Configuring DECnet

First Published: December 15, 1997
Last Updated: December 14, 2011

The Configuring DECnet module describes how to configure the Cisco implementation of the DECnet routing protocol.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the "Feature Information for Configuring DECnet" section on page 30.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Contents

How to Configure Cisco Implementation of the DECnet Routing Protocol

---

Enabling DECnet Routing

- Enabling DECnet Phase IV Routing or Enabling DECnet Phase IV Prime Routing (required)
- Assigning a DECnet Cost to Each Interface (required)
- Specifying the DECnet Node Type (required)

Enabling DECnet Phase IV Routing

To enable DECnet Phase IV routing, use the following command in global configuration mode:

Command	Purpose
Router(config)# **decnet** [*network-number*] **routing** *decnet-address*	Enables the DECnet Phase IV routing protocol on a global basis.

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 protocol differs from other routing protocols, where each interface is given a different internetwork address. Figure 1 shows the DECnet approach.

Enabling DECnet changes the MAC addresses of the router interfaces. Changing the MAC addresses is not a problem on routers equipped with nonvolatile memory. On systems that attempt to get their IP network addresses from network servers instead of 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, ensure that you 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 To use DECnet and Internet Packet Exchange (IPX) routing concurrently on the same interface, you must enable DECnet routing first, then enable IPX routing without specifying the optional MAC address. If you enable IPX first and then DECnet, IPX routing is disrupted.

After you enable DECnet routing, use the **show interfaces** EXEC command to obtain the MAC addresses. To disable DECnet routing, use the **no decnet routing** command.

Figure 1   *DECnet Nodes and Area*
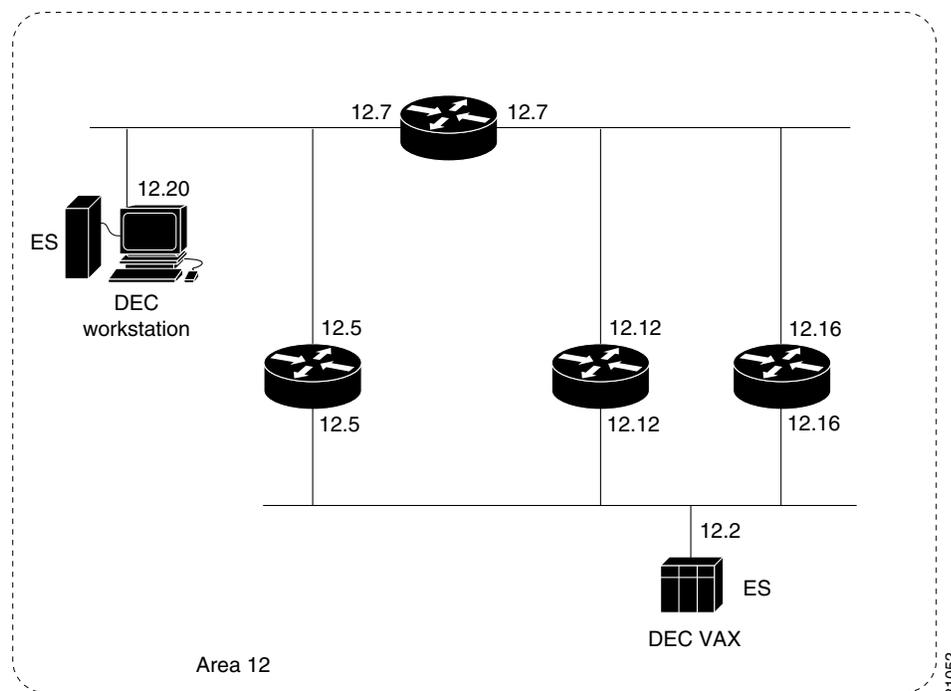
Enabling DECnet Phase IV Prime Routing

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. Using DECnet addressing conventions can cause problems in configurations where DECnet nodes must coexist with systems running protocols that have other MAC address restrictions.

DECnet Phase IV Prime allows an arbitrary MAC address on the 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, use one of the following commands in global configuration mode:

Command	Purpose
Router(config)# **decnet** [*network-number*] **routing iv-prime** *decnet-address*	Specifies Phase IV Prime routing.
Router(config)# **no decnet routing**	Stops DECnet Phase IV or Phase IV Prime routing.

Optionally, to map a DECnet multicast address to a Token Ring functional address apart from the default functional address, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **decnet multicast-map** *multicast-address-type functional-address*	Specifies the type of multicast address and functional address to which the multicast ID will map.

For examples of how to enable DECnet Phase IV Prime Routing, see the "Examples: DECnet Phase IV Prime" section at the end of this chapter.

