Configuring DECnet

Digital Equipment Corporation designed the DECnet stack of protocols in the 1970's as part of its Digital Network Architecture (DNA). DNA supports DECnet routing over Ethernet, Token Ring, Fiber Distributed Data Interface (FDDI), High-Level Data Link Control (HDLC), Point-to-Point Protocol (PPP), Frame Relay, Switched Multimegabit Data Service (SMDS), X.25, and IEEE 802.2.

DECnet supports both connectionless and connection-oriented network layers implemented by Open System Interconnection (OSI) protocols. DECnet's most recent product release is called Phase V, which is equivalent to International Organization for Standardization (ISO) Connectionless Network Service (CLNS). Phase V is compatible with the previous release, Phase IV. Phase IV was similar to OSI routing, while Phase V implements full OSI routing including support for end system-to-intermediate system (ES-IS) and intermediate system-to-intermediate system (IS-IS) connections. An end system (ES) is a nonrouting network node; an intermediate system (IS) refers to a router. ES-IS support allows ESs and ISs to discover each other. IS-IS provides routing between ISs only.

DECnet Phase IV Prime supports inherent Media Access Control (MAC) addresses, which allows DECnet nodes to coexist with systems running other protocols that have MAC address restrictions.

This chapter describes how to configure our implementation of the DECnet routing protocol. For a complete description of the commands in this chapter, refer to the "DECnet Commands" chapter of the *Router Products Command Reference* publication. For historical background and a technical overview of DECnet, see the *Internetworking Technology Overview* publication.

Cisco's Implementation of DECnet

DECnet support on a Cisco router includes local-area and wide-area DECnet Phase IV routing over Ethernet, Token Ring, FDDI, and serial lines (X.25, Frame Relay, SMDS). The following are the specifics of Cisco's support:

- Cisco routers interoperate with Digital routers, and Digital hosts do not differentiate between a Cisco router and a Digital router.

- The router uses HDLC framing rather than Digital Data Communications Message Protocol (DDCMP) framing for point-to-point lines.

- If you construct a network using both Cisco Systems and Digital equipment, you must ensure that each point-to-point line has the same type of equipment on both ends.

- Cisco and DECnet Phase IV routers have incompatible X.25 support.

- As with point-to-point lines, you must use a single vendor's equipment on the X.25 portion of your network.

- You can configure your Cisco equipment running Software Release 9.1 or later to interoperate with Digital equipment, or you can configure your Cisco equipment to operate with other Cisco routers that use prior versions of router software.

- Cisco gives you additional security options through access lists.

- Cisco routers support the address translation gateway (ATG).

    ATG allows the router to participate in multiple, independent DECnet networks. In case of duplicate addressing, ATG establishes a user-specified address translation table for selected nodes between networks.

- Digital uses some nonroutable protocols that are not part of the DECnet stack.

    For example, neither Cisco nor Digital routers can route the Maintenance Operation Protocol (MOP) and local area transport (LAT); instead, these protocols must be bridged.

- The parameters in Cisco Systems' implementation of DECnet are a subset of the parameters you can modify in Digital's Network Control Program (NCP).

    Cisco uses the same names, the same range of allowable values, and the same defaults wherever possible. You must use the configuration commands to set DECnet parameters. Cisco's DECnet implementation does not set parameters by communicating with NCP.

- Cisco supports DECnet Phase IV-to-Phase V conversion:

    — Cost information is represented in native mode for the Phase IV or Phase V protocols.

    — Digital has defined algorithms for mapping a subset of the Phase V address space onto the Phase IV address space and for converting Phase IV and Phase V packets back and forth in order to support Phase IV hosts in Phase V networks and vice versa.

- Cisco's implementation differs from Digital's in the following ways:

    — You can add Phase V support without modifying your existing Phase IV support.

    — Cisco's implementation delays converting packets from Phase IV to Phase V, while Digital's implementation converts as soon as possible.

DECnet Configuration Task List

To configure DECnet routing, complete the tasks in the following sections. Only the first task is required; the remaining are optional.

- Enable DECnet Routing

- Configure DECnet on Token Rings

- Configure Address Translation

- Enable Phase IV-to-Phase V Conversion

- Propagate Phase IV Areas through an OSI Backbone

- Establish the Routing Table Size

- Configure Level 1 Routers

- Configure Level 2 Routers

- Specify Designated Routers

- Control Access to DECnet Networks

- Enhance DECnet Performance

- Configure DECnet over WANs
- Monitor and Maintain the DECnet Network

See the end of this chapter for configuration examples.

Enable DECnet Routing

In order to enable DECnet routing, you must complete the tasks in the following sections:

- Either Enable DECnet Phase IV Routing or Enable DECnet Phase IV Prime Routing
- Assign a DECnet Cost to Each Interface
- Specify the DECnet Node Type

Enable DECnet Phase IV Routing

To enable DECnet Phase IV routing, perform the following task in global configuration mode:

Task	Command
Enable the DECnet Phase IV routing protocol on a global basis.	**decnet** [*network-number*] **routing** *decnet-address*

