Type 'show tcp ?' for help.
show netware        Display IPX information. Type 'show netware ? ' for
show isdn           Display ISDN events.  Type 'show isdn <line number>
show fr             Display Frame relay info. Type 'show fr ?' for help.
show pools          Display the assign address pools.
show modems         Display status of all modems.
show pad            Display X25/PAD information.
show uptime         Display system uptime.
show revision       Display system revision.
show v.110s         Display status of all v.110 cards.
show users          Display concise list of active users
show x25            Display status of X.25 stack
```

**Note:** Many of the Show commands are specific to a particular type of usage, for example, IP routing or OSPF. The chapters of this guide that relate to these types of connection and routing describe the relevant Show commands.

### Show commands related to network information

The following Show commands are related to monitoring protocols and other network-specific information:

*Table 13-1. Network-specific Show commands*

| Show command | Where described |
|---|---|
| `show arp` | See Chapter 9, “Configuring IP Routing.” |
| `show icmp` | See Chapter 9, “Configuring IP Routing.” |
| `show if` | See Chapter 9, “Configuring IP Routing.” |
| `show ip` | See Chapter 9, “Configuring IP Routing.” |
| `show udp` | See Chapter 9, “Configuring IP Routing.” |
| `show ospf` | See Chapter 10, “Configuring OSPF Routing.” |
| `show tcp` | See Chapter 9, “Configuring IP Routing.” |
| `show netware` | See Chapter 8, “Configuring IPX Routing.” |

*Table 13-1. Network-specific Show commands (continued)*

| Show command | Where described |
|---|---|
| `show fr` | See Chapter 4, “Configuring Frame Relay.” |
| `show pools` | See Chapter 9, “Configuring IP Routing.” |
| `show pad` | See Chapter 5, “Configuring X.25.” |
| `show x25` | See Chapter 5, “Configuring X.25.” |

### Show ISDN

The Show ISDN command enables the MAX to display the last 20 events that have occurred on the specified ISDN line. Enter the command in this format:

```
show isdn <line-number>
```

where <line-number> is the number of the ISDN line. For details on how lines are numbered, see Chapter 2, “Configuring the MAX for WAN Access.” For example, to display information about the leftmost built-in WAN port:

```
ascend% show isdn 0
```

The MAX responds with one or more of these messages:

```
PH: ACTIVATED
PH: DEACTIVATED
DL: TEI ASSIGNED (BRI interfaces only)
DL: TEI REMOVED (BRI interfaces only)
NL: CALL REQUEST
NL: CLEAR REQUEST
NL: ANSWER REQUEST
NL: CALL CONNECTED
NL: CALL FAILED/T303 EXPIRY
NL: CALL CLEARED/L1 CHANGE
NL: CALL REJECTED/OTHER DEST
NL: CALL REJECTED/BAD CALL REF
NL: CALL REJECTED/NO VOICE CALLS
NL: CALL REJECTED/INVALID CONTENTS
NL: CALL REJECTED/BAD CHANNEL ID
NL: CALL FAILED/BAD PROGRESS IE
NL: CALL CLEARED WITH CAUSE
```

In some cases, the message can include a phone number (prefixed by #), a data service (suffixed by K for kbps), a channel number, TEI assignment, and cause code. For example, this information might display:

```
PH: ACTIVATED
NL: CALL REQUEST: 64K, #442
NL: CALL CONNECTED: B2, #442
NL: CLEAR REQUEST: B1
NL: CALL CLEARED WITH CAUSE 16 B1 #442
```

For information on each of the messages that can display, see the CCITTT Blue Book Q.931 or other ISDN specifications.

### Show Modems

To display the status of the MAX unit’s digital modems:

```
ascend% show modems

slot:item    modem    status
   8:1         1       online
   8:2         2       online
   8:3         3       online
   8:4         4       idle
   8:5         5       idle
   8:6         6       idle
   8:7         7       idle
   8:8         8       idle
```

The output contains these fields:

- slot:item—The slot and port number of the modem. For example, 8:1 indicates the first port on the digital modem card installed in slot 8.
- modem: The SNMP interface number of each modem.
- status: Modem status, which may be one of the following strings:
  - idle: The modem is not in use.
  - awaiting DCD: The call is up and waiting for DCD.
  - awaiting codes: DCD is up, and the call is waiting for modem result codes.
  - online: The call is up. The modem can now send and receive data.
  - initializing: The modem is being reset.

### Show Uptime

To see how long the MAX has been running:

```
ascend% show uptime

system uptime: up 2 days, 4 hours, 38 minutes, 43 seconds
```

If the MAX stays up 1000 consecutive days with no power cycles, the number of days displayed “turns over” to 0 and begins to increment again.

### Show Revision

The Show Revision command displays the software load and version number currently running in the MAX.

```
ascend% show revision

techpubs-lab-17 system revision: ebiom.m40 5.0A
```

### Show V.110s

To display the status of the MAX unit’s v.110 cards:

```
ascend% show v.110s

slot:item    v.110s    status
   4:1         1       in use
   4:2         2       in use
   4:3         3       in use
   4:4         4       open issued
   4:5         5       carrier detected
   4:6         6       session closed
   4:7         7       idle
   4:8         8       in use
```

The output contains these fields:

- slot:item—The slot and port number of the V110 port. For example, 8:1 indicates the first port on the V110 card installed in slot 8.
- v.110s: The SNMP interface number of each V110 card.
- status: V.110 port status, which may be one of the following strings:
  - idle: The V.110 port is not in use.
  - open issued: An open was issued, but the MAX has not synced up with the far end.
  - carrier detected: A carrier was detected from the remote end.
  - in use: A V.110 session is up.

### Show Users

To display the number of active sessions:

```
ascend% show users

I Session     Line:    Slot:  Data    Service     Host           User
O ID          Channel  Port   Rate    Type[mpID]  Address        Name
O 214933581   1:2      9:1    56K     MPP[1]      192.168.4.9    arwp50
O 214933582   1:6      9:2    56K     MPP[1]      MPP Bundle     arwp50
I 214933583   1:1      3:1    28800   Termsrv     N/A            trmhavnor
O 226235553   4:1     9:1    n/a     N/A        192.200.20.21 p25s
```

The output contains the following fields:

- IO may specify I (incoming call) or O (outgoing call).
- Session ID shows the unique session-ID.

  This is the same as Acct-Session-ID in RADIUS.
- Line:Channel shows the line and channel on which the session is established.
- Slot:Port shows the slot and port of the service being used by the session, which may be the number of a slot containing a modem card and the modem on that card, or the virtual slot of the MAX unit's bridge/router, with port giving the virtual interfaces to bridge/router starting with 1 for the first session of a multichannel session.
- Data Rate shows The bearer capacity or modem speed as appropriate to the session type.
- Service Type shows the type of session, which may be Termsrv or a protocol name.

  For MP and MPP, this shows the bundle ID shared by the calls in a multichannel session. The special values Initial and Login document the progress of a session. Initial identifies sessions that do not yet have a protocol assigned. Login identifies Termsrv sessions during the login process.
- Host Address shows the network address of the host originating the session.

  For some sessions this field is N/A. For outgoing MPP sessions only the first connection has a valid network address associated with it. All other connections in the bundle have the network address as listed as MPP Bundle.
- User Name

The station name associated with the session. Initially, this value is Answer. This is usually replaced with the name of the remote host. For terminal server sessions this is the login name. Prior to login completion this field will show the string “modem x:y” where x and y are the slot and port of them modem servicing the session.

### Kill command

The Kill command enables you to disconnect a user who establishes a connection with the Ascend unit via Telnet. You can disconnect the user by session ID. The disconnect code that results is identical to the RADIUS disconnect code, allowing you to track all administrative disconnects. To terminate a Telnet session, use this format:

```
kill <session ID>
```

where <session ID> is the session ID as displayed by the Show Users command described in the preceding section. The reported disconnect cause is DIS_LOCAL_ADMIN. The active Security profile must have Edit All Calls=Yes. If Edit All Calls=No, this message displays when you issue the kill command:

```
Insufficient security level for that operation.
```

When the session is properly terminated, a message like this one displays:

```
Session 216747095 killed.
```

When the session is not terminated, a caution like this one displays:

```
Unable to kill session 216747095.
```

# SNMP administration support

The MAX supports SNMP on a TCP/IP network. An SNMP management station that uses the Ascend Enterprise MIB can query the MAX, set some parameters, sound alarms when certain conditions appear in the MAX, and so forth. An SNMP manager must be running on a host on the local IP network, and the MAX must be able to find that host, either via static route or RIP.

SNMP has its own password security, which you should set up to protect the MAX from being reconfigured from an SNMP station.

## Configuring SNMP access security

There are two levels of SNMP security: community strings, which must be known by a community of SNMP managers to access the box, and address security, which excludes SNMP access unless it is initiated from a specified IP address. These are the relevant parameters:

```
Ethernet
   Mod Config
      SNMP options...
         Read Comm=Ascend
         R/W Comm=Secret
         Security=Yes
         RD Mgr1=10.0.0.1
         RD Mgr2=10.0.0.2
         RD Mgr3=10.0.0.3
         RD Mgr4=10.0.0.4
         RD Mgr5=10.0.0.5
         WR Mgr1=10.0.0.11
         WR Mgr2=10.0.0.12
         WR Mgr3=10.0.0.13
         WR Mgr4=10.0.0.14
         WR Mgr5=10.0.0.15
```

For details on each parameter, see the *MAX Reference Guide*.

## Understanding the SNMP options

This section provides some background information on the SNMP profile settings.

- Setting community strings

  The Read Comm parameter specifies the SNMP community name for read access (up to 32 characters), and the R/W Comm parameter specifies SNMP community name for read/write access.

- Setting up and enforcing address security

  If the Security parameter is set to No (its default value), any SNMP manager that presents the right community name will be allowed access. If it is set to Yes, the MAX checks the source IP address of the SNMP manager and allows access only to those IP addresses listed in the RD MgrN and WR MgrN parameters, each of which specify up to five host addresses.

## Example SNMP security configuration

This example sets the community strings, enforces address security, and prevents write access:

**1** Open Ethernet>Mod Config>SNMP Options.

**2** Specify the Read Comm and R/W comm parameter strings.

**3** Set Security to Yes.

**4** Specify up to five host addresses in the RD MgrN parameters. Leave the WR MgrN parameters set to zero to prevent write access.

```
Ethernet
   Mod Config
      SNMP options...
         Read Comm=Secret-1
         R/W Comm=Secret-2
         Security=Yes
         RD Mgr1=10.0.0.1
         RD Mgr2=10.0.0.2
         RD Mgr3=10.0.0.3
         RD Mgr4=10.0.0.4
         RD Mgr5=10.0.0.5
         WR Mgr1=0.0.0.0
         WR Mgr2=0.0.0.0
         WR Mgr3=0.0.0.0
         WR Mgr4=0.0.0.0
         WR Mgr5=0.0.0.0
```

**5** Close the Ethernet profile.

## Setting SNMP traps

A trap is a mechanism for reporting system change in real time, for example, reporting an incoming call to a serial host port. When a trap is generated by some condition, a traps-PDU (protocol data unit) is sent across the Ethernet to the SNMP manager.

These are the parameters related to setting SNMP traps:

```
Ethernet
   SNMP Traps
      Name=
      Alarm=Yes
      Port=Yes
      Security=Yes
      Comm=
      Dest=10.2.3.4
```

For details on each parameter and the events that generate traps in the various classes, see the *MAX Reference Guide*.

### Understanding the SNMP trap parameters

This section provides some background information about setting traps.

- The community string for communicating with the SNMP manager

  The Comm field must contain the community name associated with the SNMP PDU.
- Classes of traps to be sent to the specified host

  The next three fields specify whether the MAX traps alarm events, security events, and port events and sends a trap-PDU to the SNMP manager.
- Specifying the destination address for the trap-status report.

  If DNS or YP/NIS is supported, the Dest field can contain the hostname of a system running an SNMP manager. The DNS or YP/NIS is not supported, the Dest field must contain the host’s address.

  **Note:** To turn off SNMP traps, set Dest=0.0.0.0 and delete the value for Comm.

### Example SNMP trap configuration

In this example profile, a community name is specified and the host’s IP address is specified i the Dest parameter.

1. Open an SNMP Traps profile and assign it a name.
2. Specify the community name (for example, Ascend).
3. Set the trap types to Yes.
4. Specify the IP address of the host to which the trap-PDUs will be sent.