Assigning a DECnet Cost to Each Interface

After you have enabled DECnet routing, 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, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **decnet cost** *cost-value*	Assigns a cost to an interface.

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 2 shows four routers (three Ethernet interfaces) 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 2 **DECnet Cost Values**
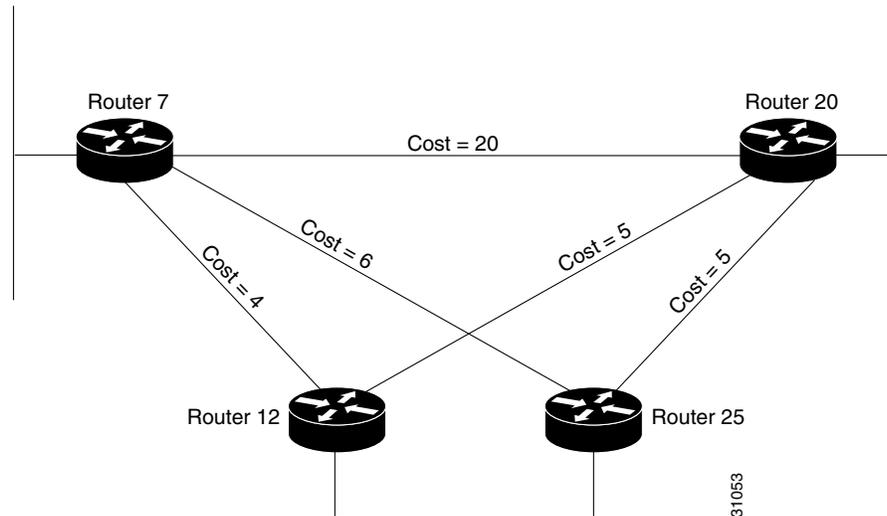
Specifying the DECnet Node Type

DECnet routing nodes are referred to as either Level 1 or Level 2 routers. You must specify the node type of the router. A Level 1 router exchanges packets with other end nodes and routers in the same area and ignores Level 2 packets; this type of routing 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 type of routing 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. Level 1, intra-area routing is the default. In Level 1 mode, Cisco IOS software sends packets destined for other areas to a designated interarea router, which forwards them outside the area.

To specify the node types, use one of the following commands in global configuration mode:

Command	Purpose
`Router(config)# `**`decnet`**` [`*`network-number`*`] `**`node-type area`**	Specifies an interarea node type of the router.
`Router(config)# `**`decnet`**` [`*`network-number`*`] `**`node-type routing-iv`**	Specifies an intra-area node type of the router.

For an example of how to configure DECnet, see the "Example: DECnet" section at the end of this chapter.

Enabling Concurrent Routing and Bridging

You can route DECnet on some interfaces and transparently bridge it on other interfaces simultaneously. To do this, you must enable concurrent routing and bridging. To configure an interface for concurrent routing and bridging, you use the **bridge crb** command.

To enable concurrent routing and bridging, use the following command in global configuration mode:

Command	Purpose
`Router(config)# bridge crb`	Enables concurrent routing and bridging.

Configuring DECnet on Token Rings

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

If you have both Release 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 Release 9.1 routers.

To run DECnet on Token Ring interfaces, use the following commands in interface configuration mode:

	Command	Purpose
Step 1	`Router(config-if)# interface tokenring number`	Enables DECnet on the Token Ring interface, and then enters interface configuration mode.
Step 2	`Router(config-if)# decnet encapsulation {pre-dec	dec}`	Configures the DECnet encapsulation mode for the specified interface.

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

Configuring Address Translation

If you set up multiple networks, we recommend that you configure address translation 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. Establishing an address translation table eliminates any potential problems of duplicate addressing occurring between networks. The address translation gateway (ATG) allows you to define multiple DECnet networks and map them.

Mapping Between Networks

Configuring ATG allows Cisco IOS software 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 because of 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, use the following command in global configuration mode:

Command	Purpose
`Router(config)# ` **`decnet`** ` first-network ` **`map`** `virtual-address second-network real-address`	Establishes a translation entry to translate a virtual DECnet address to a real DECnet address for the router.

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

For an example of how to configure address translation, see the "Example: Address Translation" section at the end of this chapter.

Making 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, provided those nodes have access to nodes that are in the map. For example, as illustrated in Figure 3 in the "Example: Address Translation" section at the end of 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 Cisco does not support Poor Man's Routing directly; the intermediate nodes must be VMS systems with Poor Man's Routing enabled in the file-access language.

Specifying Name-to-DECnet Address Mapping

You can define a name-to-DECnet address mapping, which can be used instead of typing the set of numbers associated with a DECnet address.

To define a name-to-DECnet address mapping, use the following command in global configuration mode:

Command	Purpose
`Router(config)# ` **`decnet host`** ` name decnet-address`	Defines a name-to-DECnet address mapping.