A DECnet host exists as a *node* in an *area.* An area spans many routers, and a single interface can have many areas attached to it. Therefore, if a router exists on many cables, it uses the same area and node for itself on all of them. Note how this differs from other routing protocols, where each interface is given a different internetwork address. Figure 15-1 shows the DECnet approach.
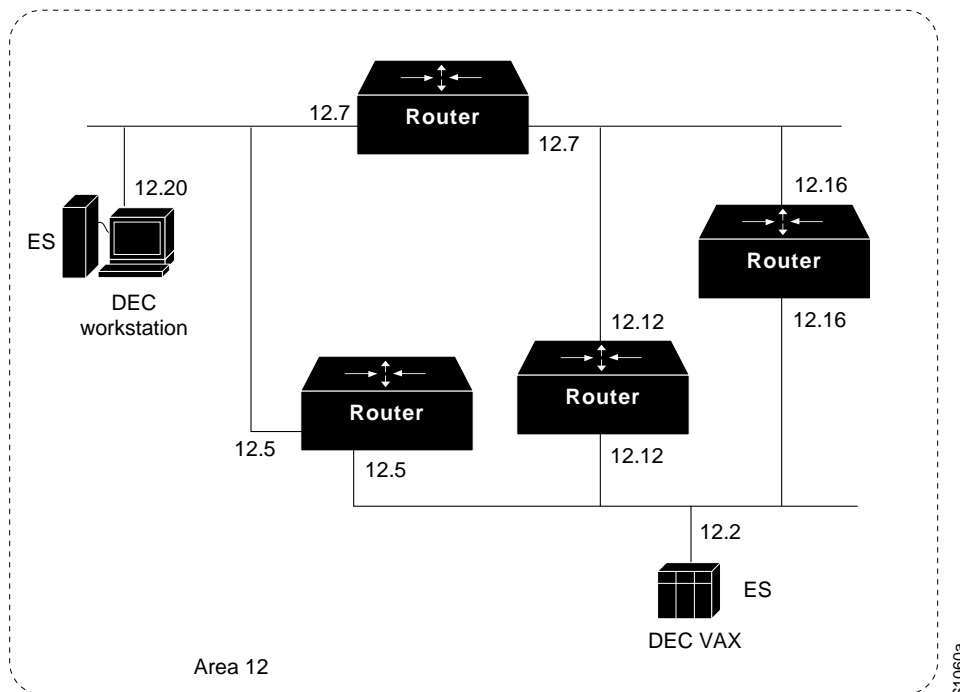

Figure 15-1 DECnet Nodes and Areas

Enabling DECnet changes the MAC addresses of the router's interfaces. This is not a problem on routers equipped with nonvolatile memory. On systems that attempt to get their Internet Protocol (IP) network addresses from network servers instead of from nonvolatile memory, there might be a problem with the hardware addresses changing and confusing other IP-speaking hosts. If you are attempting to use DECnet on such a configuration, be sure to set all global DECnet parameters before enabling DECnet routing on the interfaces.

With DECnet Phase IV Prime, the change of MAC addresses is not an issue because you can change the MAC address of the interface.

Note If you plan to use DECnet and Internet Packet Exchange (IPX) routing concurrently on the same interface, you should enable DECnet routing first, then enable IPX routing without specifying the optional MAC address. If you do this in the reverse order (that is, enable IPX, then DECnet), IPX routing will be disrupted.

Once you have enabled DECnet routing, you can obtain MAC addresses by using the **show interfaces** EXEC command. To disable DECnet routing, use the **no decnet routing** command.

Enable DECnet Phase IV Prime Routing

DECnet Phase IV requires that a MAC station address be constructed using DECnet addressing conventions, with a standard high-order byte string (AA-00-04-00) concatenated with the byte-swapped DECnet node address. This can cause problems in configurations in which DECnet nodes need to coexist with systems running protocols that have other MAC address restrictions.

DECnet Phase IV Prime allows an arbitrary MAC address on the local-area network (LAN). An address can be assigned globally (that is, assigned by the IEEE), or it can be assigned locally by a system administrator.

To enable or disable DECnet Phase IV Prime, perform one of the following tasks as appropriate in global configuration mode:

Task	Command
Specify Phase IV Prime routing.	**decnet** [*network-number*] **routing iv-prime** *decnet-address*
Stop DECnet Phase IV or Phase IV Prime routing.	**no decnet routing**

Optionally, you can map a DECnet multicast address to a Token Ring functional address other than the default functional address. To do so, perform the following task in interface configuration mode:

Task	Command
Specify the type of multicast address and the functional address to which the multicast ID will map.	**decnet multicast-map** *multicast-address-type functional-address*

Assign a DECnet Cost to Each Interface

After you have enabled DECnet routing on the router, you must assign a cost to each interface over which you want DECnet to run. Assigning a cost to an interface enables DECnet on the interface and, using a standard formula, assigns a different MAC address than that "burned in" by the manufacturer. This section describes how to assign a cost to each interface.

DECnet routing decisions are based on cost, an arbitrary measure used to compare paths on the internetwork. Costs are based on such measures as hop count or media bandwidth.The lower the cost, the better the path. You must assign a cost to each interface.

To assign a cost to each interface for DECnet Phase IV Prime, perform the following tasks in interface configuration mode:

Task	Command
Assign a cost to an interface.	**decnet cost** *cost-value*

Most DECnet installations have individualized routing strategies for using costs. Therefore, check the routing strategy used at your installation to ensure that the costs you specify are consistent with those set for other hosts on the network.