```
Ethernet
   SNMP Traps
      Name=security-traps
      Alarm=Yes
      Port=Yes
      Security=Yes
      Comm=Ascend
      Dest=10.2.3.4
```

**5** Close the SNMP Traps profile.

# Ascend enterprise traps

This section gives a brief summary of the traps generated by alarm, port, and security events. For details, see the Ascend Enterprise MIB. For details on obtaining the Ascend MIB, see "Supported MIBs" on page 13-26.

## Alarm events

Alarm events (also called "error events") use trap types defined in RFC 1215 and 1315, as well as an Ascend enterprise trap type. The following trap types from RFC 1215 are supported:

- coldStart (RFC-1215 trap-type 0)

  A coldStart trap signifies that the MAX sending the trap is reinitializing itself so that the configuration of the SNMP manager or the unit might be altered.
- warmStart (RFC-1215 trap-type 1)

  A warmStart trap signifies that the MAX sending the trap is reinitializing itself so that neither the configuration of SNMP manager or the unit is altered.
- linkDown (RFC-1215 trap-type 2)

  A linkDown trap signifies that the MAX sending the trap recognizes a failure in one of the communication links represented in the SNMP manager's configuration.
- linkUp (RFC-1215 trap-type 3)

  A linkUp trap signifies that the MAX sending the trap recognizes that one of the communication links represented in the SNMP manager's configuration has come up.
- frDLCIStatusChange (RFC-1315 trap-type 1)

  A DLCIStatusChange trap signifies that the MAX sending the trap recognizes that one of the virtual circuits (to which a DLCI number has been assigned) has changed state; that is, the link has either been created, invalidated, or it has toggled between the active and inactive states.
- eventTableOverwrite (ascend trap-type 16)

  A new event has overwritten an unread event. This trap is sent only for systems that support Ascend's accounting MIB. Once sent, additional overwrites will not cause another trap to be sent until at least one table's worth of new events have occurred.

## Port state change events

These traps are effective on a port-by-port basis for each port pointed to by ifIndex. The hostPort objects are used to associate a change with ifIndex objects.

- portInactive (ascend trap-type 0)

  AIM port associated with the passed index has become inactive.
- portDualDelay (ascend trap-type 1)

  AIM port associated with the passed index is delaying the dialing of a second to avoid overloading devices that cannot handle two calls in close succession.
- portWaitSerial (ascend trap-type 2)

  AIM port associated with the passed index has detected DTR and is waiting for an HDLC controller to come online. CTS is off (V.25 bis dialing only).

- portHaveSerial (ascend trap-type 3)

  AIM port associated with the passed index is waiting for V.25 bis commands. CTS is on.
- portRinging (ascend trap-type 4)

  AIM port associated with the passed index has been notified of an incoming call.
- portCollectDigits (ascend trap-type 5)

  AIM port associated with the passed index is receiving digits from an RS366 interface (RS-366 dialing only).
- portWaiting (ascend trap-type 6)

  AIM port associated with the passed index is waiting for connect notification from the WAN after dialing or answer notification has been issued.
- portConnected (ascend trap-type 7)

  AIM port associated with the passed index has changed state. This change of state can be from connected to unconnected or vice versa. If connected to the far end, end-to-end data can flow but has not yet been enabled.

  The following trap report sequence shows a link is up:

  portWaiting (6)

  portConnected (7)

  portCarrier (8)

  The following trap report sequence shows a link is down:

  portConnected (7)

  portInactive (0)
- portCarrier (ascend trap-type 8)

  AIM port associated with the passed index has end-to-end data flow enabled.
- portLoopback (ascend trap-type 9)

  AIM port associated with the passed index has been placed in local loopback mode.
- portAcrPending (ascend trap-type 10)

  AIM port associated with the passed index has set ACR on the RS366 interface, and is waiting for the host device (RS-366 dialing only).
- portDTENotReady (ascend trap-type 11)

  AIM port associated with the passed index is waiting for DTE to signal a ready condition when performing X.21 dialing.

## Security events

Security events are used to notify users of security problems and track access to the unit from the console. The MIB-II event “authenticationError” is a security event. The other security events are Ascend-specific.

- authenticationFailure (RFC-1215 trap-type 4)

  An authenticationFailure trap signifies that the MAX sending the trap is the addressee of a protocol message that is not properly authenticated.
- consoleStateChange (ascend trap-type 12)

  The console associated with the passed console index has changed state. To read the console’s state get ConsoleEntry from the Ascend enterprise MIB.
- portUseExceeded (ascend trap-type 13)

The serial host port's use exceeds maximum set by Max DS0 Mins Port parameter associated with the passed index (namely, the interface number).

- systemUseExceeded (ascend trap-type 14)

  The serial host port's use exceeds maximum set by Max DS0 Mins System parameter associated with the passed index (namely, the interface number).
- maxTelnetAttempts (ascend trap-type 15)

  There have been three consecutive failed attempts to login onto this MAX via Telnet.

## Supported MIBs

You can download the most up-to-date verson of the Ascend Enterprise MIB by logging in as "anonymous" to ftp.ascend.com. (No password is required.) In addition to the Ascend MIB, the MAX also supports objects related to Ascend functionality in the following Internet standard MIBs:

- MIB-II implementation (RFC 1213)
- DS1 MIB implementation (RFC 1406)
- RS232 MIB implementation (RFC-1317)
- Frame Relay MIB implementation (RFC-1315)
- Modem MIB implementation (RFC 1696)

You can download the most recent version of these RFCs by logging in as "anonymous" to ftp.ds.internic.net. (No password is required.)

# Troubleshooting

# A

This appendix explores the types of problems that might interrupt or prevent call transmission, and suggests some procedures for addressing those problems. It covers these topics:

# ISDN cause codes

ISDN cause codes are numerical diagnostic codes sent from an ISDN switch to a DTE; these codes provide an indication of why a call failed to be established or why a call terminated. The cause codes are part of the ISDN D-channel signaling communications supported by the Signaling System 7 supervisorial network (WAN). When you dial a call from the MAX using ISDN access, the MAX reports the cause codes in the Message Log status menu. When the MAX clears the call, a cause code is reported even when inband signaling is in use. If the PRI or BRI switch type is 1TR6 (Germany), see Table A-2.

Table A-1 lists the numerical cause codes and provides a description of each.

*Table A-1. ISDN cause codes*

| Code | Cause |
|---|---|
| 0 | Valid cause code not yet received |
| 1 | Unallocated (unassigned) number |
| 2 | No route to specified transit network (WAN) |
| 3 | No route to destination |
| 4 | Send special information tone |
| 5 | Misdialed trunk prefix |
| 6 | Channel unacceptable |
| 7 | Call awarded and being delivered in an established channel |
| 8 | Prefix 0 dialed but not allowed |
| 9 | Prefix 1 dialed but not allowed |
| 10 | Prefix 1 dialed but not required |
| 11 | More digits received than allowed, but the call is proceeding |
| 16 | Normal clearing |
| 17 | User busy |
| 18 | No user responding |
| 19 | No answer from user (user alerted) |
| 21 | Call rejected |
| 22 | Number changed |
| 23 | Reverse charging rejected |
| 24 | Call suspended |

*Table A-1. ISDN cause codes (continued)*

| Code | Cause |
|---|---|
| 25 | Call resumed |
| 26 | Non-selected user clearing |
| 27 | Destination out of order |
| 28 | Invalid number format (incomplete number) |
| 29 | Facility rejected |
| 30 | Response to STATUS ENQUIRY |
| 31 | Normal, unspecified |
| 33 | Circuit out of order |
| 34 | No circuit/channel available |
| 35 | Destination unattainable |
| 37 | Degraded service |
| 38 | Network (WAN) out of order |
| 39 | Transit delay range cannot be achieved |
| 40 | Throughput range cannot be achieved |
| 41 | Temporary failure |
| 42 | Switching equipment congestion |
| 43 | Access information discarded |
| 44 | Requested circuit channel not available |
| 45 | Pre-empted |
| 46 | Precedence call blocked |
| 47 | Resource unavailable, unspecified |
| 49 | Quality of service unavailable |
| 50 | Requested facility not subscribed |
| 51 | Reverse charging not allowed |
| 52 | Outgoing calls barred |
| 53 | Outgoing calls barred within CUG |

*Table A-1. ISDN cause codes (continued)*

| Code | Cause |
|---|---|
| 54 | Incoming calls barred |
| 55 | Incoming calls barred within CUG |
| 56 | Call waiting not subscribed |
| 57 | Bearer capability not authorized |
| 58 | Bearer capability not presently available |
| 63 | Service or option not available, unspecified |
| 65 | Bearer service not implemented |
| 66 | Channel type not implemented |
| 67 | Transit network selection not implemented |
| 68 | Message not implemented |
| 69 | Requested facility not implemented |
| 70 | Only restricted digital information bearer capability is available |
| 79 | Service or option not implemented, unspecified |
| 81 | Invalid call reference value |
| 82 | Identified channel does not exist |
| 83 | A suspended call exists, but this call identity does not |
| 84 | Call identity in use |
| 85 | No call suspended |
| 86 | Call having the requested call identity has been cleared |
| 87 | Called user not member of CUG |
| 88 | Incompatible destination |
| 89 | Nonexistent abbreviated address entry |
| 90 | Destination address missing, and direct call not subscribed |
| 91 | Invalid transit network selection (national use) |
| 92 | Invalid facility parameter |
| 93 | Mandatory information element is missing |

*Table A-1. ISDN cause codes (continued)*

| Code | Cause |
|---|---|
| 95 | Invalid message, unspecified |
| 96 | Mandatory information element is missing |
| 97 | Message type non-existent or not implemented |
| 98 | Message not compatible with call state or message type non-existent or not implemented |
| 99 | Information element nonexistent or not implemented |
| 100 | Invalid information element contents |
| 101 | Message not compatible with call state |
| 102 | Recovery on timer expiry |
| 103 | Parameter nonexistent or not implemented, passed on? |
| 111 | Protocol error, unspecified |
| 127 | Internetworking, unspecified |

Table A-2 lists the cause codes for the 1TR6 switch type.

*Table A-2. ISDN cause codes for 1TR6 switch type*

| 1TR6 Code | Cause |
|---|---|
| 1 | Invalid call reference value |
| 3 | Bearer service not implemented. (Service not available in the A-exchange or at another position in the network, or no application has been made for the specified service.) |
| 7 | Call identity does not exist. (Unknown call identity) |
| 8 | Call identity in use. (Call identity has already been assigned to a suspended link.) |
| 10 | No channel available. (No useful channel available on the subscriber access line—only local significance.) |
| 16 | Requested facility not implemented. (The specified FAC code is unknown in the A-exchange or at another point in the network.) |
| 17 | Request facility no subscribed. (Request facility rejected because the initiating or remote user does not have appropriate authorization.) |

*Table A-2. ISDN cause codes for 1TR6 switch type (continued)*

| 1TR6 Code | Cause |
|---|---|
| 32 | Outgoing calls barred. (Outgoing call not possible due to access restriction which has been installed.) |
| 33 | User access busy . (If the total made up of the number of free B-channels and the number of calling procedures without any defined B-channel is equal to four, then any new incoming calls will be cleared down from within the network. The calling party receives a DISC with cause “user access busy” (= 1st busy instance) and engaged tone.) |
| 34 | Negative CUG comparison. (Link not possible due to negative CUG comparison.) |
| 37 | Communication as semi-permanent link not permitted |
| 48 - 50 | Not used. (Link not possible, e.g. because RFNR check is negative.) |
| 53 | Destination not obtainable. (Link cannot be established in the network due to incorrect destination address, services or facilities) |
| 56 | Number changed. (Number of B-subscriber has changed.) |
| 57 | Out of order. (Remote TE not ready) |
| 58 | No user responding. (No TE has responded to the incoming SETUP or call has been interrupted, absence assumed—expiry of call timeout T3AA.) |
| 59 | User busy. (B-subscriber busy) |
| 61 | Incoming calls barred. (B-subscriber has installed restricted access against incoming link or the service which has been requested is not supported by the B-subscriber) |
| 62 | Call rejected. (To A-subscriber: Link request actively rejected by B-subscriber —by sending a DISC in response to an incoming SETUP. To a TE during the phase in which an incoming call is being established: The call has already been accepted by another TE on the bus.) |
| 89 | Network congestion. (Bottleneck situation in the network; e.g. all-trunks-busy, no conference set free) |
| 90 | Remote user initiated. (Rejected or cleared down by remote user or exchange.) |

*Table A-2. ISDN cause codes for 1TR6 switch type (continued)*

| 1TR6 Code | Cause |
|---|---|
| 112 | Local procedure error. (In REL: Call cleared down due to local errors; e.g. invalid messages or parameters, expiry of timeout, etc. In SUS REJ: The link must not be suspended because another facility is already active. In RES REJ: No suspended call available. In FAC REJ: No further facility can be requested because one facility is already being processed, or the specified facility may not be requested in the present call status.) |
| 113 | Remote procedure error. (Call cleared down due to error at remote end.) |
| 114 | Remote user suspended. (The call has been placed on hold or suspended at the remote end.) |
| 115 | Remote user resumed. (Call at remote end is no longer on hold, suspended or in the conference status.) |
| 127 | User Info discarded locally. (The USER INFO message is rejected locally. This cause is specified in the CON CON message.) |
| 35 | Non existent CUG. (This CUG does not exist.) |

# Common problems and their solutions

This section lists problems you might encounter and describes ways to resolve them.

## General problems

### Calls fail between AIM ports

The following first-level diagnostic commands can help in troubleshooting calls between AIM ports:

- For a local loopback toward an application at its AIM port interface, use the Local LB command in the Port Diag menu.
- For a loopback toward an application at its remote-end AIM interface, use the DO Beg/ End Rem LB command.
- For a channel-by-channel error measurement, use the DO Beg/End BERT command.
- To resynchronize a multichannel call, use the DO Resynchronize command.

You must be in a profile or status window specific to an AIM port with a call online to use each DO command. For information on the Local LB command and on each DO command, see the *MAX Reference Guide*