The assigned DECnet name is displayed, where applicable, in the output of the **decnet route** and **show hosts** EXEC commands.

Enabling 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 Connectionless Network Service (CLNS) configured on your router; then use the following command in global configuration mode:

Command	Purpose
Router(config)# **decnet conversion** *nsap-prefix*	Enables DECnet Phase IV-to-Phase V (and vice versa) conversion on the router.

Verify 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. Enabling CLNS on all interfaces allows 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.

For an example of how to enable a Phase IV area through an OSI backbone, see the "Example: Phase IV-to-Phase V Conversion" section at the end of this chapter.

Propagating Phase IV VAX Clusters to Phase V Areas

A Phase IV VAX cluster comprises one or more VAX machines, each with its own individual node address, and a supplemental node address for the cluster. One VAX machine, known as the gratuitous router, will act as the router for the cluster and advertise the cluster alias as an ISO CLNS end system that is attached to the gratuitous router.

The gratuitous router forms an adjacency with the nearest Phase IV router through the process of exchanging L1 router hellos with this router, similar to the process that Phase IV end systems follow to form an adjacency with Phase IV routers through the exchange of endnode hellos.

The Phase IV router will target the cluster alias specifically looking for L1 routing updates from the gratuitous router, extracting the cluster alias from the update, and injecting the cluster alias into the Phase V cloud as an ISO CLNS end system. The router will also advertise all routes as being reachable through itself at a cost of 704 and a hop count value of 29, so that the gratuitous router will always attempt to route through the Phase IV router unless it already has a better route. Thus, the Phase IV VAX cluster is made reachable to remote end systems.

> **Note** For the conversion between Phase IV and Phase V to function, the Phase V area must be numbered so that it matches the converted Phase IV area.

The gratuitous router must form an adjacency with the router that is performing the Phase IV-to Phase-V conversion; therefore, the VAX cluster must be located on the same physical LAN as the Phase IV and Phase V routers.

The hold time for the cluster alias adjacency has a default of 300 seconds and must exceed the VAX broadcast routing timer. To configure the DECnet cluster alias adjacency, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **decnet cluster-holdtime**	Sets a hold time for a cluster alias adjacency.

To propagate Phase IV VAX clusters to Phase V areas, perform the tasks in these sections:

- Enabling Phase IV-to-Phase V Conversion
- Configuring CLNS IS-IS
- Configuring DECnet Cluster Alias Updates and Setting the DECnet Cluster Hold Time

Enabling Phase IV-to-Phase V Conversion

To enable Phase IV-to-Phase V conversion, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# **decnet conversion nsap-prefix**	Enables DECnet Phase IV-to-Phase V (and vice versa) conversion on the router.

Configuring CLNS IS-IS

To enable Connectionless Network Service (CLNS) Intermediate System-to-Intermediate System (IS-IS), use the following commands in global configuration mode:

	Command	Purpose
Step 1	Router(config)# **clns routing**	Enables routing of CLNS packets.
Step 2	Router(config)# **router isis** [tag]	Enables IS-IS and enters router configuration mode.

Configuring DECnet Cluster Alias Updates and Setting the DECnet Cluster Hold Time

To configure DECnet cluster alias updates and set the DECnet cluster hold time, use the following commands beginning in interface configuration mode:

	Command	Purpose
Step 1	Router(config-if)# **decnet cluster-alias update**	Allows DECnet cluster aliases updates to be propagated.
Step 2	Router(config-if)# **decnet cost** *cost-value*	Assigns a cost to an interface.
Step 3	Router(config-if)# **decnet cluster holdtime** *seconds*	Sets a hold time for a cluster alias adjacency.

For an example of how to propagate Phase IV VAX clusters to Phase V areas, see the "Example: Phase IV VAX Cluster Alias to Phase V Areas" section at the end of this chapter.

Propagating 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 Open System Interconnection (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 in 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. 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 false 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, use the following command in global configuration mode:

Command	Purpose
Router(config)# **decnet advertise** *decnet-area hops cost*	Enables DECnet Phase IV areas to propagate through an OSI backbone on the router.

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, use the following command in global configuration mode:

Command	Purpose
Router(config)# **clns route** *nsap-prefix* **discard**	Advertises a static discard route on the far-end border router.

For an example of how to enable a Phase IV area through an OSI backbone, see the "Example: Phase IV Areas Through an OSI Backbone" section at the end of this chapter.