Figure 15-2 shows four routers, three Ethernets, and the various routes linking them. Each link has a different cost associated with it. The least expensive route from Router 7 to Router 20 is via Router 12.
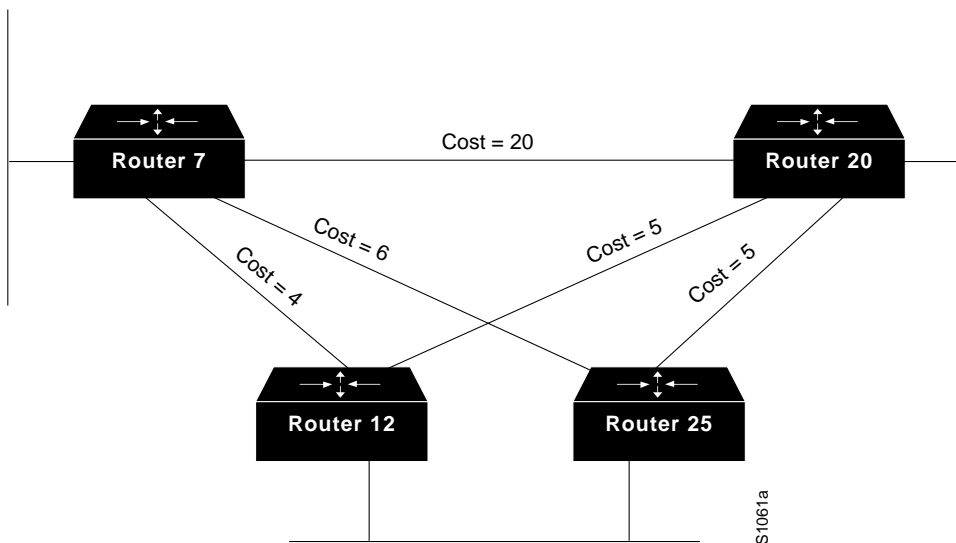

Figure 15-2 DECnet Cost Values

Specify the DECnet Node Type

DECnet routing nodes are referred to as either Level 1 or Level 2 routers. You must specify the router's node type. A Level 1 router exchanges packets with other end nodes and routers in the same area and ignores Level 2 packets; this is called *intra-area routing*. Level 2 routers participate in the DECnet routing protocol with other routers and route packets to and from routers in other areas; this is called *interarea routing*. Level 2 routers also act as Level 1 routers in their own area.

The keyword **area** indicates a Level 2, interarea, router. The keyword **routing-iv** indicates a Level 1, intra-area, router; this is the default. In Level 1 mode, the router sends packets destined for other areas to a designated interarea router, which forwards them outside the area.

To specify the node types, perform one of the following tasks in global configuration mode:

Task	Command
Specify an interarea node type of the router.	**decnet** [*network-number*] **node-type area**
Specify an intra-area node type of the router.	**decnet** [*network-number*] **node-type routing-iv**

A simple example of how to configure DECnet is found in the "DECnet Configuration Examples" section at the end of this chapter.

Configure DECnet on Token Rings

If any Cisco routers are running Software Release 9.0 or earlier, you can use the Token Ring as a backbone or transit network for DECnet routing but you cannot communicate with non-Cisco DECnet nodes on the Token Ring.

If all Cisco routers are running Software Release 9.1 or later, you can set DECnet encapsulation to allow Cisco interoperation with non-Cisco equipment.

If you have both 9.0 and 9.1 routers in the same network, and you want them to interoperate, you must set the encapsulation type to **pre-dec** on the 9.1 routers.

To run DECnet on Token Ring interfaces, you must complete the following steps in the order specified:

Step 1 Enable DECnet routing on the Token Ring interface (see further discussion on Token Ring interfaces in the Interface Commands chapter).

Step 2 Set the DECnet encapsulation mode for the interface.

To complete these steps, perform the following tasks in interface configuration mode:

Task		Command
Step 1	Enable DECnet on the Token Ring interface, and then enter interface configuration mode.	**interface tokenring** *number*[1]
Step 2	Configure the DECnet encapsulation mode for the specified interface.	**decnet encapsulation** {**pre-dec** | **dec**}

1. This command is documented in the "Interface Commands" chapter of the *Router Products Command Reference* publication.

Use the keyword **dec** with routers running Software Release 9.1 or later. Use the keyword **pre-dec** with routers running Software Release 9.0 or earlier, or in a network where routers running 9.0 and routers running 9.1 must interoperate.

Configure Address Translation

If you set up multiple networks, we recommend that you configure address translation in order to avoid problems with duplicate addressing between networks. If you have multiple DECnet networks, you must establish an address translation table for selected nodes between networks. This eliminates any potential problems of duplicate addressing occurring between networks. The address translation gateway (ATG) allows you to define multiple DECnet networks and map between them.

Configuring ATG allows the router to route traffic for multiple independent DECnet networks and to establish a user-specified address translation for selected nodes between networks. Address translation allows connectivity between DECnet networks that might not otherwise be possible due to address conflicts (duplicate addresses) between them. Configuring ATG can be done over all media types.

When you use ATG, all the DECnet configuration commands implicitly apply to network number 0 unless you specify otherwise.

To translate a virtual DECnet address to a real network address, perform the following task in global configuration mode:

Task	Command
Establish a translation entry to translate a virtual DECnet address to a real DECnet address for the router.	**decnet** *first-network* **map** *virtual-address second-network real-address*

To display the address mapping information used by the DECnet ATG, use the **show decnet map** EXEC command.

A simple example of how to configure address translation can be found in the "DECnet Configuration Examples" section at the end of this chapter.