### DO menus do not allow most operations

When the list of DO commands appears, many operations may not be not available if the right profile is not selected. Because the MAX can manage a number of calls simultaneously, you might need to select a specific Connection profile, Port profile, or a Call profile in order to see certain DO commands. For example, to dial a Call profile or a Connection profile, you must move to the Call profile (Host/6>Port N Menu>Directory) or the Connection profile, and then type Ctrl-D 1.

Note that you cannot dial if Operations=No for the control port. If a call is already active, DO 2 (Hang Up) appears instead of DO 1 (Dial). If the line is not available, Trunk Down appears in the message log and you cannot dial.

### POST takes more than 30 seconds to complete

The MAX now downloads the 12MOD modem code, waits for the modems to checksum the downloaded code, and then verifies the checksum matches before continuing with AT POST. Previously, the MAX downloaded the modem code and immediately commence with AT POST. This feature helps to reduce the POST failure rates for the MOD12 cards.

The 12MOD digital modem slot card boots every time the MAX is power-cycled, and requires boot-up configuration data from the MAX. This means the MAX makes two further attempts to download the code for the MAX’s MOD12 digital 12-modem slot card if the first boot-up fails.

Previously, the MAX downloaded the required code and immediately commenced with AT POST (which sends the string “AT” to each modem and waits for the modem to respond with “OK”). Now the MAX downloads the modem code, waits for the modems to checksum the downloaded code, and then verifies that the checksum matches before continuing. If the checksum does not match, the MAX will download the code again, up to 2 more times. If the checksum still doesn't match after three download attempts, the MAX will fail the entire slot card.

## Configuration problems

The most common problems result from improperly configured profiles.

### Some channels do not connect

You may encounter a problem where the Line Status menu shows that the MAX is calling multiple channels simultaneously, but only some of the channels connect.

An international MAX placed the call or the call was from the U.S. to another country. In some countries, setting the Parallel Dial parameter in the System profile above 1 or 2 violates certain dialing rules, and only some of the channels can connect during call setup. Try reducing the Parallel Dial parameter to the value 2. If the problem persists, try reducing it to 1.

### Data is corrupted on some international calls

You may notice that the data appears to be corrupted on single- or multichannel calls dialed in the U.S. to another country. On some international calls, the data service per channel is not conveyed by the WAN to the MAX answering the call. You must therefore set Force 56=Yes in the Call profile. If you do not, the MAX incorrectly thinks that the call uses 64-kbps channels.

### Only the base channel connects

You may encounter a problem where the first channel of an inverse multiplexing or MP+ call connects, but then the call clears or does not connect on the remaining channels.

The most common error in defining Line profiles is specifying incorrect phone numbers. The MAX cannot successfully build inverse multiplexing or MP+ calls if the phone numbers in the Line profile of the called unit are incorrect. The phone numbers that you specify in the Line profile are the numbers local to your unit. Do not enter the phone numbers of the MAX you are calling in the Line profile. The numbers you are calling belong in the Call profile, Destination profile, or Connection profile.

### No Channel Avail error message

When the MAX tries to place a call, if the error message No Channel Avail appears in the Message Log display, check the Line profile configuration. This message can also indicate that the lines’ cables have been disconnected or were installed incorrectly.

### Restored configuration has incorrect RADIUS parameters

The RADIUS Server submenu used to consist of 3 clients (specific host addresses) and 1 Server Key for all 3 clients. If the MAX supports the new RADIUS Server, the restoration of the MAX configuration will cause a problem because the new RADIUS Server allows up to 9 addresses (host or net) and a Server Key for each address. When you restore configurations with the old Client Address list, the netmask assigned to the clients will be the default netmask of the address type given (for example, 128.50.1.1 will get a netmask of 16) and not the previous 32-bit (single host) address. In addition, the Server Key will not automatically be set. You must set the Server Key manually for each client in the RADIUS Server submenu.

## Hardware configuration problems

If you cannot communicate with the MAX through the Palmtop or the vt100 control terminal, you might have a terminal configuration, control port cable, or MAX hardware problem.

### Cannot access the vt100 or Palmtop menus

If no data is displayed on the vt100 or the Palmtop, verify that the unit completes all of the power-on self tests successfully by following these steps:

**1** Verify that the MAX and your terminal are set at the same speed.

**2** Locate the LED labeled FAULT.

**3** Switch on the MAX.

The FAULT LED should remain off except during the power-on self tests. If you are using the vt100 interface, type Ctrl-L to refresh the screen. If you are using the Palmtop Controller, unplug it, wait five seconds, and plug it back in to refresh the screen.

If the FAULT LED remains on longer than a minute, there is a MAX hardware failure. A blinking FAULT LED also indicates a hardware failure. Should these situations arise, contact Ascend Customer Support.

### FAULT LED is off but no menus are displayed

If the unit passed its power-on self tests and you still cannot communicate with the vt100 interface, type Ctrl-L to refresh the screen. If you still do not see any data, check the cabling between the MAX and your terminal as follows:

**1** Check the pin-out carefully on the 9-pin cable.

The control terminal plugs into the HHT-vt100 cable or 9-pin connector labeled Control on the back of the MAX. If you are connecting to an IBM PC-like 9-pin serial connector, a straight-through cable is appropriate. Otherwise, you might need a 9-to-25 pin conversion cable.

**2** Check the flow control settings on your vt100 terminal.

If you are not communicating at all with the MAX, see whether you can establish communications after you have turned off all transmit and receive flow control at your terminal or terminal emulator.

**3** Determine whether you need a null-modem cable converter.

In general, these are not required for communications to the MAX. However, so many different cable and terminal configurations are available that occasionally a null-modem cable converter might be required.

### Random characters appear in the vt100 interface

If random or illegible characters appear on your display, there is probably a communications settings problem. You must make these settings:

- 9600 bits per second data rate
- 8 data bits
- 1 stop bit
- No flow control
- No parity

If you have changed the data rate through the Port profile, make certain that your vt100 terminal matches that rate.If the Palmtop screen presents scrambled information, unplug the Palmtop from its coiled cable, wait five seconds, and plug it back in to refresh the screen.

### A power-on self test fails

If the start-up display indicates a failure in any of its tests, an internal hardware failure has occurred with the unit. In this case, contact Ascend Customer Support.

## AIM port interface problems

There are two ways to test the AIM port interface:

- A local loopback test
- Through true end-to-end communications

Many codecs or other AIM devices support some knowledge of loopback. For example, when the MAX is in loopback mode and is connected to a codec, users see their own images through the codec. Likewise, most bridge/router devices recognize and report a diagnostic message when a packet is sent out and received by the same module. More often than not, the codec must be configured explicitly to accept the loopback from the communications device.

Local loopback testing is the best aid when troubleshooting the AIM port interface—the interface between the codec and the MAX. All of the symptoms and operations described in this section assume you are working from the local loopback diagnostics menu. Unless otherwise specified, the AIM port interfaces in this section can include the Ascend Remote Port Modules (RPMs).

The first and most critical aspect of the AIM port interface is the cable or cables connecting the codec to the MAX. If you are unsure about the cabling required, contact Ascend Customer Support.

## The MAX reports data errors on all calls

This problem can indicate that you have installed faulty host interface cables or cables not suited to the application. Information on host interface cabling requirements is found in *MAX Getting Started*

## Calls cannot be made, answered, or cleared using control leads

If you have purchased or built your own cables, verify the pin-out against the MAX pin-out for compatibility. *MAX Getting Started* lists the host interface pin-outs.

Frequently, a DB-25 breakout box is useful for monitoring control leads and for making quick changes to the cabling. However, because the host interface is running V.35 or RS-422 signal levels, you must verify that the breakout box is passive; that is, you must verify that the breakout box is not regenerating RS-232 level signals.

## The codec indicates that there is no connection

The codec expects one or more of its control lines to be active. If no lines are active, toggle the various outputs available on the local loopback diagnostics menu. If there is still no connection, verify that you have installed the host cables correctly as described in *MAX Getting Started.* If the cabling is installed correctly, examine the host interface cable pin-outs as described in *MAX Getting Started*.

## The codec does not receive data

To resolve this problem:

1. Verify that the codec is configured to accept a loopback at the communications device. Frequently, a codec requires certain control lines to be active during data transfer. Therefore, you might want to toggle the various host interface output lines, especially DSR and CD, to ensure that they are active.
2. If there is still no data transfer, your cable might not provide one or more control lines required by the host; refer to the documentation of your equipment for a description of what pins it requires to be active. These control lines are generally the most important ones:

- Carrier Detect (CD)
- Clear To Send (CTS)
- Data Set Ready (DSR)

3 If you are convinced that the control lines are in their correct states, but there is still no data transfer, you might have a clocking problem. The MAX provides both the transmit data clocks and the receive data clocks to your equipment through the host interface.The codec must be configured to accept the clocks from the MAX.

4 Check your cable length.

If the cable length exceeds the recommended distances, you should be using terminal timing. Alternately, you might need to install RPMs.

5 Check the data rate.

You can adjust the data rate from the local loopback diagnostics menu by choosing the number of channels. Some applications cannot work above or below a certain data rate; for example, some high performance codecs cannot operate at data rates less than 384 kbps. In such cases, adjust the number of channels of data being looped back.

## The codec cannot establish a call when DTR is active

You may notice that the Port profile is set to establish calls when DTR is active, but the codec cannot establish a call. If the codec is going to originate the calls directly by using control-lead dialing, the call origination and clearing mechanisms must be configured for compatibility between the MAX and the codec. To verify a compatible configuration from the local loopback diagnostics menu:

1 Disable each of the MAX output control lines except DSR.

To disable an output control line, toggle it to be Inactive (-). At this time, the codec should indicate that there is no connection.

2 Request an outgoing call from your equipment and monitor the Port Leads status menu of the ports active in the call.

One or more of the control line inputs should go active and remain active for some period of time. If the DTR input is not one of the leads that changes state, your cable is not properly configured. In this case, you must change the cable to route the appropriate host output signal to the DTR input of the MAX. The MAX must use the DTR lead to establish outgoing calls.

3 Once you have made any changes required to verify that the DTR lead becomes active when the MAX requests the call, configure the Port profile to expect the DTR input.

In the Port profile, set the Dial Call=DTR Active.

## Calls initiated by control-lead toggling are cleared too soon

You may encounter a problem where the MAX clears a call initiated by control-lead toggling before it completely establishes the call. If the call is cleared almost immediately, the Port profile most likely has a configuration error. To find the source of the problem:

1 Place an outgoing call from the codec while monitoring the Port Leads status menu of the AIM ports used in the call.

2 Watch the DTR input carefully while the MAX is establishing the call.

If the DTR input indicates Active (+) and then shortly thereafter returns to Inactive (-), the MAX is using DTR as a pulse to place the call. Make sure that the Clear parameter in the

Port profile does not have the value DTR Inactive. (DTR Inactive should be selected for Clear only when the application maintains DTR positive during the call.)

**3** While your equipment is still dialing the call, toggle the value of the CD output to indicate to your equipment that the call completed. At this time, watch the control leads very carefully. Make certain that any control leads that toggle while the call is being established are not used in the Clear parameter to clear the call. This type of configuration error is the most likely cause of a call being cleared almost immediately.

### The codec cannot clear a call

You may encounter a problem where a codec-initiated call cannot be cleared. If the call cannot be cleared from the codec, the Port profile most likely has a configuration error. To verify the source of the problem:

**1** Place an outgoing call from your equipment while monitoring the Port Leads status menu of the AIM ports used in the call.

**2** Toggle the CD output to Active (+) once the host has requested the outgoing call. The codec should recognize that the call is online.

**3** Make a request to clear the call from the codec.

**4** Watch the control leads very carefully as one or more of the input control lines toggle. Generally, either DTR or RTS is the line that toggles. Record whether the control lead input goes to Active (+) or Inactive (-) when the call is cleared; then, check that the value of the Clear parameter in the Port profile matches the action that the codec takes when the call is cleared.

## ISDN PRI and BRI interface problems

### Calls are not dialed or answered reliably

To resolve this problem, check your cabling.