Establishing the Routing Table Size

You can configure the maximum number of addresses and areas allowed in the Cisco IOS software routing table. It is best to keep the number of routing updates small. All areas or nodes that cannot be reached must be advertised as unreachable. 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, use either or both of the following commands in global configuration mode as needed:

Command	Purpose
Router(config)# **decnet** [*network-number*] **max-address** *value*	Sets the maximum node address that can exist in the network.
Router(config)# **decnet** [*network-number*] **max-area** *area-number*	Sets the largest number of areas that Cisco IOS software can handle in its routing table.

Configuring 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.

Setting Areas as Unreachable

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

Setting Maximum Number of Hops

You can also set the maximum number of hops (or traversal of different paths) that Cisco IOS software considers usable for intra-area routing. The software 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, use either or both of the following commands in global configuration mode as needed:

Command	Purpose
Router(config)# **decnet** [*network-number*] **max-cost** *cost*	Sets the maximum cost value for intra-area routing.
Router(config)# **decnet** [*network-number*] **max-hops** *hop-count*	Sets the maximum hop count value for intra-area routing.

Configuring 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, Cisco IOS software sends packets destined for other areas via the least-cost path to other interarea routers.

Setting Areas as Unreachable

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

Setting Maximum Number of Hops

You can also set the maximum number of hops for a usable route to a distant area. Cisco IOS software 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, use either or both of the following commands in global configuration mode as needed:

Command	Purpose
Router(config)# **decnet** [*network-number*] **area-max-cost** *value*	Sets the maximum cost specification value for interarea routing.
Router(config)# **decnet** [*network-number*] **area-max-hops** *value*	Sets the maximum hop count value for interarea routing.

Specifying Designated Routers

You can determine the router with 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 the priority to help ensure that it is elected the designated router in its area. The priority is specified on a per-interface basis.

To specify designated routers, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **decnet router-priority** *value*	Assigns or changes a priority number to a router on a per-interface basis to receive packets for which no destination is specified.

Configuring Static Routing

Static routing is used when it is not possible or desirable to use dynamic routing. The following are some instances of when you would use static routing:

- The routers do not support the same dynamic routing protocol.
- Your network includes WAN links that involve paying for connect time or for per-packet charges.
- You want routers to advertise connectivity to external networks, but you are not running an interdomain routing protocol.
- You must interoperate with equipment from another vendor that does not support any of the dynamic routing protocols that we support.
- The router operates over X.25, Frame Relay, or Switched Multimegabit Data Service (SMDS) networks.

Note An interface that is configured for static routing cannot reroute around failed links.

To configure static routing, perform any of the tasks in the following sections:

- Configuring a Static Route (Optional)
- Configuring a Static Route for an Interface (Optional)
- Configuring a Default Static Route (Optional)
- Configuring a Default Static Route for an Interface (Optional)
- Configuring DECnet Static Route Propagation (Optional)

Configuring a Static Route

You can configure a specific static route and apply it globally even when you use dynamic routing.

To apply a specific static route globally, use the following command in global configuration mode:

Command	Purpose
Router(config)# **decnet route** *decnet-address next-hop-address* [*hops* [*cost*]]	Configures a specific static route.

Configuring a Static Route for an Interface

You can select a specific interface for a specific static route when you do not know the address of your neighbor.

To apply a specific static route to a specific interface, use the following command in global configuration mode:

Command	Purpose
Router(config)# **decnet route** *decnet-address next-hop-type number* [*snpa-address*] [*hops* [*cost*]]	Configures a specific static route for a specific interface.

Configuring a Default Static Route

You can configure a default static route and apply it globally, even when you use dynamic routing.

To apply a default static route globally, use the following command in global configuration mode:

Command	Purpose
Router(config)# **decnet route default** *next-hop-address* [*hops* [*cost*]]	Configures a default route.

Configuring a Default Static Route for an Interface

You can configure a specific interface for a default static route when you do not know the address of your neighbor.

To apply a default static route to a specific interface, use the following command in global configuration mode:

Command	Purpose
Router(config)# **decnet route default** *next-hop-type number* [*snpa-address*] [*hops* [*cost*]]	Configures a specific default route for a specific interface.

Configuring DECnet Static Route Propagation

When you use static routes or default static routes, you can specify whether the static routes are propagated. By default, DECnet static routes will not be propagated to other routers.

To enable or disable static route propagation, use the following commands in global configuration mode:

Command	Purpose
`Router(config)# decnet propagate static`	Enables static route propagation.
`Router(config)# no decnet propagate static`	Disables static route propagation.

Controlling Access to DECnet Networks

Cisco provides several layers of access control for network security. You can perform any or all of the tasks in the following sections:

- Creating an Access List Based on Source Addresses (Optional)
- Creating an Access List Based on Source and Destination Addresses (Optional)
- Adding Filters to Access Lists (Optional)
- Configuring Access Groups (Optional)
- Configuring Routing Filters (Optional)

Creating 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, use the following command in global configuration mode:

Command	Purpose
`Router(config)# access-list` *access-list-number* {`permit` | `deny`} *source source-mask*	Creates an access list to restrict access to a single address.

