

Configuring Legacy DDR Hubs

This chapter describes how to configure legacy dial-on-demand routing on interfaces functioning as the hub in a hub-and-spoke network topology. This chapter considers a *hub* interface to be any interface that calls or receives calls from more than one other router and a *spoke* interface to be an interface that calls or receives calls from exactly one router.

For configuration tasks for the spoke interfaces in a hub-and-spoke network topology, see the “Configuring Legacy DDR Spokes” chapter in this manual. For a complete description of the DDR commands mentioned in this chapter, refer to the “Legacy DDR Hubs Commands” chapter in the *Dial Solutions Command Reference*. To locate documentation of other commands that appear in this chapter, use the command reference master index or search online.

For information about the Dialer Profiles implementation of DDR, see the “Configuring Peer-to-Peer DDR with Dialer Profiles” chapter in this manual.

DDR Issues

A DDR configuration applies to a specified router interface but serves to meet the communication needs of the network. The router configured for DDR has a function to serve in preserving communications and ensuring that routes are known to other routers at both ends of the dial link. Thus, these issues are important:

- Types and number of router interfaces to be configured for dial-on-demand routing
- Function of each specific interface—to place calls, or receive calls, or both—and the number of sites connecting to the interface
- Identity and characteristics of the router at the other end of each connection—phone number, host name, next-hop network protocol addresses, type of signaling used or required, ability to place or receive calls, other requirements
- Types of packets that will be allowed to trigger outgoing calls—if the interface places calls
- End of the connection which will control the communication: initiating calls, and terminating calls when the line is idle
- Method for authenticating other routers—if the interface receives calls from multiple sites
- Passing routing information across the dial link

Configuration Task Flow

Before you configure DDR, make sure you have completed the preparations for bridging or routing as described in the “Deciding and Preparing to Configure DDR” chapter of this manual. That chapter provides information about the minimal requirements. For detailed information about bridging, routing, and wide-area networking configurations, refer to the appropriate chapters in other volumes of this documentation set.

When you configure DDR on a hub interface in a hub-and-spoke topology, you perform the following general steps:

- Step 1** Specify the interface that will place calls to or receive calls from multiple sites. (See the “Configuring Legacy DDR Spokes” chapter for information about configuring an interface to place calls to or receive calls from one site only.)
- Step 2** Enable DDR on the interface. This step is not required for some interfaces; for example, ISDN interfaces and passive interfaces that receive only from DTR-dialing interfaces.
- Step 3** Configure the interface to receive calls only, if applicable. Receiving calls from multiple sites requires each inbound call to be authenticated.
- Step 4** Configure the interface to place calls only, if applicable.
- Step 5** Configure the interface to place and receive calls, if applicable.
- Step 6** If the interface will place calls, specify access control for:
 - Transparent bridging—Assign the interface to a bridge group, and define dialer lists associated with the bridging access lists. The interface switches between members of the same bridge group, and dialer lists specify which packets can trigger calls.
 - or
 - Routed protocols—Define dialer lists associated with the protocol access lists to specify which packets can trigger calls.
- Step 7** Customize the interface settings (timers, interface priority, hold queues, bandwidth on demand, and disabling fast switching) as needed.

When you have configured the interface and it is operational, you can monitor its performance and its connections as described in the “Monitor DDR Connections” section.

You can also enhance DDR by configuring Multilink PPP and configuring PPP callback. The PPP configuration tasks are described in the “Configuring Media-Independent PPP” chapter of this manual.

See the “Legacy DDR Hub Configuration Examples” section later in this chapter for examples of how to configure DDR on your network.

DDR Configuration Task List

To configure DDR on an interface, complete the tasks in the following sections. The first five bulleted items are required. The remaining tasks are not absolutely required, but might be necessary in your networking environment.

- Specify the Interface
- Enable DDR on the Interface

- Configure the Interface to Place Calls Only
or
Configure the Interface to Receive Calls Only
or
Configure the Interface to Place and Receive Calls
- Configure Access Control for Outgoing Calls, if applicable
- Customize the Interface Settings, as needed
- Configure to Send Traffic over Frame Relay, X.25, or LAPB Networks, if needed

You can also monitor DDR connections. See the “Monitor DDR Connections” section for commands and other information.

Specify the Interface

You can configure any asynchronous, synchronous serial, ISDN, or dialer interface for Legacy DDR.

Note When you specify an interface, make sure to use the interface numbering scheme supported on the network interface module or other port hardware on the router. On the Cisco 7200 series, for example, you specify an interface by indicating its type, slot number, and port number.

To specify an interface to configure for DDR, complete the following task in global configuration mode:

Task	Command
Specify an interface to configure for DDR. or	interface async <i>number</i> interface serial <i>number</i> interface bri <i>number</i>
Specify an ISDN PRI D channel (T1). Specify an ISDN PRI D channel (E1) or	interface serial <i>slot/port:23</i> interface serial <i>slot/port:15</i>
Specify a logical interface to function as a dialer rotary group leader.	interface dialer <i>number</i>

Dialer interfaces are logical or virtual entities, but they use physical interfaces to place or receive calls.

Enable DDR on the Interface

This step is required for asynchronous serial, synchronous serial, and logical dialer interfaces.

This step is not required for ISDN interfaces (BRI interfaces and ISDN PRI D channels) and for *purely passive* interfaces that will receive calls only from interfaces that use DTR dialing.

Enabling DDR on an interface usually requires you to specify the type of dialer to be used. This step is not required for ISDN interfaces because the software automatically configures ISDN interfaces to be dialer type ISDN.

Configure the Interface to Place Calls Only

To enable DDR on the interface, complete the following task in interface configuration mode:

Task	Command
Enable DDR on an asynchronous interface or a synchronous serial interface using V.25bis modems.	dialer in-band [no-parity odd-parity]

You can optionally specify parity if the modem on this interface uses the V.25bis command set. The 1984 version of the V.25bis specification states that characters must have odd parity. However, the default for the **dialer in-band** command is no parity.

Configure the Interface to Place Calls Only

To configure an interface to place calls to multiple destinations, complete the following tasks. The first task is required for all interface types. The second task is required only if you specified a dialer interface.

- Define the Dialing Destination
- Specify a Physical Interface to Use and Assign it to a Dialer Rotary Group

Define the Dialing Destination

For calling multiple sites, an interface or dialer rotary group must be configured to map each next hop protocol address to the dial string (some form of a telephone number) used to reach it.

To define each dialing destination, perform one of the following tasks in interface configuration mode:

Task	Command
Define a dialing destination for a synchronous serial interface or a dialer interface.	dialer map <i>protocol next-hop-address dial-string[:isdn-subaddress]</i>
Define a dialing destination for an ISDN interface (including an ISDN PRI D channel).	dialer map <i>protocol next-hop-address</i> [spc] [speed 56 64] [broadcast] [<i>dial-string[:isdn-subaddress]</i>]
Define a dialing destination for an asynchronous interface. If a modem dialing chat script has not been assigned to the line or a system login chat script must be specified, define both a dialing destination and the chat scripts to use.	dialer map <i>protocol next-hop-address</i> [modem-script <i>modem-regexp</i>] [system-script <i>system-regexp</i>] [<i>dial-string[:isdn-subaddress]</i>]

Repeat this step as many times as needed to ensure that all dialing destinations are reachable via some next hop address and dialed number.