The first and most critical aspect of the interface is the physical cable connecting the MAX to the line or terminating equipment. Typically, WAN interface cabling problems appear immediately after installation. If you are unsure about the cabling required, contact Ascend Customer Support. *MAX Getting Started* describes the general PRI and BRI interface requirements, and lists cabling pin-outs.

### The Net/BRI lines do not dial or answer calls

Do not connect the MAX unit’s Net/BRI ports directly to U-interface BRI lines. The MAX unit’s Net/BRI ports require carrier-approved NT1 (network terminating 1) equipment between the MAX and BRI lines. Note that Net/BRI outbound calls require the use of trunk groups.

### No Logical Link status

You may notice that the status of a Net/BRI line in the Line Status display is No Logical Link.

In some countries outside the U.S., it is common for no logical link to exist before the MAX places a call. In the U.S., when you first plug a line into the MAX or switch power on, the central office switch can take as long as 15 minutes to recognize that the line is now available.

You might have to wait that long for the line state to change to Active (A). The physical link can exist without a logical link up on the line.

If you wait longer than 15 minutes and the line is still not available:

**1** Check whether all the ISDN telephone cables are wired straight through.

If you are running multipoint (passive bus) on your switch, all of the ISDN telephone cables must be wired straight through. If any of the cables are wired to cross over, you will not be able to place calls.

**2** Check that 100% termination is provided on each ISDN line.

**3** Check whether you have correctly specified the SPIDs (Service profile Identifiers) in the Line profile for each line. If the SPIDs are not correctly specified, the line status might indicate No Logical Link. Check with your system manager or carrier representative to obtain the SPID or SPIDs for your line. You specify your SPIDs using the Pri SPID and Sec SPID parameters in the Line profile.

### WAN calling errors occur in outbound Net/BRI calls

You may encounter a problem where the Call Status window immediately indicates a WAN calling error when the MAX places a call on a Net/BRI module. To resolve the problem:

**1** Check the value of the Data Svc parameter in the Call or Connection profile.

Try both the 64K and 56K options for Data Svc to see whether using a different value solves the problem.

**2** Check whether you are using the correct dialing plan.

Depending on how the BRI lines are configured, you might need to type four, seven, or ten digits to communicate with the remote end.

Four-digit dialing involves the last four digits of your phone number. For example, if your phone number is (415) 555-9015, four-digit dialing requires that you type only the last four digits—9015. Seven-digit dialing specifies that you dial the digits 5559015, and ten-digit dialing requires 4155559015.

If you are sending the incorrect number of digits, the MAX cannot route the call. Ask your carrier representative for the correct dialing plan, or simply try all of the possibilities.

**3** Verify explicitly with your carrier representative that the line is capable of supporting the call types you are requesting.

## ISDN PRI and BRI circuit-quality problems

### Excessive data errors on calls to AIM ports

You may encounter a problem where the MAX reports excessive data errors on some calls to AIM ports. The MAX provides a BERT (byte error test) that counts data errors that occur on each channel during a call to a AIM port. The BERT checks the data integrity from the MAX at one end of the call to the MAX at the other end.

If you have verified that the MAX is correctly installed and configured, and you have previously placed calls without excessive errors, run the BERT using the command DO Beg/End BERT. Do not clear the call before running the BERT. You can run a BERT only under these conditions:

- A call is active.

- The Call Type parameter is set to AIM, FT1-B&O, or FT1-AIM.
- The Call Mgm parameter is set to Manual, Dynamic, or Delta.

You can also configure the Auto BERT parameter in the Call profile to run an automatic BERT. If the BERT indicates very high errors on some of the channels, clear the call and redial. When redialed, the call might take a different path, correcting the excessive error problem.

### Excessive handshaking on calls to AIM ports

Handshaking is a normal and momentary occurrence during call setup and when the MAX increases or decreases bandwidth. If there is trouble in the circuits that carry the call, frequent handshaking can occur. If the trouble is serious enough to degrade the quality of the call, the MAX disconnects. If handshaking is continuous for over a minute, the problem is probably not due to the quality of the line, and you should call Ascend Customer Support.

### Inbound data is scrambled during an AIM Static call

Because an AIM Static call does not have a management channel, it is possible for data scrambling to occur because of WAN slips, a type of timing error. Slips are a very infrequent occurrence. If you encounter such problems, clear the call and redial.

## Problems accessing the WAN

### Only some channels are dialed for AIM or BONDING calls

You may encounter a problem where whenever the MAX makes an AIM or BONDING call, it dials only some of the channels. To resolve this problem:

1. Verify that there are enough channels enabled for switched services in the Line profile to meet the requirements of the Parallel Dial parameter in the System profile.
2. Try adding bandwidth once the call is up.

   If you can add bandwidth, the solution is to adjust the Parallel Dial parameter in the System profile. A value of 5 works for almost all WAN providers, while some support substantially more. If adding bandwidth does not work, the problem is most likely within the individual channel translations. In this case, call your carrier representative.

### The MAX never uses some channels

To resolve this problem:

1. If you are making AIM or BONDING calls, verify that the affected channels are enabled for switched services in the Line profile.
2. Check whether the channels enabled in your Line profile correspond to the channels enabled in the circuit. If only some of the channels in the circuit are available for data calls, you must specifically enable those channels in your Line profile.
3. If you place a call and some channels are always skipped, call your carrier representative.

# Incoming call routing problems

Routing problems occur when a call is connected to the answering MAX but cannot be routed to one of its slots.

## Call status drops back to IDLE

You may see a condition where after the Call Status window reports ANSWERING and HANDSHAKING, it drops back to IDLE. This condition might not indicate a problem. It can indicate that the call was initially answered and that when its routing was checked, the target AIM port was busy or disabled. Handshaking does not occur on calls to the MAX unit’s internal router, but calls can initially be answered and then quickly cleared during normal operation, such as during the receipt of an incorrect password.

## Dual-port call status drops back to IDLE

If when trying to make a dual-port call, the Call Status menu reports ANSWERING and HANDSHAKING, and then drops back to IDLE, check the status of both ports specified in the Dual Ports, Port 1/2 Dual, Port 3/4 Dual, or Port 5/6 Dual parameter of the answering MAX. If either port in the pair is busy, the call cannot be routed to that pair.

## AIM or BONDING call status drops back to IDLE

If when trying to make an AIM or BONDING call, the Call Status window reports ANSWERING and HANDSHAKING, and then drops back to IDLE, check that the routing parameters are configured correctly. If the routing parameters are configured incorrectly, an AIM, BONDING, or AIM/DBA call might be routed to ports that cannot support these types of calls.

# Bridge/router problems

## The link is of uncertain quality

When running FTP (File Transfer Protocol), the data transfer rate appears in bytes per second. Multiply this rate times 8 to get the bits per second. For example, suppose that you are connected to Detroit on a 56-kbps B channel and that FTP indicates a 5.8 kbyte/s data rate; in this case, the link is running at 5.8x8=46.8 kbps, or approximately 83% efficiency. Many factors can affect efficiency, including the load on the FTP server, the round-trip delay, the overall traffic between endpoints, and the link quality.

You can check link quality in the WAN Stat status window, or by running a ping between the same endpoints. Dropped packets hurt the link’s efficiency, as does round-trip delay. Random round-trip delay indicates heavy traffic, a condition that also drops the efficiency of the link.

## The MAX hangs up after answering an IP call

To resolve this problem:

**1** If you are running PPP, check that you have entered the proper passwords.

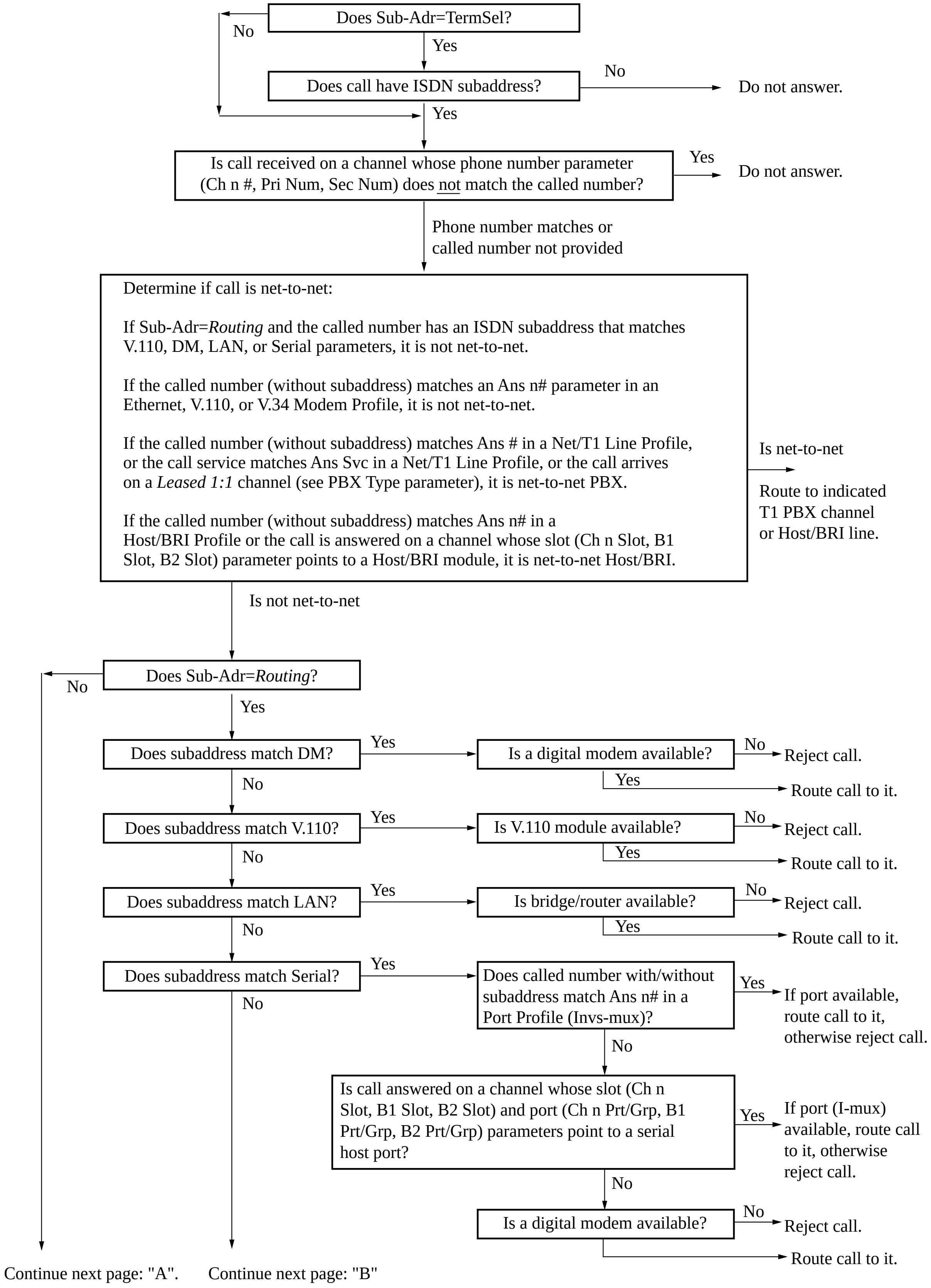
**2** Check that Auth is set to PAP or CHAP.

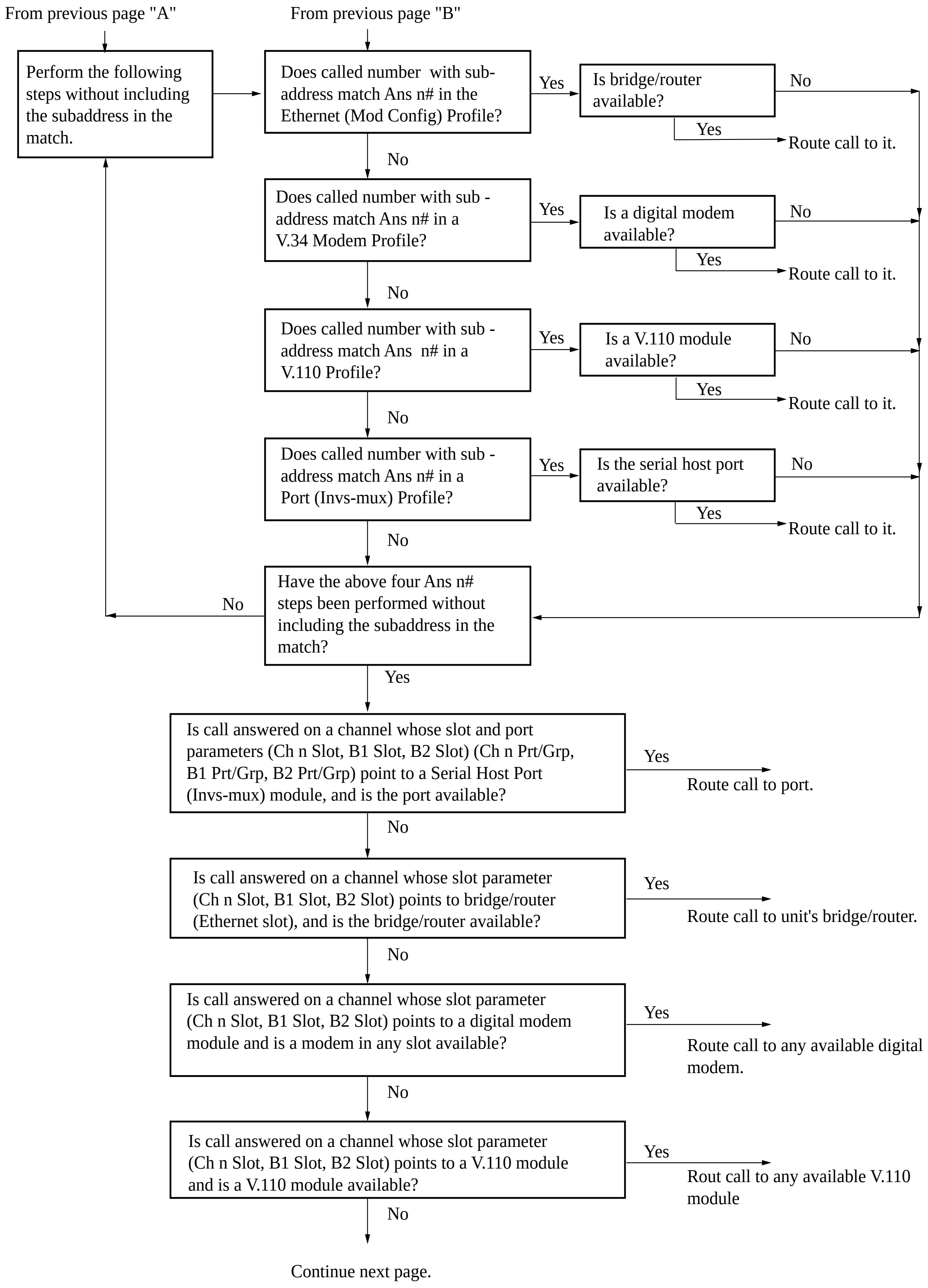
**3** If you are routing IP over PPP, check that the calling device gives its IP address

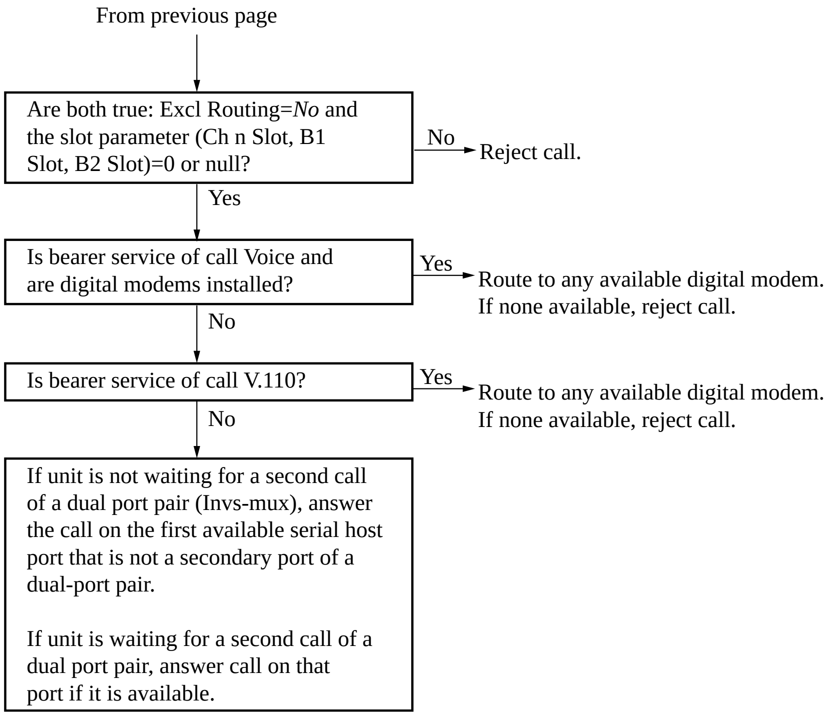
Some calling devices supply their names, but not their IP addresses. However, you can derive an IP address if the calling device is listed in a local Connection profile or on a RADIUS authentication server. Try enabling PAP or CHAP for the Recv Auth parameter so that the MAX matches the caller's name to the Station parameter in a Connection profile and gets the corresponding LAN Adrs.

# Call routing flow charts

The next pages include detailed flow-control information about inbound and outbound call routing in the MAX. To understand these charts, you should be familiar with the parameters referenced in many of the steps. For background information about call routing setups using these parameters, see Chapter 2, "Configuring the MAX for WAN Access."


Does Sub-Adr=TermSel?
No
Yes
Does call have ISDN subaddress?
No
Do not answer.
Yes
Is call received on a channel whose phone number parameter (Ch n #, Pri Num, Sec Num) does not match the called number?
Yes
Do not answer.
Phone number matches or called number not provided
Determine if call is net-to-net:
If Sub-Adr=Routing and the called number has an ISDN subaddress that matches V.110, DM, LAN, or Serial parameters, it is not net-to-net.
If the called number (without subaddress) matches an Ans n# parameter in an Ethernet, V.110, or V.34 Modem Profile, it is not net-to-net.
If the called number (without subaddress) matches Ans # in a Net/T1 Line Profile, or the call service matches Ans Svc in a Net/T1 Line Profile, or the call arrives on a Leased 1:1 channel (see PBX Type parameter), it is net-to-net PBX.
If the called number (without subaddress) matches Ans n# in a Host/BRI Profile or the call is answered on a channel whose slot (Ch n Slot, B1 Slot, B2 Slot) parameter points to a Host/BRI module, it is net-to-net Host/BRI.
Is net-to-net
Route to indicated T1 PBX channel or Host/BRI line.
Is not net-to-net
Does Sub-Adr=Routing?
No
Yes
Does subaddress match DM?
Yes
Is a digital modem available?
No
Reject call.
Yes
Route call to it.
No
Does subaddress match V.110?
Yes
Is V.110 module available?
No
Reject call.
Yes
Route call to it.
No
Does subaddress match LAN?
Yes
Is bridge/router available?
No
Reject call.
Yes
Route call to it.
No
Does subaddress match Serial?
Yes
Does called number with/without subaddress match Ans n# in a Port Profile (Invs-mux)?
Yes
If port available, route call to it, otherwise reject call.
No
No
Is call answered on a channel whose slot (Ch n Slot, B1 Slot, B2 Slot) and port (Ch n Prt/Grp, B1 Prt/Grp, B2 Prt/Grp) parameters point to a serial host port?
Yes
If port (I-mux) available, route call to it, otherwise reject call.
No
Is a digital modem available?
No
Reject call.
Route call to it.
Continue next page: "A".
Continue next page: "B"


From previous page "A"
From previous page "B"
Perform the following steps without including the subaddress in the match.
Does called number with sub-address match Ans n# in the Ethernet (Mod Config) Profile?
Yes
Is bridge/router available?
No
Yes
Route call to it.
No
Does called number with sub - address match Ans n# in a V.34 Modem Profile?
Yes
Is a digital modem available?
No
Yes
Route call to it.
No
Does called number with sub - address match Ans n# in a V.110 Profile?
Yes
Is a V.110 module available?
No
Yes
Route call to it.
No
Does called number with sub - address match Ans n# in a Port (Invs-mux) Profile?
Yes
Is the serial host port available?
No
Yes
Route call to it.
No
Have the above four Ans n# steps been performed without including the subaddress in the match?
No
Yes
Is call answered on a channel whose slot and port parameters (Ch n Slot, B1 Slot, B2 Slot) (Ch n Prt/Grp, B1 Prt/Grp, B2 Prt/Grp) point to a Serial Host Port (Invs-mux) module, and is the port available?
Yes
Route call to port.
No
Is call answered on a channel whose slot parameter (Ch n Slot, B1 Slot, B2 Slot) points to bridge/router (Ethernet slot), and is the bridge/router available?
Yes
Route call to unit's bridge/router.
No
Is call answered on a channel whose slot parameter (Ch n Slot, B1 Slot, B2 Slot) points to a digital modem module and is a modem in any slot available?
Yes
Route call to any available digital modem.
No
Is call answered on a channel whose slot parameter (Ch n Slot, B1 Slot, B2 Slot) points to a V.110 module and is a V.110 module available?
Yes
Rout call to any available V.110 module
No
Continue next page.


From previous page
Are both true: Excl Routing=*No* and the slot parameter (Ch n Slot, B1 Slot, B2 Slot)=0 or null?
No
Reject call.
Yes
Is bearer service of call Voice and are digital modems installed?
Yes
Route to any available digital modem. If none available, reject call.
No
Is bearer service of call V.110?
Yes
Route to any available digital modem. If none available, reject call.
No
If unit is not waiting for a second call of a dual port pair (Invs-mux), answer the call on the first available serial host port that is not a secondary port of a dual-port pair.
If unit is waiting for a second call of a dual port pair, answer call on that port if it is available.

# Upgrading System Software

# B

This appendix covers these topics:

**Note:** To obtain a system software upgrade for the MAX, log into the Ascend FTP server or use a Web browser to access www.ascend.com. The Web pages contain links to software releases at ftp://ftp.ascend.com/pub/Software-Releases.

# Upgrading system software

To upgrade the MAX unit’s system software:

1. If necessary, activate a Security profile in which Field Service is enabled.
2. Save the configuration to a file.
3. Load the new system software.
4. Restore the configuration.

Detailed instructions for each of these tasks are provided in this appendix.

To check which version of the system software is currently installed and which Security profile is activated, look at the Sys Options status window. For example, this Sys Options window shows that the Full Access profile is activated (Security profile 9) and the MAX is running system software version 5.0a.