Make a "Poor Man's Routing" Connection

As an additional feature and security precaution, DECnet "Poor Man's Routing" can be used between nodes outside of the translation map as long as those nodes have access to nodes that are in the map. For example, as illustrated in Figure 15-5 in the "DECnet Configuration Examples" section later in this chapter, a user on node B could issue the following VMS operating system command:

```
$ dir A::D::E::
```

When a Poor Man's Routing connection is made between two networks, only the two adjacent nodes between the networks will have any direct knowledge about the other network. Application-level network access can then be specified to route through the connection.

Note   We do not support Poor Man's Routing directly; the intermediate nodes must be VMS systems with Poor Man's Routing enabled in file access language (FAL).

Enable Phase IV-to-Phase V Conversion

Routers that have conversion enabled advertise reachability to both Phase IV and Phase V hosts in both Phase IV and Phase V routing updates. If you have Phase IV hosts in Phase V networks and vice versa, you must enable Phase IV-to-Phase V conversion (and vice versa) in order for all nodes to communicate with each other. To enable DECnet conversion, you must have both DECnet and ISO CLNS configured on your router. Then perform the following task in global configuration mode:

Task	Command
Enable DECnet Phase IV-to-Phase V (and vice versa) conversion on the router.	**decnet conversion** *nsap-prefix*

Make sure that the area you specify in the **decnet conversion** global configuration command is the same as the area you specified in the ISO CLNS address. You must also enable CLNS on all interfaces, even if the router has only Phase IV hosts on some of the interfaces. This enables information about those routers to be included in link state packets and consequently, enables other routers to be informed about the routers connected by that interface.

An example of how to enable a Phase IV area through an OSI backbone can be found in the "Phase IV-to-Phase V Conversion Example" section later in this chapter.

Propagate Phase IV Areas through an OSI Backbone

One limitation of the Phase IV-to-Phase V conversion has been the inability to propagate Phase IV area routes through OSI clouds. Using the "advertise" feature, you can explicitly configure any DECnet Phase IV areas that you want to propagate outward. You configure the border routers at the Phase IV/Phase V junction.

When distant routers send a packet destined across the cloud to a border router, the router converts the route and sends it as an OSI packet. In order for the converting router to have the corresponding OSI entry to which to convert the Phase IV packet, the other border router at the Phase IV/V junction must inject "static discard" routes. In this way, the first router converts the packet from Phase IV to Phase V, sending it through the cloud, and at the other end, the router advertising the static discard route converts the packet back to Phase IV and discards the Phase V packet. In effect, a fake entry is created in the Phase IV area table to propagate this information to other routers. This entry will not overwrite a native Phase IV entry if one already exists in the table.

To enable Phase IV areas to propagate through an OSI backbone on the router, perform the following task in global configuration mode:

Task	Command
Enable DECnet Phase IV areas to propagate through an OSI backbone on the router.	**decnet advertise** *decnet-area hops cost*

To enable the border router *at the far end* to convert the Phase V packet back to Phase IV, it must advertise a static discard route. To configure the far border router, perform the following task in global configuration mode:

Task	Command
Advertise a static discard route on the far-end border router	**clns route** *nsap-prefix* **discard**[1]

1. This command is documented in the "ISO CLNS Commands" chapter of the *Router Products Command Reference* publication.

An example of how to enable a Phase IV area through an OSI backbone can be found in the "Configuring Phase IV Areas through an OSI Backbone Example" section at the end of this chapter.

Establish the Routing Table Size

You can configure the maximum number of addresses and areas allowed in the router's routing table. It is best to keep routing updates small. All areas or nodes that cannot be reached must be advertised as unreachable to the router. When configuring the routing table size, indicate the maximum node and area numbers that can exist in the network. In general, all routers on the network should use the same values for maximum addresses and nodes.

To establish the routing table size, perform either or both of the following tasks in global configuration mode:

Task	Command
Set the maximum node address that can exist in the network on the router.	**decnet** [*network-number*] **max-address** *value*
Set the largest number of areas that the router can handle in its routing table.	**decnet** [*network-number*] **max-area** *area-number*

Configure Level 1 Routers

Perform any of the tasks in the following section for the routers you have configured as Level 1 (intra-area) routers. In Level 1 mode, the router sends packets destined for other areas to a designated interarea router, which forwards them outside the area.

Set Areas as Unreachable

You can set the maximum cost that the router considers usable for intra-area routing. The router ignores routes within its local area that have a cost greater than the value you specify.

You also can set the maximum number of hops, or traversal of different paths that the router considers usable for intra-area routing. The router ignores routes within its local area that have a value greater than you specify.

To set certain intra-areas as unreachable based on cost value or hop count, perform either or both of the following tasks in global configuration mode:

Task	Command
Set the maximum cost value for intra-area routing on the router.	**decnet** [*network-number*] **max-cost** *cost*
Set the maximum hop count value for intra-area routing on the router.	**decnet** [*network-number*] **max-hops** *hop-count*

Configure Level 2 Routers

Perform any of the tasks in the following section for the routers you have configured as Level 2 (interarea) routers. In Level 2 mode, the router sends packets destined for other areas via the least-cost path to another interarea router.

Set Areas as Unreachable

You can set the maximum cost for a usable route to a distant area. The router treats as unreachable any route with a cost greater than the value you specify.