If you intend to send traffic over other types of networks, see the appropriate section “Configure the Interface for Sending Traffic over a Frame Relay Network,” “Configure the Interface for Sending Traffic over an X.25 Network,” and “Configure the Interface for Sending Traffic over a LAPB Network.”

Specify a Physical Interface to Use and Assign it to a Dialer Rotary Group

This section applies only if you specified a dialer interface to configure for DDR.

To assign a physical interface to a dialer rotary group, perform the following tasks starting in global configuration mode:

Task	Command
Step 1 Specify a physical interface to use.	interface serial <i>number</i> interface async <i>number</i>
Step 2 Assign the specified physical interface to a dialer rotary group.	dialer rotary-group <i>number</i>

Repeat these two steps for each physical interface to be used by the dialer interface.

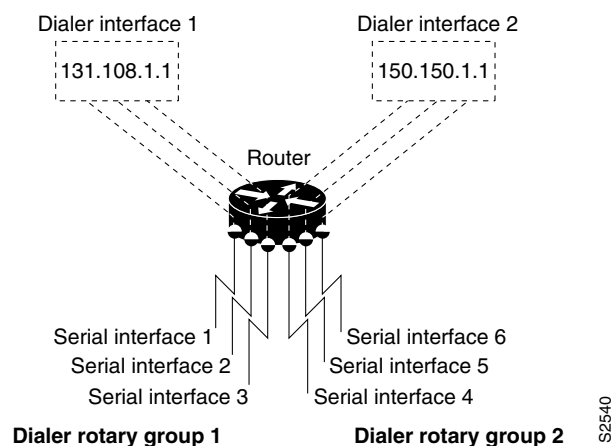
An ISDN BRI is a rotary group of B channels. An ISDN interface can be part of a rotary group comprising other interfaces (synchronous, asynchronous, ISDN BRI, or ISDN PRI). However, Cisco supports at most one level of recursion; that is, a rotary of rotaries is acceptable, but a rotary of rotaries of rotaries is not supported.

Interfaces in a dialer rotary group do not have individual addresses; when the interface is being used for dialing, it inherits the parameters configured for the dialer interface. However, if the individual interface is configured with an address and it is subsequently used to establish a connection from the user EXEC level, the individual interface address again applies.

Note When you look at your configuration file, commands will not appear in the order in which you entered them. You will also see interface configuration commands that you did not enter, because each interface assigned to a dialer rotary group inherits the parameters of the dialer interface in the dialer rotary group.

Figure 110 illustrates how dialer interfaces work. In this configuration, serial interfaces 1, 2, and 3 are assigned to dialer rotary group 1 and thereby take on the parameters configured for dialer interface 1. When it is used for dialing, the IP address of serial interface 2 is the same as the address of the dialer interface, 131.108.1.1.

Figure 110 Sample Dialer Interface Configuration



Configure the Interface to Receive Calls Only

Once DDR is enabled on an asynchronous serial, synchronous serial, and ISDN interface, the interface can receive calls from multiple sites using one line or multiple lines.

However, interfaces that receive calls from multiple sites require authentication of the remote sites. In addition, dialer interfaces require at least one physical interface to be specified and added to the dialer rotary group. Complete the tasks in the following sections:

- Configure the Interface for TACACS+
or
- Configure the Interface for PPP Authentication
- Specify Physical Interfaces and Assign them to the Dialer Rotary Group

Configure the Interface for TACACS+

To configure Terminal Access Controller Access Control System (TACACS) as an alternative to host authentication, perform the following task in interface configuration mode:

Task	Command
Configure TACACS.	ppp use-tacacs [single-line] or aaa authentication ppp

Use the **ppp use-tacacs** command with TACACS and Extended TACACS. Use the **aaa authentication ppp** command with Authentication, Authorization, and Accounting (AAA)/TACACS+.

Configure the Interface for PPP Authentication

This section specifies the minimum required configuration for PPP CHAP or PAP authentication. For more detailed information, see the “Configuring Media-Independent PPP and Multilink PPP” chapter of this manual.

To use CHAP or PAP authentication, perform the following tasks beginning in interface configuration mode:

After you have enabled one of these protocols, the local router or access server requires authentication of the remote devices that are calling. If the remote device does not support the enabled authentication protocol, no traffic will be passed to that device.

Step 1 For CHAP, configure host name authentication and the secret or password for each remote system with which authentication is required.

Step 2 Map the protocol address to the name of the host calling in.

To enable PPP encapsulation, perform the following task in interface configuration mode:

Task	Command
Step 1 Enable PPP on an interface.	encapsulation ppp
Step 2 Enable CHAP on an interface. or Enable PAP on an interface.	ppp authentication chap [if-needed] ppp authentication pap

Task	Command
Step 3 For any host calling in to the local router or access server, map its host name (case-sensitive) to the next hop address used to reach it. Repeat this step for each host calling in to this interface.	dialer map <i>protocol next-hop-address name hostname</i>
Step 4 Return to global configuration mode.	exit
Step 5 Specify the password to be used in CHAP caller identification. Repeat this step to add a username entry for each remote system from which the local router or access server requires authentication.	username <i>hostname password secret</i>

Specify Physical Interfaces and Assign them to the Dialer Rotary Group

To assign a physical interface to a dialer rotary group, perform the following tasks starting in global configuration mode:

Task	Command
Step 1 Specify a physical interface to use.	interface serial <i>number</i> interface async <i>number</i>
Step 2 Assign the specified physical interface to a dialer rotary group.	dialer rotary-group <i>number</i>

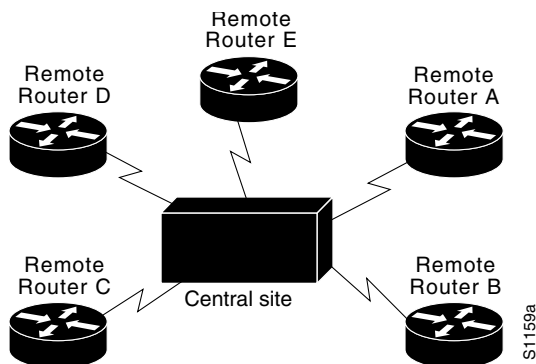
Repeat these two steps for each physical interface to be used by the dialer interface.

Configure the Interface to Place and Receive Calls

You can configure an physical interface or dialer interface to both place and receive calls. For placing calls, the interface must be configured to map each next hop address to the telephone number to dial. For receiving calls from multiple sites, the interface must be configured to authenticate callers.

Figure 111 shows a configuration in which the central site is calling and receiving calls from multiple sites. In this configuration, multiple sites are calling in to a central site, and the central site might be calling one or more of the remote sites.

Figure 111 Hub-and-Spoke Configuration Using Dial-on-Demand Routing (DDR)



To configure a single line, multiple lines, or a dialer interface to place calls to and receive calls from multiple sites, perform the following tasks in interface configuration mode:

Step 1 Define One or More Dialing Destinations

Step 2 Define the Traffic to be Authenticated

If you intend to send traffic over other types of networks, see the appropriate section “Configure the Interface for Sending Traffic over a Frame Relay Network,” “Configure the Interface for Sending Traffic over an X.25 Network,” and “Configure the Interface for Sending Traffic over a LAPB Network.”