```
00-100 Sys Option
>Security Prof: 9      ^
 Software +5.0a+
 S/N: 5180736          v
```

If you don’t see the status windows, press Ctrl-L to refresh the screen. If the Sys Option window is not displayed, see the for information about how to make it visible.

# What you need for the upgrade

To upgrade the system software, you need the following items:

- Latest Ascend system binary

  You can download the latest system software by logging in as “anonymous” to ftp.ascend.com. No password is required.
- A personal computer with a serial connection to the MAX.
- A communication program that supports vt100 terminal emulation and XMODEM transfer. The software must be configured for vt100 emulation with the following communication parameters:
  - 9600 bits per second
  - 8 data bits
  - No parity
  - 1 stop bit
  - No flow control
  - Direct Connect
  - Sending and receiving ASCII text

**Note:** Windows versions of communications programs do *not* work with this procedure. If you are using a Macintosh communications program, you must turn off Macbinary.

# Activating the required Security profile

To upgrade system software, the active Security profile must have the Field Service permission set to Yes. To activate a profile that enables Field Service (such as the Full Access profle):

**1** Press Ctrl-D to display the DO menu.

**2** Press P or select P=Password.

**3** Select a Security profile that has Field Service=Yes.

**4** Enter the password for that profile when prompted.

The following message briefly appears in the Edit window:

```
Password accepted.
Using new security level.
```

If you have any questions about how to activate Security profiles, refer to the *MAX Security Supplement*. You are now ready to save your configured profiles.

# Saving configured profiles

There are two ways to save the MAX unit’s configuration to file:

- System>Sys Diag>Save Cfg
- TFTP transfer via SNMP SET commands

If you use the Save Cfg command as described in this section, Security profile passwords are cleared in the file and you must specify them again after restoring the configuration. If you use TFTP, the passwords are saved in the configuration file.

## Using the Save Cfg command

To use the Save Cfg command:

**1** Select System>Sys Diag>Save Cfg and press Enter.

The following message appears:

```
Ready to download - type any key to start...
```

**2** Turn on the capture feature of your communications program and specify a filename for the configuration.

Consult the documentation for your communications program if you have questions about how to turn on the capture feature.

**3** Press any key to start saving your configured profiles.

Rows of configuration information are displayed on the screen as the file is downloaded to your hard disk. When the file has been downloaded to your hard disk, your communications program displays a message indicating the download is complete.

You can terminate the process at any time by typing Ctrl-C.

**4** Turn off the capture feature of your communications program.

Consult the documentation for your communications program if you have any questions about how to turn off the capture feature.

**5** Print a copy of your configured profiles for later reference.

## Using TFTP

You can initiate and control TFTP transfer of the MAX system configuration information by using the SNMP SET command and the  TFTP subgroup of the System Status Group has been in the Ascend enterprise MIB. This section provides examples that show how to download the Ascend configuration information to a file and then restore it to the unit. For these examples, the file in which the configuration is stored has this pathname:

```
/tftpboot/ascend.cfg
```

To store the current MAX configuration in this file:

**1** Create a file named "ascend.cfg" in the tftpboot directory (for example).

Make sure the file has read/write permissions.

**2** Set the sysConfigTftpHostAddr item to the IP address of the host on which you made the file. For example:

```
SET sysConfigTftpHostAddr 10.0.0.2
```

**3** Set the sysConfigTftpFilename item to the full path of the configuration file. For example:

```
SET sysConfigTftpFilename /tftpboot/ascend.cfg
```

**4** Set the sysConfigTftpCmd item to 1 to save the configuration.

```
SET sysConfigTftpCmd 1
```

**5** To see the status of the TFTP transfer (optional):

```
GET sysConfigTftpStatus
```

# Performing the upgrade

This section describes how to upgrade to the latest Ascend system software.

**Caution:** Uploading system software overwrites all existing configuration information. You must save the MAX configuration before you begin upgrading system software.

## Upgrading to a fat load

"Fat" loads are system executables whose compressed size exceeds 960 KB. These loads require special procedures for downloading into the MAX.

If your unit currently is using a thin load system version that is not "fat load aware," you will first need to upgrade your current thin system to make it fat load aware. This thin system should be backed up in case of fat load failure.  See "Loading a thin system that is "fat load aware"" on page B-5.

### Loading a "fat load aware" system executable using TFTP

**1** From the MAX vt100 interface, access the diagnostics monitor by typing these characters in rapid succession:

```
Esc [ Esc =
```

Or, press Ctrl-D to invoke the DO menu and select D=Diagnostics.

**2** At the > prompt, type:

**`tloadcode`** *hostname filename*

where hostname is the name or IP address of your TFTP server, and filename is the name of the system software on the server. For example, the command:

**`tloadcode tftp-server ascend.bin`**

loads ascend.bin into flash from the machine named tftp-server. The current configuration is also saved to flash before new code is received, as a precaution.

One of the following messages appears.

- The following message is displayed at the default rate of 9600 bps if the load is thin:

```
UART initialized
thin load: inflate
...........................................................
starting system...
```

- The following message appears at the default rate of 9600 bps if the load is fat:

```
UART initialized
fat load: inflate
............................................................
starting system...
```

This completes load if you have no errors.

## Loading a thin system that is “fat load aware”

If a fat load has a CRC (cyclic redundancy check) error, the following message appears:

```
UART initialized
fat load: bad CRC!!
forcing serial download at 57600 bps
please download a "thin" system...
```

Immediately after this message appears, the serial console speed is switched to 57600 bps, and control is transferred to the boot ROM’s Xmodem serial download routine. To recover from this error and load the fat system, you must load a thin system that is fat system aware. This thin load is required here because the boot ROM knows nothing about the new fat load format and only supports the traditional thin load. This thin load is probably not the system you will actually run, but it must be loaded first as a stepping stone toward downloading the desired fat system over the ethernet via tloadcode.

**1** Invoke your Xmodem software to load the thin load through the console port.

**2** Start the download of a thin load using the tloadcode command.

```
>>>> tloadcode:
```

The output of tloadcode has been modified slightly. When you download a traditional thin load, the following appears on the diagnostics monitor screen:

```
> tload yourmachinename /loads/mhpt1.bin
saving config to flash
.........................................
.
loading code from 192.168.1.82:69
file /loads/mhpt1.bin...
thin load:
..................................................................
.....
```

The change is the addition of the line “thin load” between the mention of the file name and the long series of dots.

**3** After you have finished loading the fat aware thin load, reboot the unit.

**4** Download the fat load using the tloadcode command.

When you download a fat load, the following appears on the diagnostics monitor screen:

```
> tload yourmachinename /loads/mhpt1bri.bin
saving config to flash
........................................
loading code from 192.168.1.82:69
file /loads/mhpt1bri.bin...
fat load part 1:
..................................................................
......
fat load part 2:
..................................................
```

Note the “fat load part *x*:” messages. They notify you when the first and second halves of the fat load are being loaded.

### Future unsupported loads

In the future, if you attempt to load a system that does not use the fat load format introduced by this feature, the load will be rejected if your current system does not support the new format.

```
> tload yourmachinename /loads/mhpt1bri-moldy.bin
saving config to flash
.........................................
loading code from 192.168.1.82:69
file /ascend/mb4/rtr/mhpt1bri/mhpt1bri-fatty.bin...
incompatible fat load format--discarding downloaded data
```

## Upgrading using a thin load

Older system images that are less than the maximum 960 KB are referred to as “thin” loads. To upgrade your MAX using a thin load:

**1** From the MAX vt100 interface, type these characters in rapid succession:

```
Esc [ Esc -
```

(Press the escape key, the left bracket key, the escape key, and the minus key, in that order, in rapid succession.) You will see the following string of Xmodem control characters:

```
CKCKCKCK
```

If you don’t see those characters, you probably didn’t press the four-key sequence quickly enough. Try again—most people use both hands and keep one finger on the escape key.

**2** Use the Xmodem file transfer protocol to send the system binary to the MAX.

**3** Your communications program begins sending the binary file to your MAX. This normally takes anywhere from 5 to 15 minutes. The time displayed on the screen does not represent real time. Don’t worry if your communication program displays several “bad batch” messages. This is normal.

When the upgrade process is complete, the MAX resets itself. When the self-test is complete, the MAX’s initial menu appears in the Edit window with all parameters set to default values.

# Restoring configured profiles

There are two ways to restore the MAX unit's configuration from a saved file:

- System>Sys Diag>Restore Cfg
- TFTP transfer via SNMP SET commands

**Note:** If you use Restore Cfg after saving the configuration with a Save Cfg command, passwords are not restored. In addition, no matter which method you use to restore the configured profiles, the updated software may include new parameters that require additional configuration.

## Using the Restore Cfg command

To use the Restore Cfg command:

**1** Select System>Sys Diag>Restore Cfg and press Enter.

The following message appears:

```
Waiting for upload data...
```

**2** Send the configuration file to the MAX.

If you have questions about how to send an ASCII file, check the documentation for your communications program.

When the file upload is complete, the following message is displayed.

```
Restore complete - type any key to return to menu
```

**3** Type any key to return to the MAX vt100 interface.

## Using TFTP

To restore the configuration from the /tftpboot/ascend.cfg file:

**4** Set the sysConfigTftpHostAddr item to the IP address of the host on which you made the file. For example:

```
SET sysConfigTftpHostAddr 10.0.0.2
```

**5** Set the sysConfigTftpFilename item to the full path of the configuration file. For example:

```
SET sysConfigTftpFilename /tftpboot/ascend.cfg
```

**6** Set the sysConfigTftpCmd item to 2 to restore the configuration.

```
SET sysConfigTftpCmd 2
```

**7** To see the status of the TFTP transfer (optional):

```
GET sysConfigTftpStatus
```

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