You also can set the maximum number of hops for a usable route to a distant area. The router treats as unreachable any route with a hop count greater than the value you specify.

To set certain interareas as unreachable based on cost value or hop count, perform either or both of the following tasks in global configuration mode:

Task	Command
Set the maximum cost specification value for interarea routing on the router.	**decnet** [*network-number*] **area-max-cost** *value*
Set the maximum hop count value for interarea routing on the router.	**decnet** [*network-number*] **area-max-hops** *value*

Specify Designated Routers

You can determine the router to which all end nodes on an Ethernet communicate if they do not know where else to send a packet. This router is called the *designated* router and is the router with the highest priority. When two or more routers on a single Ethernet in a single area share the same highest priority, the router with the highest node number is selected. You can reset a router's priority to help ensure that it is elected designated router in its area. This is specified on a per-interface basis.

To specify designated routers, perform the following task in interface configuration mode:

Task	Command
Assign or change a priority number to a router on a per-interface basis to receive packets for which no destination is specified.	**decnet router-priority** *value*

Control Access to DECnet Networks

We provide several layers of access control for network security. You can complete any or all of the tasks in the following sections:

- Create an Access List Based on Source Addresses
- Create an Access List Based on Source and Destination Addresses
- Add Filters to Access Lists
- Configure Access Groups
- Configure Routing Filters

Create an Access List Based on Source Addresses

You can configure lists globally to control access by source addresses. The standard form of the DECnet access list has a source DECnet address followed by a source-mask address, with bits set wherever the corresponding bits in the address should be ignored. DECnet addresses are written in the form *area.node*. For example, 50.4 is area 50, node 4. All addresses and masks are in decimal notation.

To create a standard DECnet access list, perform the following task in global configuration mode:

Task	Command
Create an access list to restrict access to a single address.	**access-list** *access-list-number* {**permit**	**deny**} *source source-mask*

To disable the list, use the **no access-list** command.

Create an Access List Based on Source and Destination Addresses

The extended form of the DECnet access list has a source DECnet address and mask pair, followed by a destination DECnet address and mask pair.

To configure an extended DECnet access list, perform the following task in global configuration mode:

Task	Command
Create an extended access list for several addresses.	**access-list** *access-list-number* {**permit**	**deny**} *source source-mask* [*destination destination-mask*]

To disable the extended access list, use the **no access-list** command.

Add Filters to Access Lists

DECnet access lists can be used to filter *connect initiate* packets. With these packets, you can filter by DECnet object type, such as MAIL.

To add filters to access lists, perform the following task in global configuration mode:

Task	Command
Add filtering (by DECnet object type) to an access list.	**access-list** *access-list-number* {**permit**	**deny**} *source source-mask* [*destination destination-mask* {**eq**	**neq**} [[*source-object*] [*destination-object*] [*identification*]] **any**]

Configure Access Groups

You can restrict access to specific interfaces by applying an access list to them. Interfaces that are associated with the same access list are considered to be an access group.

To configure access groups, perform the following task in interface configuration mode:

Task	Command
Assign an access list to a specified interface.	**decnet access-group** *access-list-number*

Configure Routing Filters

You can control access to hello messages or routing information being received or sent out on an interface. Addresses that are not in the access list are shown in the update message as unreachable.

To configure routing filters, perform either or both of the following tasks, as needed, in interface configuration mode:

Task	Command
Control access to hello messages or routing information received on a specified interface.	**decnet in-routing-filter** *access-list-number*
Control access to routing information being sent out on a specified interface.	**decnet out-routing-filter** *access-list-number*

Enhance DECnet Performance

To optimize internetwork performance, complete any or all of the tasks in the following sections:

- Set Maximum Equal-Cost Paths

- Establish Selection for Paths of Equal Cost

- Set Maximum Visits

- Adjust the Hello Timer

- Disable Fast Switching

- Set the Congestion Threshold

- Adjust the Broadcast Routing Timer

Set Maximum Equal-Cost Paths

You can set the maximum number of equal-cost paths to a destination on a global basis. Limiting the number of equal-cost paths can save memory on routers with limited memory or very large configurations. Additionally, in networks with a large number of multiple paths and end systems with limited ability to cache out-of-sequence packets, performance might suffer when traffic is split between many paths.

To set maximum equal-cost paths, perform the following task in global configuration mode:

Task	Command
Set the maximum number of equal-cost paths to a destination. Paths are set in the routing table.	**decnet** [*network-number*] **max-paths** *value*

Use the **show decnet route** EXEC command to display the first hop route to a specified address and to show all equal-cost paths to a single destination.

Establish Selection for Paths of Equal Cost

You can establish one of two methods for selecting among paths of equal cost on the router: on a round-robin basis, which is the default, or by configuring the router so that traffic for any higher-layer session is always routed over the same path.

In the round-robin or *normal* mode, the first packet is sent to the first node, the second packet to the second node, and so on. If the final node is reached before all packets are sent, the next packet in line is sent to the first node, then to the second node, and so forth.

The *interim* mode supports older implementations of DECnet (VMS Versions 4.5 and earlier) that do not support out-of-order packet caching. Other sessions might take another path, thus using equal-cost paths that a router might have for a particular destination.