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

Creating 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, use the following command in global configuration mode:

Command	Purpose
`Router(config)# access-list` *access-list-number* {`permit` | `deny`} *source source-mask* [*destination destination-mask*]	Creates an extended access list for several addresses.

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

Adding 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, use the following command in global configuration mode:

Command	Purpose
Router(config)# **access-list** *access-list-number* {**permit** | **deny**} *source source-mask* [*destination destination-mask* {**eq** | **neq**} [[*source-object*] [*destination-object*] [*identification*]] **any**]	Adds filtering (by DECnet object type) to an access list.

Configuring 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, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **decnet access-group** *access-list-number*	Assigns an access list to a specified interface.

Configuring Routing Filters

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

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

Command	Purpose
Router(config-if)# **decnet in-routing-filter** *access-list-number*	Controls access to hello messages or routing information received on a specified interface.
Router(config-if)# **decnet out-routing-filter** *access-list-number*	Controls access to routing information being sent on a specified interface.

Configuring DECnet Accounting

DECnet accounting enables you to collect information about DECnet packets and the number of bytes that are switched through the Cisco IOS software. You collect accounting information based on the source and destination DECnet addresses. DECnet accounting tracks only DECnet traffic that is routed out of an interface on which DECnet accounting is configured; it does not track traffic generated by or terminating at the router itself.

DECnet access lists and fast switching support DECnet accounting statistics. Autonomous and silicon switching engine (SSE) switching do not support DECnet accounting statistics.

The Cisco IOS software maintains two accounting databases: an active database and a checkpoint database. The active database contains accounting data tracked until the database is cleared. When the active database is cleared, its contents are copied to the checkpoint database. Using these two databases together enables you to monitor both current traffic and traffic that has previously traversed the router.

To configure DECnet accounting, perform the tasks described in the following sections:

- Enabling DECnet Routing on the Router
- Enabling DECnet Accounting
- Customizing DECnet Accounting

Enabling DECnet Routing on the Router

To enable DECnet routing, use the following commands in global configuration mode:

	Command	Purpose
Step 1	Router(config)# **decnet** [*network-number*] **routing** [**iv-prime**] *decnet-address*	Enables DECnet routing.
Step 2	Router(config)# **decnet** [*network-number*] **node-type** [**area** | **routing-iv**]	Specifies the node type (interarea or intra-area).

Enabling DECnet Accounting

To enable DECnet accounting on a specific interface, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# **interface** *type slot*/*port*	Specifies the serial interface.
Step 2	Router(config-if)# **decnet cost** *cost-value*	Specifies the cost value for the interface.
Step 3	Router(config-if)# **decnet accounting**	Enables DECnet accounting.

Note   If DECnet accounting is enabled on an interface but no accounting list is specified, DECnet accounting will track all traffic through the interface, up to the accounting threshold limit.

For an example of how to enable DEC net accounting on a specific interface, see the "Example: DECnet Accounting Configuration" section at the end of this chapter.

Customizing DECnet Accounting

To customize DECnet accounting, use one or more of the following commands in global configuration mode:

Command	Purpose
Router(config)# **decnet accounting threshold** *threshold*	Specifies the maximum number of accounting entries.
Router(config)# **decnet accounting transits** *count*	Specifies the maximum number of transit entries.
Router(config)# **decnet accounting list** *src-dec-address dest-dec-address*	Specifies the source and destination pair addresses for which DECnet accounting information is kept. Use one command for each source and destination pair.

Enhancing DECnet Performance

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

- Setting Maximum Equal-Cost Paths (Optional)
- Establishing Selection for Paths of Equal Cost (Optional)
- Setting Maximum Visits (Optional)
- Adjusting the Hello Timer (Optional)
- Disabling Fast Switching (Optional)
- Setting the Congestion Threshold (Optional)
- Adjusting the Broadcast Routing Timer (Optional)

Setting 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 with 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, use the following command in global configuration mode:

Command	Purpose
Router(config)# **decnet** [*network-number*] **max-paths** *value*	Sets the maximum number of equal-cost paths to a destination. Paths are set in the routing table.

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

Establishing 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 Cisco IOS software 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, use one of the following commands in global configuration mode:

Command	Purpose
Router(config)# **decnet path-split-mode normal**	Specifies that traffic is routed over equal-cost paths on a round-robin basis.
Router(config)# **decnet path-split-mode interim**	Specifies that traffic is always routed over the same path.