Define One or More Dialing Destinations

For calling multiple sites, an interface or dialer rotary group must be configured to map each next hop protocol address to the dial string (some form of a telephone number) used to reach it.

To define each dialing destination, perform one of the following tasks in interface configuration mode:

Task	Command
Define only one dialing destination (used to configure one phone number on multiple lines only).	dialer string <i>dial-string[:isdn-subaddress]</i>
Define one of several dialing destinations for a synchronous serial interface or a dialer interface.	dialer map <i>protocol next-hop-address dial-string[:isdn-subaddress]</i>
Define one of several dialing destinations for an ISDN interface (including an ISDN PRI D channel).	dialer map <i>protocol next-hop-address [spc] [speed 56 64] [broadcast] [dial-string[:isdn-subaddress]]</i>
Define one of several dialing destinations for an asynchronous interface. If a modem dialing chat script has not been assigned to the line or a system login chat script must be specified, define both a dialing destination and the chat scripts to use.	dialer map <i>protocol next-hop-address [modem-script modem-regexp] [system-script system-regexp] dial-string[:isdn-subaddress]</i>

Repeat this step as many times as needed to ensure that all dialing destinations are reachable via some next hop address and dialed number.

Define the Traffic to be Authenticated

Calls from the multiple sites must be authenticated. Authentication can be done through CHAP or PAP. In addition, the interface must be configured to map a host's protocol address to the name to use for authenticating the remote host.

To enable CHAP or PAP on an interface and authenticate sites that are calling in, perform the following tasks in interface configuration mode:

Task	Command
Step 1 Configure an interface for PPP encapsulation.	encapsulation ppp
Step 2 Enable CHAP. or Enable PAP.	ppp authentication chap [if-needed] or ppp authentication pap [if-needed]
Step 3 Map the protocol address to a host name.	dialer map <i>protocol next-hop-address</i> name <i>hostname</i> [modem-script <i>modem-regexp</i>] [system-script <i>system-regexp</i>] [<i>dial-string[:isdn-subaddress]</i>]

If the dial string is not used in Step 3, the interface will be able to receive calls from the host, but will not be able to place calls to the host.

Repeat Step 3 for each site from which the router will receive calls.

Configure Access Control for Outgoing Calls

Protocol access lists and dialer access lists are central to the operation of DDR. In general, access lists are used as the screening criteria for determining when to initiate DDR calls. All packets are tested against the dialer access list. Packets that match a permit entry are deemed *interesting* or *packets of interest*. Packets that do not match a permit entry or that do match a deny entry are deemed *uninteresting*. When a packet is found to be interesting, either the dialer idle timer is reset (if the line is active) or a connection is attempted (assuming the line is available but not active). If a tested packet is deemed *uninteresting*, it will be forwarded if it is intended for a destination known to be on a specific interface and the link is active. However, such a packet will not initiate a DDR call and will not reset the idle timer.

Configure Access Control for Bridging

When you completed preparations for bridging over DDR, you entered global access lists to specify the protocol packets to be permitted or denied, and global dialer lists to specify which access list to use and which dialer group will place the outgoing calls.

Now you must tie those global lists to an interface configured for DDR. You accomplish that by assigning selected interfaces to a bridge group. Because packets are bridged only among interfaces that belong to the same bridge group, you need to assign this interface and others to the same bridge group.

To assign an interface to a bridge group, complete the following task in interface configuration mode:

Task	Command
Assign the specified interface to a bridge group.	bridge-group <i>bridge-group</i>

For examples of bridging over DDR, see the “Transparent Bridging over DDR Examples” section later in this chapter.

Configure Access Control for Routing

Before you perform the tasks outlined in this section, you should have completed the preparations for routing a protocol over DDR as described briefly in the “Deciding and Preparing to Configure DDR” chapter in this manual and as described in greater detail in the *Network Protocols Configuration Guide, Part 1*, *Network Protocols Configuration Guide, Part 2*, and *Network Protocols Configuration Guide, Part 3*.

An interface can be associated only with a single dialer access group; multiple dialer access group assignments are not allowed. To specify the dialer access group to which you want to assign an access list, perform the following task in interface configuration mode:

Task	Command
Specify the number of the dialer access group to which the specific interface belongs.	dialer-group <i>group-number</i>

Customize the Interface Settings

Perform the tasks in the following sections as needed to customize DDR in your network:

- Configure Timers on the DDR Interface
- Set Dialer Interface Priority
- Configure a Dialer Hold Queue
- Configure Bandwidth on Demand
- Disable and Reenable DDR Fast Switching

Configure Timers on the DDR Interface

Perform the tasks in the following sections as needed to configure DDR interface timers:

- Set Idle Time for Busy Interfaces
- Set Line-Down Time
- Set Carrier-Wait Time

Set Line-Idle Time

To specify the amount of time a line will stay idle before it is disconnected, perform the following task in interface configuration mode:

Task	Command
Set line-idle time.	dialer idle-timeout <i>seconds</i>

Set Idle Time for Busy Interfaces

The dialer fast idle timer is activated if there is contention for a line. Contention occurs when a line is in use, a packet for a different next hop address is received, and the busy line is required to send the competing packet.

If the line has been idle for the configured amount of time, the current call is disconnected immediately and the new call is placed. If the line has not yet been idle as long as the fast idle timeout period, the packet is dropped because there is no way to get through to the destination. (After the packet is dropped, the fast idle timer remains active and the current call is disconnected as soon as it has been idle for as long as the fast idle timeout). If, in the meantime, another packet is transmitted to the currently connected destination, and it is classified as interesting, the fast-idle timer is restarted.

To specify the amount of time a line for which there is contention will stay idle before the line is disconnected and the competing call is placed, perform the following task in interface configuration mode:

Task	Command
Set idle time for high traffic lines.	dialer fast-idle <i>seconds</i>

This command applies both to inbound and outbound calls.

Set Line-Down Time

To set the length of time the interface stays down before it is available to dial again after a line is disconnected or fails, perform the following task in interface configuration mode:

Task	Command
Set the interface downtime.	dialer enable-timeout <i>seconds</i>

This command applies both to inbound and outbound calls.

Set Carrier-Wait Time

To set the length of time an interface waits for the telephone service (carrier), perform the following task in interface configuration mode:

Task	Command
Set the length of time the interface waits for the carrier to come up when a call is placed.	dialer wait-for-carrier-time <i>seconds</i>

For asynchronous interfaces, this command sets the total time to wait for a call to connect. This time is set to allow for running the chat script.

Set Dialer Interface Priority

You can assign dialer priority to an interface. Priority indicates which interface in a dialer rotary group will get used first. Perform the following task in interface configuration mode:

Task	Command
Specify which dialer interfaces will be used first.	dialer priority <i>number</i>

For example, you might give one interface in a dialer rotary group higher priority than another if it is attached to faster, more reliable modem. In this way, the higher-priority interface will be used as often as possible.

The range of values for *number* is 0 through 255. Zero is the default value and lowest priority; 255 is the highest priority. This command applies to outgoing calls only.