To select normal or interim mode on the router, perform one of the following tasks in global configuration mode:

Task	Command
Specify that traffic is routed over equal-cost paths on a round-robin basis.	**decnet path-split-mode normal**
Specify that traffic is always routed over the same path.	**decnet path-split-mode interim**

Set Maximum Visits

You can determine the number of times that a packet can pass through a router. The router ignores packets that have a value greater than the amount of visits you specify. Digital recommends that the value be at least twice the number of maximum hops, to allow packets to reach their destinations when routes are changing.

To set the number of times a packet can pass through a router, perform the following task in global configuration mode:

Task	Command
Set the number of times a packet can pass through a router.	**decnet** [*network-number*] **max-visits** *value*

Adjust the Hello Timer

Hosts use the hello messages to identify the hosts with which they can communicate directly. The router sends hello messages every 15 seconds by default. On extremely slow serial lines, you might want to increase this value on a per-interface basis to reduce overhead.

To adjust the interval for sending hello messages, perform the following task in interface configuration mode:

Task	Command
Adjust the interval (in seconds) for sending hello messages on interfaces with DECnet enabled.	**decnet hello-timer** *seconds*

Disable Fast Switching

By default, our DECnet routing software implements fast switching of DECnet packets. You might want to disable fast switching in order to save memory space on interface cards and help avoid congestion when high-bandwidth interfaces are writing large amounts of information to low-bandwidth interfaces. This is especially important when using rates slower than T1.

To disable fast switching of DECnet packets, perform the following task in interface configuration mode:

Task	Command
Disable fast switching of DECnet packets on a per-interface basis.	**no decnet route-cache**

Set the Congestion Threshold

If a router configured for DECnet experiences congestion, it sets the *congestion-experienced* bit. You can define the congestion threshold on a per-interface basis. By setting this threshold, you will cause the system to set the congestion-experienced bit if the output queue has more than the specified number of packets in it.

To set the congestion threshold, perform the following task in interface configuration mode:

Task	Command
Set the congestion threshold.	**decnet congestion-threshold** *number*

Adjust the Broadcast Routing Timer

Other routers use broadcast updates to construct local routing tables. Increasing the time between routing updates on a per-interface basis reduces the amount of unnecessary network traffic. Digital calls this parameter the *broadcast routing timer* because Digital uses a different timer for serial lines. Our DECnet implementation does not make this distinction.

To adjust the broadcast routing timer, perform the following task in interface configuration mode:

Task	Command
Adjust how often the router sends routing updates that list all the hosts that the router can reach on a per-interface basis.	**decnet routing-timer** *seconds*

Configure DECnet over WANs

You can configure DECnet over X.25, SMDS, and Frame Relay networks. To do this, configure the appropriate address mappings as described in the "Configuring X.25 and LAPB," Configuring SMDS," and "Configuring Frame Relay" chapters, respectively.

Monitor and Maintain the DECnet Network

To clear counters, test network node reachability, and display information about DECnet networks, perform the following tasks at the EXEC prompt:

Task	Command
Clear the DECnet counters.	**clear decnet counters**
Test network node reachability. (privileged).	**ping**
Test network node reachability using a simple ping facility (user).	**ping decnet** {*host* | *address*}
Display the global DECnet parameters.	**show decnet**
Display the global DECnet status and configuration for all interfaces, or the status and configuration for a specified interface, including address, paths, cost, access lists, and more.	**show decnet interface** [*type number*]
List a router's address mapping information used by the DECnet ATG.	**show decnet map**
Display all Phase IV and Phase IV Prime neighbors and the MAC address associated with each neighbor	**show decnet neighbors**
Display a router's DECnet routing table.	**show decnet route** [*decnet-address*]
List a router's DECnet traffic statistics, including datagrams sent, received, and forwarded.	**show decnet traffic**

DECnet Configuration Examples

The following sections provide examples that show some common DECnet configuration activities:

- Example of Enabling DECnet
- Configuring Phase IV Areas through an OSI Backbone Example
- Example of Configuring Address Translation
- Examples of Configuring DECnet Phase IV Prime

Example of Enabling DECnet

The following example illustrates the commands required for enabling DECnet. DECnet routing is established on a router at address 4.27. The node is configured as a Level 2, or interarea router. A cost of four is set for the Ethernet 0 interface. A cost of ten is set for the serial 1 interface.

```
decnet routing 4.27
decnet node area
interface ethernet 0
decnet cost 4
interface serial 1
decnet cost 10
```

Phase IV-to-Phase V Conversion Example

The following example illustrates that for the DECnet Phase IV-to-Phase V conversion to work properly, CLNS ISIS must be configured on certain interfaces.

Note that although Router A has only Phase IV hosts connected by its Ethernet 0 interface, that interface must be configured for CLNS ISIS for Router A to convert the Phase IV adjacency information into Phase V. If Router A's Ethernet interface 0 is not configured for CLNS ISIS, Router B will never get information about Router D and endnode 1.
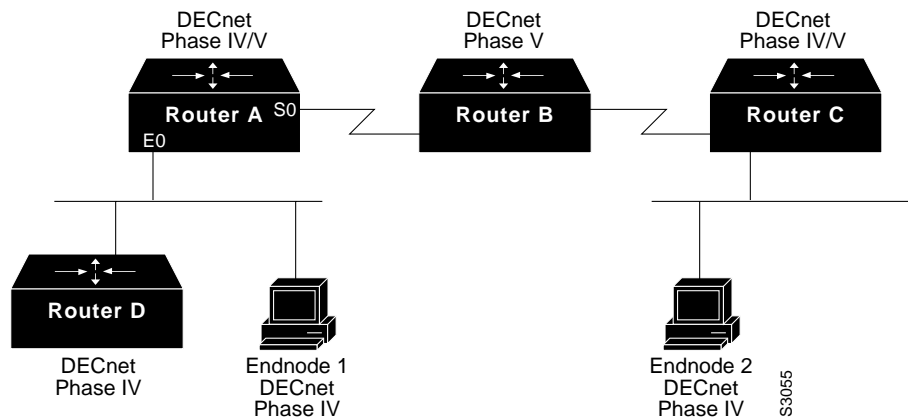