Setting Maximum Visits

You can determine the number of times that a packet can pass through a router. Cisco IOS software 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, use the following command in global configuration mode:

Command	Purpose
Router(config)# **decnet** [*network-number*] **max-visits** *value*	Sets the number of times a packet can pass through a router.

Adjusting the Hello Timer

Hosts use the hello messages to identify the hosts with which they can communicate directly. The Cisco IOS software 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, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **decnet hello-timer** *seconds*	Adjusts the interval (in seconds) for sending hello messages on interfaces with DECnet enabled.

Disabling Fast Switching

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

To disable fast switching of DECnet packets, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **no decnet route-cache**	Disables fast switching of DECnet packets on a per-interface basis.

Setting 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, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **decnet congestion-threshold** *number*	Sets the congestion threshold.

Adjusting 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, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **decnet routing-timer** *seconds*	Adjusts how often Cisco IOS software sends routing updates that list all the hosts that the router can reach on a per-interface basis.

Configuring DECnet over DDR

Dial-on-demand routing (DDR) is now supported for DECnet. For more information, refer to the "Dial-on-Demand Routing" section in the *Cisco IOS Dial Technologies Configuration Guide*.

Configuring DECnet over PPP

DECnet packets can now be fast switched over PPP. For more information, refer to the *Cisco IOS Dial Technologies Configuration Guide.*

Configuring DECnet over WANs

You can configure DECnet over X.25, SMDS, and Frame Relay networks by configuring the appropriate address mappings as described in the "Configuring X.25 and LAPB," "Configuring SMDS," and "Configuring Frame Relay" chapters in the *Cisco IOS Wide-Area Networking Configuration Guide*.

Enabling Split Horizon

Split horizon is enabled by default. When split horizon is enabled, routing updates sent out on an interface do not include any information that was originally learned from that interface, and broadcasts are not re-sent on the receiving interface. Disabling split horizon causes Cisco IOS software to include all information in routing updates and to resend broadcast packets on the network from which they were received.

To disable split horizon, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **no decnet split-horizon**	Disables split horizon when sending routing updates.

Routing DECnet over ISL in Virtual LANs

DECnet can be routed over virtual LAN (VLAN) subinterfaces using the Inter-Switch Link (ISL) encapsulation protocol. Full-feature Cisco IOS software is supported on a per-VLAN basis, allowing standard DECnet capabilities to be configured on VLANs. Refer to the *Cisco IOS Switching Services Configuration Guide* for information on configuring DECnet routing over ISL in VLANs.

Monitoring and Maintaining the DECnet Network

To clear counters, test network node reachability, and display information about DECnet networks, use the following commands in user EXEC or privileged EXEC mode:

Command	Purpose
Router> **clear decnet counters**	Clears the DECnet counters.
Router> **ping decnet** {*host* | *address*}	Tests network node reachability.
Router# **show decnet**	Displays the global DECnet parameters.
Router> **show decnet interface** [*type number*]	Displays 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.
Router> **show decnet map**	Lists address mapping information used by the DECnet ATG.
Router# **show decnet neighbors**	Displays all Phase IV and Phase IV Prime neighbors and the MAC address associated with each neighbor.
Router> **show decnet route** [*decnet-address*]	Displays DECnet routing table.
Router# **show decnet static**	Displays static DECnet routing table.
Router> **show decnet traffic**	Lists DECnet traffic statistics, including datagrams sent, received, and forwarded.

Configuring MOP

To enable Maintenance Operation Protocol (MOP) on an interface, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **mop enabled**	Enables MOP.

> ✎
> **Note**   To disable MOP packets on member links, disable MOP on the port-channel interface by using the **no mop enabled** command.

To enable an interface to send out periodic MOP system identification messages on an interface, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **mop sysid**	Enables MOP message support.

> ✎
> **Note**   There is no emission of MOP frames on an interface that is configured with xconnect. MOP remains enabled on the xconnect interface.

Configuration Examples for Cisco Implementation of the DECnet Routing Protocol

- Examples: DECnet Phase IV Prime
- Example: DECnet
- Example: Address Translation
- Example: Phase IV-to-Phase V Conversion
- Example: Phase IV VAX Cluster Alias to Phase V Areas
- Example: Phase IV Areas Through an OSI Backbone
- Example: DECnet Accounting Configuration

Examples: 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.