Configure a Dialer Hold Queue

Sometimes packets destined for a remote router are discarded because no connection exists. Establishing a connection using an analog modem can take time, during which packets are discarded. However, configuring a dialer hold queue will allow *interesting* outgoing packets to be queued and sent as soon as the modem connection is established.

A dialer hold queue can be configured on any type of dialer, including in-band synchronous, asynchronous, DTR, and ISDN dialers. Also, *hunt group leaders* can be configured with a dialer hold queue. If a hunt group leader (of a rotary dialing group) is configured with a hold queue, all members of the group will be configured with a dialer hold queue and no individual member's hold queue can be altered.

To establish a dialer hold queue, perform the following task in interface configuration mode:

Task	Command
Create a dialer hold queue and specify the number of packets to be held in it.	dialer hold-queue <i>packets</i>

As many as 100 packets can be held in an outgoing dialer hold queue.

Configure Bandwidth on Demand

You can configure a dialer rotary group to use additional bandwidth by placing additional calls to a single destination if the load for the interface exceeds a specified weighted value. Parallel communication links are established based on traffic load. The number of parallel links that can be established to one location is not limited.

To set the dialer load threshold for bandwidth on demand, perform the following task in interface configuration mode:

Task	Command
Configure the dialer rotary group to place additional calls to a destination, as indicated by interface load.	dialer load-threshold <i>load</i>

Once multiple links are established, they are still governed by the load threshold. If the total load falls below the threshold, an idle link will be torn down.

Disable and Reenable DDR Fast Switching

Fast switching is enabled by default on all DDR interfaces. When fast switching is enabled or disabled on an ISDN D channel, it is enabled or disabled on all B channels. When fast switching is enabled or disabled on a dialer interface, it is enabled or disabled on all rotary group members but cannot be enabled or disabled on the serial interfaces individually.

Fast switching can be disabled and reenabled on a protocol-by-protocol basis. To disable fast switching and reenable it, complete one of the following protocol-specific tasks:

Task	Command
Disable IP fast switching over a DDR interface.	no ip route-cache
Reenable IP fast switching over a DDR interface.	ip route cache
Disable distributed IP fast switching over a DDR interface. This feature works in Cisco 7500 routers with a Versatile Interface Processor (VIP) card.	no ip route-cache distributed
Enable distributed IP fast switching over a DDR interface. This feature works in Cisco 7500 routers with a Versatile Interface Processor (VIP) card.	ip route-cache distributed
Disable IPX fast switching over a DDR interface.	no ipx route-cache
Reenable IPX fast switching over a DDR interface.	ipx route-cache

Configure to Send Traffic over Frame Relay, X.25, or LAPB Networks

An interface configured for DDR can send traffic over networks that require LAPB, X.25, or Frame Relay encapsulation. To configure an interface for those networks, complete the tasks in the following sections:

- Configure the Interface for Sending Traffic over a Frame Relay Network
- Configure the Interface for Sending Traffic over an X.25 Network
- Configure the Interface for Sending Traffic over a LAPB Network

Configure the Interface for Sending Traffic over a Frame Relay Network

Access to Frame Relay networks is now available through dial-up connections as well as leased lines. Dial-up connectivity allows Frame Relay networks to be extended to sites that do not generate enough traffic to justify leased lines and also allows a Frame Relay network to back up another network or point-to-point line.

DDR over Frame Relay is supported for synchronous serial and ISDN interfaces and for rotary groups, and is available for in-band, DTR, and ISDN dialers.

Frame Relay supports multiple PVC connections over the same serial interface or ISDN B channel, but only one *physical* interface can be used (dialed, connected, and active) in a rotary group or with ISDN.

Configuration Restrictions

The following restrictions apply to DDR used over Frame Relay:

- Frame Relay is not available for asynchronous dialers.
- Like HDLC, LAPB, and X.25, Frame Relay does not provide authentication. However, ISDN dialers can offer some authentication through the caller ID feature.
- Only one ISDN B channel can be dialed at any one time. When configuring a rotary group, you can use only one serial interface.

Note Frame Relay subinterfaces work the same on dial-up connections as they do on leased lines.

Configuration Overview

No new commands are required to support DDR over Frame Relay. In general, you configure Frame Relay and configure DDR. In general, complete the following steps to configure an interface for DDR over Frame Relay:

- Specify the interface.
- Specify the protocol identifiers for the interface.

For example, enter the IP address and mask, the IPX network number, and the AppleTalk cable range and zone.

- Configure Frame Relay, as described in the “Configuring Frame Relay” chapter in the *Wide-Area Networking Configuration Guide*.

As a minimum, you must enable Frame Relay encapsulation and decide whether you need to do static or dynamic address mapping. If you decide to do dynamic mapping, you do not need to enter a command because Inverse ARP is enabled by default. If you decide to do static mapping, you must enter Frame Relay mapping commands.

You can then configure various options as needed for your Frame Relay network topology.

- Configure DDR.

At a minimum, you must decide and configure the interface for outgoing calls only, incoming calls only, or both outgoing and incoming calls.

You can also configure DDR for your routed protocols (as specified in the “Deciding and Preparing to Configure DDR” chapter) and for snapshot routing (as specified in the “Configure Snapshot Routing” chapter of this manual). You can also customize DDR on your router or access server (as described in the “Customize the Interface Settings” section later in this chapter).

For examples of configuring various interfaces for DDR over Frame Relay, see the “Frame Relay Support Examples” section later in this chapter.

Configure the Interface for Sending Traffic over an X.25 Network

X.25 interfaces can now be configured to support DDR. Synchronous serial and ISDN interfaces on our routers and access servers can be configured for X.25 addresses, X.25 encapsulation, and mapping of protocol addresses to a remote host’s X.25 address. In-band, DTR, and ISDN dialers can be configured to support X.25 encapsulation, but rotary groups cannot. On ISDN dialers configured for X.25 encapsulation, only one B channel can be used.

To configure an interface to support X.25, perform the following X.25-specific tasks in interface configuration mode and also complete the DDR configuration of the interface:

Task	Command
Step 1 Configure the interface to use X.25 encapsulation.	encapsulation x25 [dte dce] [ietf]
Step 2 Assign an X.25 address to the interface.	x25 address x.121-address
Step 3 Set up the LAN protocols-to-remote host address mapping.	x25 map protocol address [protocol2 address2 [...[protocol9 address9]]] x.121-address [option]

The order of DDR and X.25 configuration tasks is not critical; you can configure DDR before or after X.25, and you can even mix the DDR and X.25 commands.

For an example of configuring an interface for X.25 encapsulation and then completing the DDR configuration, see the section “X.25 Support Configuration Example” later in this chapter.

Configure the Interface for Sending Traffic over a LAPB Network

Dial-on-demand routing over serial lines now supports Link Access Procedure, Balanced (LAPB) encapsulation, in addition to the previously supported PPP, HDLC, and X.25 encapsulations.

LAPB encapsulation is supported on synchronous serial, ISDN, and dialer rotary group interfaces, but not on asynchronous dialers.