Figure 15-3 Sample Phase IV/V Network

Configuration for Router A

```
decnet routing 1.1
decnet conversion 49
clns routing
router isis
net 49.0001.aa00.0400.0104.00
interface e 0
clns router isis
decnet cost 4
interface s 0
clns router isis
```

Sample Configuration for Router D

```
decnet routing 1.10
interface e 0
decnet cost 4
```

Configuring Phase IV Areas through an OSI Backbone Example

The following example illustrates how to configure border routers to propagate Phase IV areas through an OSI backbone using the advertise feature. In this example, Router X in area 8 wants to communicate with Router Y in area 9. Figure 15-4 illustrates the network, and the configurations that follow illustrate the commands required for enabling the advertise feature.
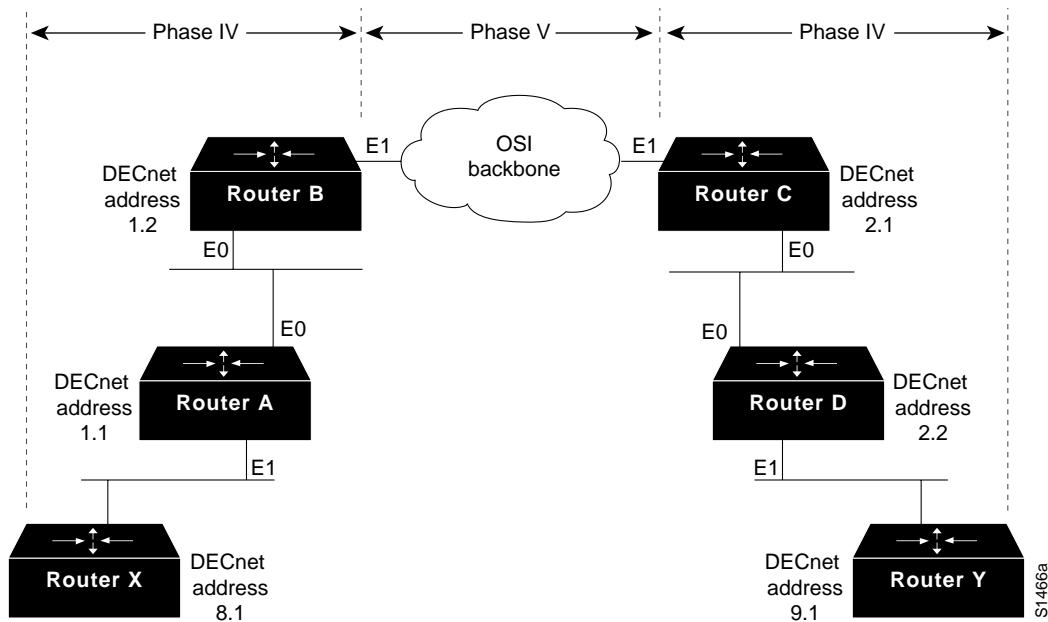
Figure 15-4   Sample Phase IV/Phase V Network

Configuration for Router B

```
decnet conversion 49
!Propagate Area 9 reachability information
decnet advertise 9 4 2
!Create dummy OSI route to force conversion to Phase IV
clns route 49.0008 discard
```

Configuration for Router C

```
decnet conversion 49
!Propagate Area 8 reachability information
decnet advertise 8 6 3
!Create dummy OSI route to force conversion to Phase IV
clns route 49.0009 discard
```

Router A's routing table will then contain the following, as displayed with the **show decnet route** EXEC command:

```
   Area       Cost   Hops   Next Hop to Node      Expires  Prio

  *1           0      0      (Local) -> 1.1
  *8           4      1      Ethernet1 -> 8.1        35      64    A
  *9           5      2      Ethernet0 -> 1.2
   Node       Cost   Hops   Next Hop to Node      Expires  Prio

  *(Area)      0      0      (Local) -> 1.1
  *1.1         0      0      (Local) -> 1.1
  *1.2         4      1      Ethernet4 -> 1.2        38      64    VA
```

Router B's routing table will then contain the following:

```
    Area        Cost  Hops   Next Hop to Node      Expires  Prio

   *1            0     0       (Local) -> 1.2
   *8            8     2     Ethernet0 -> 1.1
   *9            4     2         (OSI) -> 1.2
    Node        Cost  Hops   Next Hop to Node      Expires  Prio

   *(Area)       0     0       (Local) -> 1.2
   *1.1          4     1     Ethernet0 -> 1.1        37      64    VA
   *1.2          0     0       (Local) -> 1.2
```

Router C's router table will then contain the following:

```
    Area        Cost  Hops   Next Hop to Node      Expires  Prio

   *2            0     0       (Local) -> 2.1
   *8            6     3         (OSI) -> 2.1
   *9            8     2     Ethernet0 -> 2.2
    Node        Cost  Hops   Next Hop to Node      Expires  Prio

   *(Area)       0     0       (Local) -> 2.1
   *2.1          0     0       (Local) -> 2.1
   *2.2          4     1     Ethernet0 -> 2.2        33      64    VA
```