Because the default encapsulation is HDLC, you must explicitly configure LAPB encapsulation. To configure an interface to support LAPB encapsulation, perform the following task in interface configuration mode and also complete the DDR configuration of the interface:

Task	Command
Specify LAPB encapsulation.	encapsulation lapb [<i>dte</i> <i>dce</i>] [<i>multi</i> <i>protocol</i>]

For more information about the serial connections on which LAPB encapsulation is appropriate, see the **encapsulation lapb** command in the “X.25 and LAPB Commands” chapter of the *Wide-Area Networking Command Reference*.

For an example of configuring an interface for DDR over LAPB, see the “X.25 Support Configuration Example” section later in this chapter.

Monitor DDR Connections

To monitor DDR connections and snapshot routing, perform the following tasks in privileged EXEC mode:

Task	Command
Display general diagnostics about the DDR interface.	show dialer [<i>interface type number</i>]
Display current dialer maps, next-hop protocol addresses, user names, and the interfaces on which they are configured.	show dialer map
Display information about the ISDN interface.	show interfaces bri 0
Display status about the IPX interface.	show ipx interface [<i>type number</i>]
Display information about the IPX packets transmitted by the router or access server, including watchdog counters.	show ipx traffic
Display information about the AppleTalk packets transmitted by the router or access server.	show appletalk traffic
Display information about the Banyan VINES packets transmitted by the router or access server.	show vines traffic
Display information about the DECnet packets transmitted by the router or access server.	show decnet traffic
Display information about the XNS packets transmitted by the router or access server.	show xns traffic
Clear the values of the general diagnostic statistics.	clear dialer

Legacy DDR Hub Configuration Examples

The examples provided in this section show various DDR configurations as follows:

- Transparent Bridging over DDR Examples
- Configuring DDR in an IP Environment Example
- AppleTalk Configuration Example
- Banyan VINES Configuration Example
- DECnet Configuration Example
- ISO CLNS Configuration Example
- XNS Configuration Example
- Set Up Hub-and-Spoke DDR for Asynchronous Interfaces and Authentication Example
- Dialing a Single Site or Multiple Sites Example
- Configuring Multiple Destinations Example
- Configuring Dialer Interfaces and Dialer Rotary Groups Example
- DDR Using Dialer Interface and PPP Encapsulation Example
- Set Up Two-Way DDR with Authentication Example
- Frame Relay Support Examples
- X.25 Support Configuration Example
- LAPB Support Configuration Example

Transparent Bridging over DDR Examples

The following two examples differ only in the packets that cause calls to be placed. The first example specifies by protocol (any bridge packet is permitted to cause a call to be made); the second example allows a finer granularity by specifying the Ethernet type codes of bridge packets.

The first example configures serial interface 1 for DDR bridging. Any bridge packet is permitted to cause a call to be placed.

```
no ip routing
!
interface Serial1
  no ip address
  encapsulation ppp
  dialer in-band
  dialer enable-timeout 3
  dialer map bridge name urk broadcast 8985
  dialer hold-queue 10
  dialer-group 1
  ppp authentication chap
  bridge-group 1
  pulse-time 1
!
dialer-list 1 protocol bridge permit
bridge 1 protocol ieee
bridge 1 hello 10
```

The second example also configures the serial interface 1 for DDR bridging. However, this example includes an **access-list** command that specifies the Ethernet type codes that can cause calls to be placed and a **dialer list protocol list** command that refers to the specified access list.

```
no ip routing
!
interface Serial1
no ip address
encapsulation ppp
dialer in-band
dialer enable-timeout 3
dialer map bridge name urk broadcast 8985
dialer hold-queue 10
dialer-group 1
ppp authentication chap
bridge-group 1
pulse-time 1
!
access-list 200 permit 0x0800 0xFFFF8
!
dialer-list 1 protocol bridge list 200
bridge 1 protocol ieee
bridge 1 hello 10
```

Configuring DDR in an IP Environment Example

The following example illustrates how to configure DDR to call one site from a synchronous serial interface in an IP environment. You could use the same configuration on an asynchronous serial interface by changing **interface serial 1** to specify an asynchronous interface (for example, **interface async 0**).

```
interface serial 1
ip address 131.108.126.1 255.255.255.0
dialer in-band
dialer idle-timeout 600
dialer string 5551234
pulse-time 1
! The next command adds this interface to the dialer access group defined with
! the dialer-list command
dialer-group 1
!
!The first access list statement, below, specifies that IGRP updates are not
!interesting packets. The second access-list statement specifies that all
!other IP traffic such as Ping, Telnet, or any other IP packet is interesting.
!The dialer-list command then creates dialer access group 1 and states that
!access list 101 is to be used to classify packets as interesting or
!uninteresting. The ip route commands specify that there is a route to network
!131.108.29.0 and to network 131.108.1.0 via 131.108.126.2. This means that
!several destination networks are available through a router that is dialed
!from interface serial 1.
!
access-list 101 deny igmp 0.0.0.0 255.255.255.255 255.255.255.255 0.0.0.0
access-list 101 permit ip 0.0.0.0 255.255.255.255 0.0.0.0 255.255.255.255
dialer-list 1 list 101
ip route 131.108.29.0 131.108.126.2
ip route 131.108.1.0 131.108.126.2
ip local pool dialin 101.102.126.2 101.102.126.254
```

With many modems, the **pulse-time** command must be used so that DTR is dropped for sufficient time to allow the modem to disconnect.

AppleTalk Configuration Example

In the following example, DDR is configured for AppleTalk access using an ISDN BRI. Two access lists are defined: one for IP and IGRP, and one for AppleTalk. AppleTalk packets from network 2141 only (except broadcast packets) can initiate calls.

```
interface BRI0
 ip address 130.1.20.107 255.255.255.0
 encapsulation ppp
 appletalk cable-range 2141-2141 2141.65
 appletalk zone SCruz-Eng
 no appletalk send-rtmps
 dialer map ip 130.1.20.106 broadcast 1879
 dialer map appletalk 2141.66 broadcast 1879
 dialer-group 1
!
access-list 101 deny igrp 0.0.0.0 255.255.255.255 255.255.255.255 0.0.0.0
access-list 101 permit ip 0.0.0.0 255.255.255.255 0.0.0.0 255.255.255.255
access-list 601 permit cable-range 2141-2141 broadcast-deny
access-list 601 deny other-access
!
dialer-list 1 list 101
dialer-list 1 list 601
```

Banyan VINES Configuration Example

In the following example, a router is configured for VINES and IP DDR with in-band dialing. The VINES access list does not allow RTP routing updates to place a call, but any other data packet is interesting.

```
vines routing BBBB BBBB:0001
!
hostname RouterA
!
username RouterB password 7 030752180500
username RouterC password 7 00071A150754
!
interface serial 0
 ip address 131.108.170.19 255.255.255.0
 encapsulation ppp
 vines metrics 10
 vines neighbor AAAAAAAA:0001 0
 dialer in-band
 dialer map ip 131.108.170.151 name RouterB broadcast 4155551234
 dialer map vines AAAAAAAA:0001 name RouterC broadcast 4155551212
 dialer-group 1
 ppp authentication chap
 pulse-time 1
!
access-list 101 deny igrp 0.0.0.0 255.255.255.255 0.0.0.0 255.255.255.255
access-list 101 permit ip 0.0.0.0 255.255.255.255 0.0.0.0 255.255.255.255
!
vines access-list 107 deny RTP 00000000:0000 FFFFFFFF:FFFF 00000000:0000 FFFFFFFF:FFFF
vines access-list 107 permit IP 00000000:0000 FFFFFFFF:FFFF 00000000:0000 FFFFFFFF:FFFF
!
dialer-list 1 protocol ip list 101
dialer-list 1 protocol vines list 107
```

DECnet Configuration Example

In the following example, a router is configured for DECnet DDR with in-band dialing:

```
decnet routing 10.19
!
username RouterB password 7 030752180531
!
interface serial 0
no ip address
decnet cost 10
encapsulation ppp
dialer in-band
dialer map decnet 10.151 name RouterB broadcast 4155551212
dialer-group 1
ppp authentication chap
pulse-time 1
!
access-list 301 permit 10.0 0.1023 0.0 63.1023
!
dialer-list 1 protocol decnet list 301
```

ISO CLNS Configuration Example

In the following example, a router is configured for CLNS DDR with in-band dialing:

```
username RouterB password 7 111C140B0E
clns net 47.0004.0001.0000.0c00.2222.00
clns routing
clns filter-set ddrline permit 47.0004.0001....
!
interface serial 0
no ip address
encapsulation ppp
dialer in-band
dialer map clns 47.0004.0001.0000.0c00.1111.00 name RouterB broadcast 1212
dialer-group 1
ppp authentication chap
clns enable
pulse-time 1
!
clns route default serial 0
dialer-list 1 protocol clns list ddrline
```

XNS Configuration Example

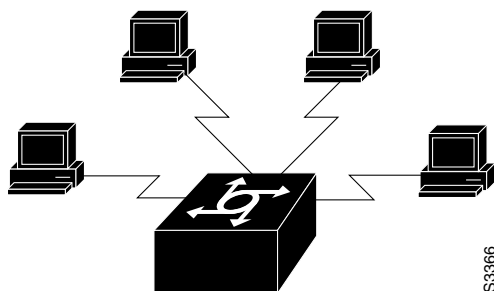
In the following example, a router is configured for XNS DDR with in-band dialing. The access lists deny broadcast traffic to any host on any network, but allow all other traffic.

```
xns routing 0000.0c01.d8dd
username RouterB password 7 111B210A0F
interface serial 0
no ip address
encapsulation ppp
xns network 10
dialer in-band
dialer map xns 10.0000.0c01.d877 name RouterB broadcast 4155551212
dialer-group 1
ppp authentication chap
pulse-time 1
access-list 400 deny -1 -1.ffff.ffff.ffff 0000.0000.0000
access-list 400 permit -1 10
dialer-list 1 protocol xns list 400
```

Set Up Hub-and-Spoke DDR for Asynchronous Interfaces and Authentication Example

You can set up dial-on-demand routing (DDR) to provide service to multiple remote sites. In a hub-and-spoke configuration, you can use a generic configuration script to set up each remote connection. Figure 112 illustrates a typical hub-and-spoke configuration.

Figure 112 Hub-and-Spoke DDR Configuration



This configuration is demonstrated in the following two subsections.

Spoke Router

The following example, configuration is performed on the spoke side of the connection. (A different “spoke” password must be specified for each remote client.) It provides authentication by identifying a password that must be provided on each end of the connection.

```
interface ethernet 0
 ip address 172.30.44.1 255.255.255.0
!
interface async 7
 async mode dedicated
 async default ip address 128.150.45.1
 ip address 1172.30.45.2 255.255.255.0
 encapsulation ppp
 ppp authentication chap
 dialer in-band
 dialer map ip 172.30.45.1 name hub system-script hub 1234
 dialer map ip 172.30.45.255 name hub system-script hub 1234
 dialer-group 1
!
ip route 172.30.43.0 255.255.255.0 172.30.45.1
 ip default-network 172.30.0.0
 chat-script generic ABORT BUSY ABORT NO ## AT OK ATDT\T TIMEOUT 30 CONNECT
 chat-script hub "" "" name: spokel word" <spokel-passwd> PPP
 dialer-list 1 protocol ip permit
!
username hub password <spokel-passwd>
!
router igrp 109
 network 172.30.0.0
 passive-interface async 7
!
line 7
 modem InOut
 speed 38400
 flowcontrol hardware
 modem chat-script generic
```

Hub Router Configuration

In the following example, configuration is performed on the local side of the connection—the hub router. It configures the router for communication with three clients and provides authentication by identifying a unique password for each “spoke” in the hub-and-spoke configuration.

```

interface ethernet 0
 ip address 172.30.43.1 255.255.255.0
!
interface async 7
 async mode interactive
 async dynamic address
 dialer rotary-group 1
!
interface async 8
 async mode interactive
 async dynamic address
 dialer rotary-group 1
!
interface dialer 1
 ip address 172.30.45.2 255.255.255.0
 no ip split-horizon
 encapsulation ppp
  ppp authentication chap
 dialer in-band
 dialer map ip 172.30.45.2 name spoke1 3333
 dialer map ip 172.30.45.2 name spoke2 4444
 dialer map ip 172.30.45.2 name spoke3 5555
 dialer map ip 172.30.45.255 name spoke1 3333
 dialer map ip 172.30.45.255 name spoke2 4444
 dialer map ip 172.30.45.255 name spoke3 5555
 dialer-group 1
!
ip route 172.30.44.0 255.255.255.0 172.30.45.2
ip route 172.30.44.0 255.255.255.0 172.30.45.3
ip route 172.30.44.0 255.255.255.0 172.30.45.4
 dialer-list 1 protocol ip list 101
 access-list 101 deny igrp 0.0.0.0 255.255.255.255 0.0.0.0 255.255.255.255
 access-list 101 permit ip 0.0.0.0 255.255.255.255 0.0.0.0 255.255.255.255
 chat-script generic ABORT BUSY ABORT NO ## AT OK ATDT\T TIMEOUT 30 CONNECT
!
username spokel password <spokel-passwd>
username spoke2 password <spoke2-passwd>
username spoke3 password <spoke3-passwd>
username spokel autocommand ppp 172.30.45.2
username spoke2 autocommand ppp 172.30.45.3
username spoke3 autocommand ppp 172.30.45.4
!
router igrp 109
 network 172.30.0.0
 redistribute static
!
line 7
 login tacacs
 modem InOut
 speed 38400
 flowcontrol hardware
 modem chat-script generic

```

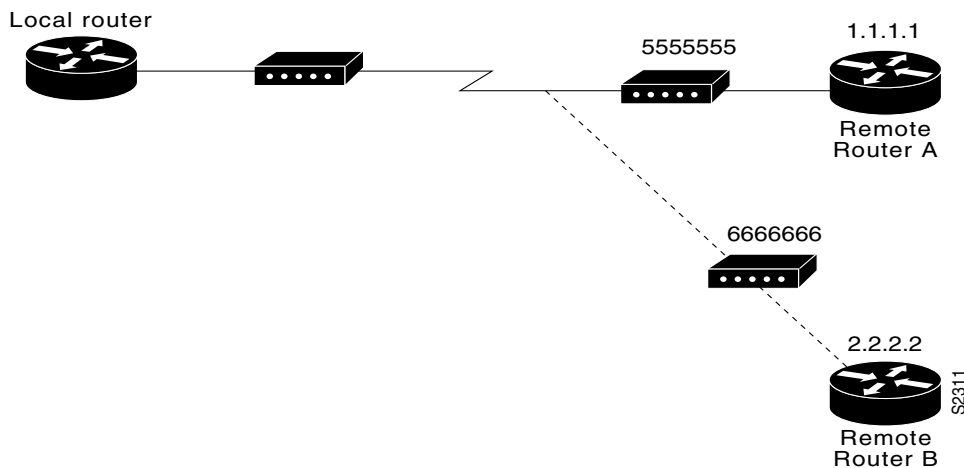
The **redistribute static** command can be used to advertise static route information for DDR applications. Without this command, static routes to the hosts or network that the router can access with DDR will not be advertised to other routers with which the router is communicating. This

behavior can block communication because some routes will not be known. See the **redistribute static ip** command, described in the “IP Routing Protocol-Independent Commands” chapter in the *Network Protocols Command Reference, Part 1*.