Example of Configuring Address Translation

In Figure 15-5, the router is connected to two DECnet networks using Ethernet. The following example illustrates how to configure an ATG between Network 0 and Network 1.
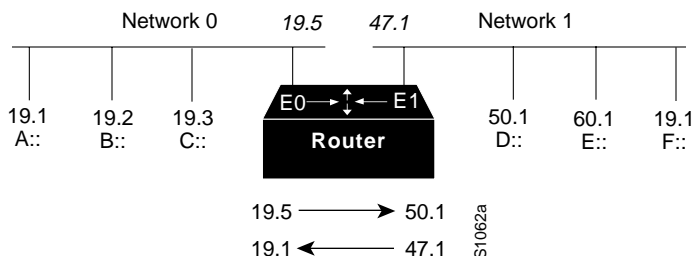

Figure 15-5 ATG Configuration Example

In Network 0, the router is configured at address 19.4 and is a Level 1 router. In Network 1, the router is configured at address 50.5 and is an area router. At this point, no routing information is exchanged between the two networks. Each network in the router has a separate routing table.

```
decnet 0 routing 19.4
decnet 0 node routing-iv
interface ethernet 0
decnet 0 cost 1
!
decnet 1 routing 50.5
decnet 1 node area
interface ethernet 1
decnet 1 cost 1
```

To establish a translation map, enter these commands:

```
decnet 0 map 19.5 1 50.1
decnet 1 map 47.1 0 19.1
```

Packets in Network 0 sent to virtual address 19.5 will be routed to Network 1, and the destination address will be translated to 50.1. Packets sent to virtual address 47.1 in Network 1 will be routed to Network 0 as 19.1.

Table 15-1 defines the parameters for the translation map.

Table 15-1   A Packet Exchange between Nodes A and D

Source			Destination	
A packet addressed as:	19.1	19.5	is received on Ethernet 0 as 19.5	
Translates to:	47.1	50.1	and is transmitted out Ethernet 1 as 50.1	
A reply packet:	50.1	47.1	is received on Ethernet 1	
Translates to:	19.5	19.1	and is transmitted on Ethernet 0	

Network 0 uses a block of addresses from its area to map the remote nodes. In Network 0, the router will advertise nodes 19.5 and 19.6. These nodes must not already exist in Network 0.

Network 1 uses another area for the address translation. Since the router will be advertising the availability of area 47, that area should not already exist in Network 1, because DECnet area fragmentation could occur.

Only nodes that exist in the maps on both networks will be able to communicate directly. Network 0 node 19.1 will be able to communicate with Network 1 node 50.1 (as 19.5), but will not be able to communicate directly with Network 1 node 60.1.

When naming nodes, use the appropriate address in each network. See the lists that follow for examples.

Network 0 VMS NCP Command File Sample

```
$ MCR NCP
define node 19.1 name A
define node 19.2 name B
define node 19.3 name C
define node 19.4 name GS
define node 19.5 name D
define node 19.6 name F
```

Network 1 VMS NCP Command File Sample

```
$ MCR NCP
define node 50.1 name D
define node 50.5 name GS
define node 60.1 name E
define node 19.1 name F
define node 47.1 name A
define node 47.2 name C
```

Examples of Configuring DECnet Phase IV Prime

This section includes examples of configuring DECnet Phase IV Prime support for inherent MAC addresses. The comments in these examples point out some possible configuration errors, in addition to explaining correct command lines.

In the following example, Ethernet 0 interface is configured for DECnet Phase IV Prime.

```
decnet routing iv-prime 1.1
interface ethernet 0
decnet cost 10
! Interface Ethernet 0 will have aa-00-04-00 form of MAC address. Router is
! bilingual on interface Ethernet 0.
```

In the following example, Token Ring 1 interface is configured with a MAC address that is not supported by DECnet Phase IV.

```
decnet routing 2.1
interface Token Ring 1
decnet cost 5
mac-address 0000.0c00.62e6
! Interface Token Ring 1 has MAC address as set
! This is an error because the token ring interface has a MAC address that is
! not Phase IV-compatible, and the router is not running Phase IV Prime.
```

In the following example, the router is not configured to support DECnet Phase IV Prime until later in the configuration.

```
interface tokenring 1
decnet cost 5
mac-address 0000.0c00.62e6
! invalid configuration, since router is only Phase IV.
decnet routing iv-prime 5.5
! Become a Phase IV Prime router

interface tokenring 1
mac-address 0000.0c00.62e6
! Valid configuration since the router is now running Phase IV Prime.
```

The following example shows valid and invalid ways of using the **decnet multicast-map** command.

```
decnet routing iv-prime 3.4

interface tokenring 1
decnet multicast-map phiv-prime-all-bridges c000.2000.0000
! Invalid value (phiv-prime-all-bridges) for multicast ID string

interface tokenring 1
decnet multicast-map iv-prime-all-routers d000.2000.0000
! Invalid value (d000.2000.0000) for functional address

interface tokenring 1
decnet multicast-map iv-prime-all-routers c000.2000.0000
! This will work. The command redefines the multicast to functional address
! mapping for the "all Phase IV Prime routers" multicast.
```