Dialing a Single Site or Multiple Sites Example

Assume that your configuration is as shown in Figure 113 and your router receives a packet with a next hop address of 1.1.1.1.

Figure 113 Sample Dialer String or Dialer Map Configuration



If the interface on your router is configured to call a single site with phone number 5555555, it will send the packet to that site, assuming that the next hop address 1.1.1.1 indicates the same remote device as phone number 5555555. The **dialer string** command is used to specify the string (telephone number) to be called.

```
interface serial 1
  dialer in-band
  dialer string 5555555
```

If the interface is configured to dial multiple sites, the interface or dialer rotary group must be configured so that the correct phone number, 5555555, is mapped to the address 1.1.1.1. If this mapping is not configured, the interface or dialer rotary group does not know what phone number to call to deliver the packet to its correct destination, which is the address 1.1.1.1. In this way, a packet with a destination of 2.2.2.2 will not be sent to 5555555. The **dialer map** command is used to map next hop addresses to phone numbers.

```
interface serial 1
  dialer in-band
  dialer map ip 1.1.1.1 5555555
  dialer map ip 2.2.2.2 6666666
```

Configuring Multiple Destinations Example

The following example demonstrates how to specify multiple destination numbers to dial for outgoing calls:

```
interface serial 1
 ip address 131.108.126.1 255.255.255.0
 dialer in-band
 dialer wait-for-carrier-time 100
 pulse-time 1
 dialer-group 1
 dialer map ip 131.108.126.10 5558899
 dialer map ip 131.108.126.15 5555555
 !
 access-list 101 deny igrp 0.0.0.0 255.255.255.255 255.255.255.255 0.0.0.0
 access-list 101 permit ip 0.0.0.0 255.255.255.255 0.0.0.0 255.255.255.255
 dialer-list 1 protocol ip list 101
```

As in the “Configuring DDR in an IP Environment Example” section, a pulse time is assigned and a dialer access group specified.

The first **dialer map** command specifies that the number 555-8899 is to be dialed for IP packets with a *next-hop-address* value of 131.108.126.10. The second **dialer map** then specifies that the number 5555555 will be called when an IP packet with a *next-hop-address* value of 131.108.126.15 is detected.

Configuring Dialer Interfaces and Dialer Rotary Groups Example

The following configuration places serial interfaces 1 and 2 into dialer rotary group 1, defined by the **interface dialer 1** command:

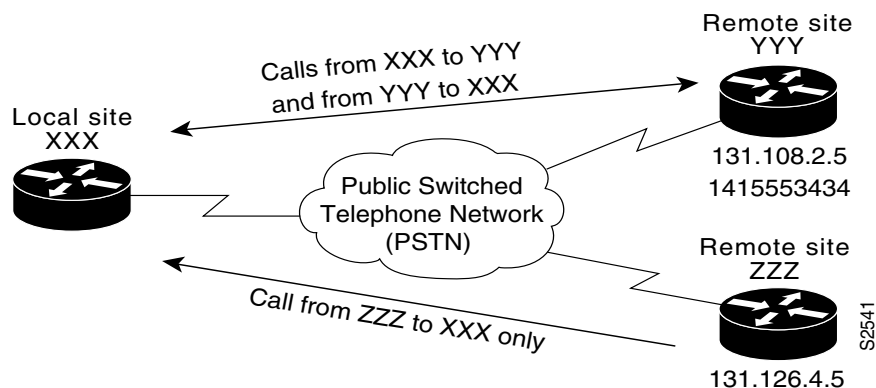
```
!PPP encapsulation is enabled for interface dialer 1.
interface dialer 1
 encapsulation ppp
 dialer in-band
 ip address 131.108.2.1 255.255.255.0
 ip address 131.126.2.1 255.255.255.0 secondary
 !The first dialer map command allows remote site YYY and the central site to
 !call each other. The second dialer map command, with no dialer string, allows
 !remote site ZZZ to call the central site but the central site cannot call
 !remote site ZZZ (no phone number).
 !
 dialer map ip 131.108.2.5 name YYY 1415553434
 dialer map ip 131.126.2.55 name ZZZ
 !
 !The DTR pulse signals for three seconds on the interfaces in dialer group 1.
 !This holds the DTR low so the modem can recognize that DTR has been dropped.
 pulse-time 3

 !Serial interfaces 1 and 2 are placed in dialer rotary group 1. All the
 !interface configuration commands (the encapsulation and dialer map commands
 !shown earlier in this example) that applied to interface dialer 1 also apply
 !to these interfaces.
interface serial 1
 dialer rotary-group 1
interface serial 2
 dialer rotary-group 1
```

DDR Using Dialer Interface and PPP Encapsulation Example

The following example shows a configuration for XXX, the local router shown in Figure 114. In this example, remote Routers YYY and ZZZ can call Router XXX. Router XXX has dialing information only for Router YYY and cannot call Router ZZZ.

Figure 114 Dial-on-Demand Routing Configuration



Router XXX

```
username YYY password theirsystem
username ZZZ password thatsystem

!Create a dialer interface with PPP encapsulation and CHAP authentication.
interface dialer 1
 ip address 131.108.2.1 255.255.255.0
 ip address 131.126.4.1 255.255.255.0 secondary
 encapsulation ppp
 ppp authentication chap
 dialer in-band
 dialer group 1
!The first dialer map command indicates that calls between the remote site
!YYY and the central site will be placed at either end. The second dialer
!map command, with no dialer string, indicates that remote site ZZZ will call
!the central site but the central site will not call out.
 dialer map ip 131.108.2.5 name YYY 1415553434
 dialer map ip 131.126.4.5 name ZZZ
!The DTR pulse holds the DTR low for three seconds, so the modem can recognize
!that DTR has been dropped.
 pulse-time 3
!
!Place asynchronous serial interfaces 1 and 2 in dialer group 1.
!The interface commands applied to dialer group 1 (for example,
!PPP encapsulation and CHAP) apply to these interfaces.
!
interface async 1
 dialer rotary-group 1
interface async 2
 dialer rotary-group 1
```

Set Up Two-Way DDR with Authentication Example

You can set up two-way dial-on-demand routing (DDR) with authentication in which both the client and server have dial-in access to each other. This configuration is demonstrated in the following two subsections.

Remote Configuration

The following example configuration is performed on the remote side of the connection. It provides authentication by identifying a password that must be provided on each end of the connection.

```
username local password secret1
username remote password secret2
!
interface ethernet 0
 ip address 172.30.44.1 255.255.255.0
!
interface async 7
 ip address 172.30.45.2 255.255.255.0
 async mode dedicated
 async default ip address 172.30.45.1
 encapsulation ppp
 dialer in-band
 dialer string 1234
 dialer-group 1
!
ip route 172.30.43.0 255.255.255.0 async 7
ip default-network 172.30.0.0
chat-script generic ABORT BUSY ABORT NO ## AT OK ATDT\T TIMEOUT 30 CONNECT
dialer-list 1 protocol ip permit
!
line 7
 no exec
 modem InOut
 speed 38400
 flowcontrol hardware
 modem chat-script generic
```

Local Configuration

The following example configuration is performed on the local side of the connection. As with the remote side configuration, it provides authentication by identifying a password for each end of the connection.

```
username remote password secret1
username local password secret2
!
interface ethernet 0
 ip address 172.30.43.1 255.255.255.0
!
interface async 7
 async mode dedicated
 async default ip address 172.30.45.2
 dialer rotary-group 1
!
interface async 8
 async mode dedicated
 async default ip address 172.30.45.2
 dialer rotary-group 1
!
```

```
interface dialer 1
 ip address 172.30.45.2 255.255.255.0
 encapsulation ppp
 ppp authentication chap
 dialer in-band
 dialer map ip 172.30.45.2 name remote 4321
 dialer load-threshold 80
!
ip route 172.30.44.0 255.255.255.0 172.30.45.2
 chat-script generic ABORT BUSY ABORT NO ## AT OK ATDT\T TIMEOUT 30 CONNECT
!
router igrp 109
 network 172.30.0.0
 redistribute static
 passive-interface async 7
!
line 7
 modem InOut
 speed 38400
 flowcontrol hardware
 modem chat-script generic
```

Frame Relay Support Examples

The examples in this section present various combinations of interfaces, Frame Relay features, and DDR features.

Frame Relay Access with In-Band Dialing and Static Mapping Example

In the following example, a router is configured for IP over Frame Relay using in-band dialing. A Frame Relay static map is used to associate the next-hop protocol address to the DLCI. The dialer string allows dialing to only one destination.

```
interface Serial0
 ip address 1.1.1.1 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 1.1.1.2 100 broadcast
 dialer in-band
 dialer string 4155551212
 dialer-group 1
!
access-list 101 deny igrp any host 255.255.255.255
access-list 101 permit ip any any
!
dialer-list 1 protocol ip list 101
```

Frame Relay Access with ISDN Dialing and DDR Dynamic Maps Example

The following example shows a BRI interface configured for Frame Relay and for IP, IPX, and AppleTalk routing. No static maps are defined because this setup relies on Frame Relay local management interface (LMI) signaling and Inverse ARP to determine the network addresses-to-DLCI mappings dynamically. (Because Frame Relay Inverse ARP is enabled by default, no command is required.)

```
interface BRI0
 ip address 1.1.1.1 255.255.255.0
 ipx network 100
 appletalk cable-range 100-100 100.1
 appletalk zone ISDN
 no appletalk send-rtmps
```

```

encapsulation frame-relay IETF
dialer map ip 1.1.1.2 broadcast 4155551212
dialer map apple 100.2 broadcast 4155551212
dialer map ipx 100.0000.0c05.33ed broadcast 4085551234
dialer-group 1
!
access-list 101 deny igrp any host 255.255.255.255
access-list 101 permit ip any any
access-list 901 deny -1 FFFFFFFF 452
access-list 901 deny -1 FFFFFFFF 453
access-list 901 deny -1 FFFFFFFF 457
access-list 901 deny -1 FFFFFFFF 0 FFFFFFFF 452
access-list 901 deny -1 FFFFFFFF 0 FFFFFFFF 453
access-list 901 deny -1 FFFFFFFF 0 FFFFFFFF 457
access-list 901 permit -1
access-list 601 permit cable-range 100-100 broadcast-deny
access-list 601 deny other-access
!
dialer-list 1 protocol ip list 101
dialer-list 1 protocol novell list 901
dialer-list 1 protocol apple list 601

```

Frame Relay Access with ISDN Dialing and Subinterfaces Example

The following example shows a BRI interface configured for Frame Relay and for IP, IPX, and AppleTalk routing. Two logical subnets are used; a point-to-point subinterface and a multipoint subinterface are configured. Frame Relay Annex A (LMI type Q933a) and Inverse ARP are used for dynamic routing.

```

interface BRI0
no ip address
encapsulation frame-relay
dialer string 4155551212
dialer-group 1
frame-relay lmi-type q933a
!
interface BRI0.1 multipoint
ip address 1.1.100.1 255.255.255.0
ipx network 100
appletalk cable-range 100-100 100.1
appletalk zone ISDN
no appletalk send-rtmps
frame-relay interface-dlci 100
frame-relay interface-dlci 110
frame-relay interface-dlci 120
!
interface BRI0.2 point-to-point
ip address 1.1.200.1 255.255.255.0
ipx network 200
appletalk cable-range 200-200 200.1
appletalk zone ISDN
no appletalk send-rtmps
frame-relay interface-dlci 200 broadcast IETF
!
access-list 101 deny igrp any host 255.255.255.255
access-list 101 permit ip any any
access-list 901 deny -1 FFFFFFFF 452
access-list 901 deny -1 FFFFFFFF 453
access-list 901 deny -1 FFFFFFFF 457
access-list 901 deny -1 FFFFFFFF 0 FFFFFFFF 452
access-list 901 deny -1 FFFFFFFF 0 FFFFFFFF 453
access-list 901 deny -1 FFFFFFFF 0 FFFFFFFF 457
access-list 901 permit -1

```

```
access-list 601 permit cable-range 100-100 broadcast-deny
access-list 601 permit cable-range 200-200 broadcast-deny
access-list 601 deny other-access

dialer-list 1 protocol ip list 101
dialer-list 1 protocol novell list 901
dialer-list 1 protocol apple list 601
```

X.25 Support Configuration Example

In the following example, a router is configured to support X.25 and DTR dialing:

```
interface serial 0
 ip address 131.108.170.19 255.255.255.0
 encapsulation x25
 x25 address 12345
 x25 map ip 131.108.171.20 67890 broadcast
 dialer dtr
 dialer-group 1
!
access-list 101 deny igmp 0.0.0.0 255.255.255.255 0.0.0.0 255.255.255.255
access-list 101 permit ip 0.0.0.0 255.255.255.255 0.0.0.0 255.255.255.255
!
dialer-list 1 protocol ip list 101
```

LAPB Support Configuration Example

In the following example, the router is configured for LAPB encapsulation and in-band dialing:

```
interface serial 0
 ip address 131.108.170.19 255.255.255.0
 encapsulation lapb
 dialer in-band
 dialer string 4155551212
 dialer-group 1
!
access-list 101 deny igmp 0.0.0.0 255.255.255.255 0.0.0.0 255.255.255.255
access-list 101 permit ip 0.0.0.0 255.255.255.255 0.0.0.0 255.255.255.255
!
dialer-list 1 protocol ip list 101
```