The following example shows how to configure an Ethernet interface 0 for DECnet Phase IV Prime:

```
decnet routing iv-prime 1.1
interface ethernet 0
 decnet cost 10
! Router is bilingual on Ethernet interface 0.
```

The following example shows how to configure a Token Ring interface 1 with a MAC address that is not supported by DECnet Phase IV:

```
decnet routing 2.1
interface tokenring 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.
```

The following example shows how to configure the router to support DECnet Phase IV Prime later in the configuration:

```
interface tokenring 1
 decnet cost 5
 mac-address 0000.0c00.62e6
! Invalid configuration, because 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 because 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.
```

Example: DECnet

The following example shows 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 interface 0. 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
```

Example: Address Translation

In Figure 3, the router is connected to two DECnet networks using Ethernet. The following example shows how to configure an ATG between Network 0 and Network 1.

Figure 3   ATG Configuration Example
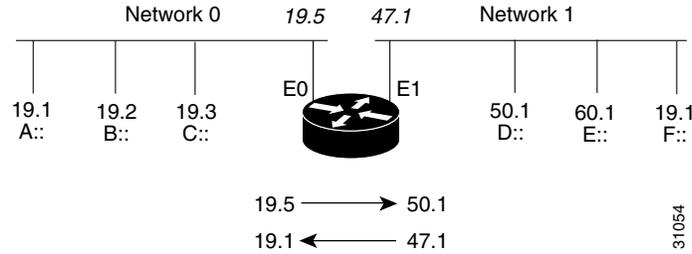
In Network 0, the router is configured at address 19.4 and is a Level 1 router. In Network 1, the router is configured at address 50.5 and is an area router. At this point, no routing information is exchanged between the two networks. Each network in the router has a separate routing table.

```
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
```

The following example shows how to establish a translation map:

```
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 1 defines the parameters for the translation map.

Table 1   Packet Exchange Between Nodes A and D

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

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. Because Cisco IOS software 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 configurations 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
```

Example: Phase IV-to-Phase V Conversion

Figure 4 shows that for the DECnet Phase IV-to-Phase V conversion to work properly, Connectionless Network Service (CLNS) Intermediate System-to-Intermediate System (IS-IS) must be configured on certain interfaces.

Note that although Router A has only Phase IV hosts connected by its Ethernet 0 interface, the interface must be configured for CLNS IS-IS for Router A to convert the Phase IV adjacency information into Phase V. If the Ethernet interface 0 on Router A is not configured for CLNS IS-IS, Router B will never receive information about Router D and end node 1.

Figure 4   Sample Phase IV-to-Phase V Network Conversion
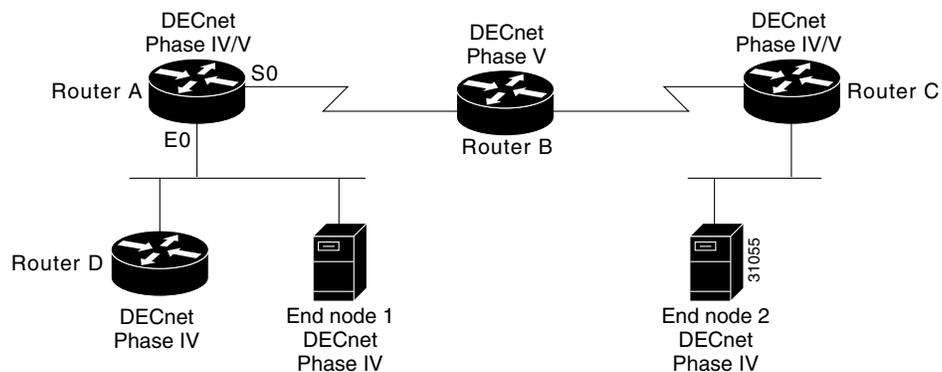
Configuration for Router A

```
decnet routing 1.1
decnet conversion 49
clns routing
router isis
 net 49.0001.aa00.0400.0104.00
interface ethernet 0
 clns router isis
```

```
 decnet cost 4
interface serial 0
 clns router isis
```

Sample Configuration for Router D

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

Example: Phase IV VAX Cluster Alias to Phase V Areas

The following example shows the commands required for allowing Phase IV VAX cluster alias to be reachable by Phase V areas. Note that cluster alias updates will only be propagated when Phase IV-to-Phase V conversion has been enabled, the router has been configured for CLNS IS-IS, and the **decnet cluster-alias update** command has been entered in order to allow updates. For the Ethernet interface 1/0 interface, a DECnet cost of four and a DECnet cluster holdtime of 200 seconds has been entered:

```
decnet routing 1.1
decnet conversion 49
clns routing
router isis
 net 49.0001.aa00.0400.0104.00
interface ethernet 1/0
 clns router isis
 decnet cost 4
 decnet cluster 200
 decnet cluster-alias update
```

Example: Phase IV Areas Through an OSI Backbone

The following example shows 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 5 illustrates the network, and the configurations that follow illustrate the commands required for enabling the advertise feature.

Figure 5 Sample Phase IV/Phase V Backbone Network
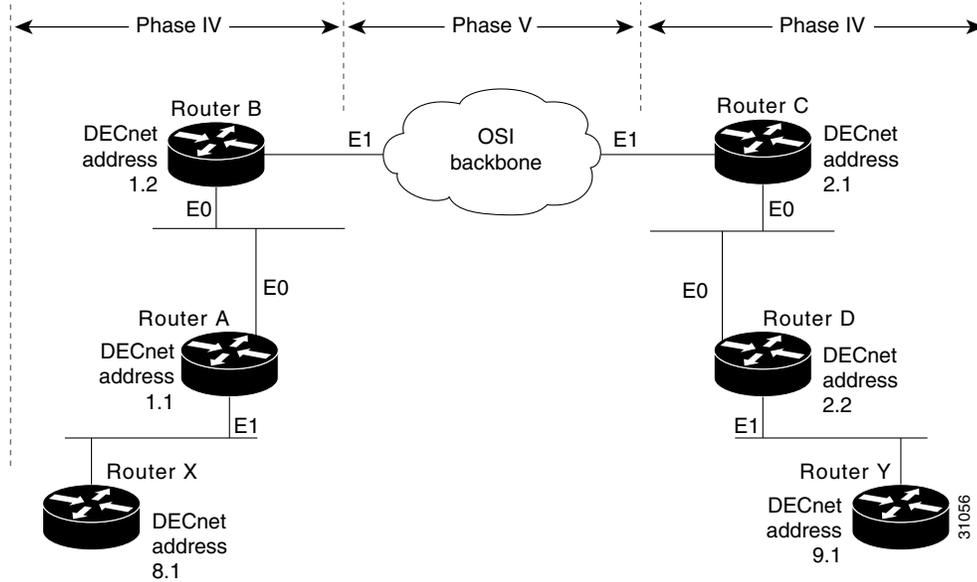
Configuration for Router B

```
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
```

The routing table for Router A 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
```

The routing table for Router B 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
```

The routing table for Router C 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: DECnet Accounting Configuration

Figure 6 illustrates DECnet accounting configured on the outbound serial interfaces for Router A and Router C. Note that because Router A and Router C exist in two different DECnet areas, they must be configured as interarea, or Level 2, routers.

Figure 6　　　　　*DECnet Accounting Configuration*
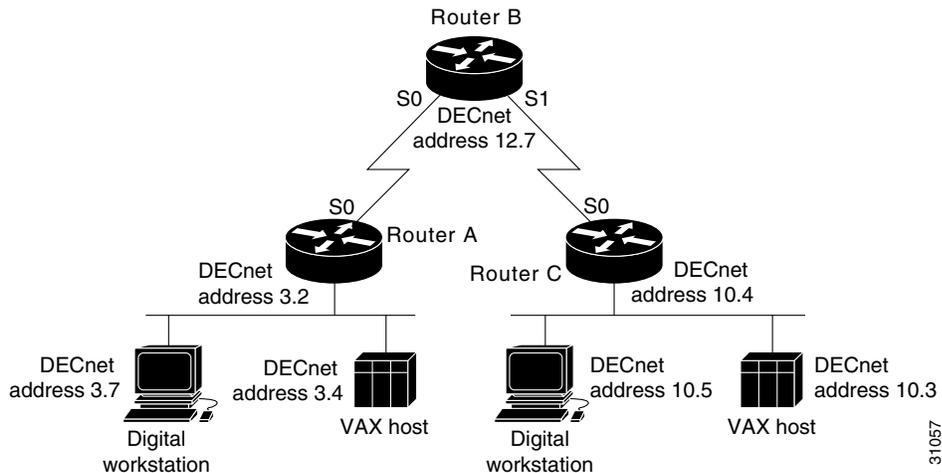
On Router A, DECnet accounting is enabled on an interface that is routing DECnet traffic. With no other commands used for the interface configuration, DECnet accounting on Router A tracks all DECnet traffic outbound on that interface up to the default accounting threshold of 512 source and destination pair addresses.

Configuration for Router A

```
decnet routing 3.2
decnet node-type area
interface serial 0
 decnet cost 20
 decnet accounting
interface ethernet 0
 decnet cost 4
```

Router B is configured to track traffic between all pairs specified in the **decnet accounting list** command. Router B also tracks traffic for pairs not specified in the **decnet accounting list** command up to the value specified for the **decnet accounting transit** command. If traffic between a source and destination endpoint pair not listed traverses the router, that traffic is added to the aggregate value, which appears in the display for the **show decnet accounting** command.

Configuration for Router B

```
decnet routing 12.7
interface serial 0
 decnet cost 20
 decnet accounting
interface serial 1
 decnet cost 20
 decnet accounting
decnet node type area
decnet accounting list 3.4 10.5
decnet accounting list 3.7 10.5
decnet accounting list 3.4 10.3
decnet accounting transits 2
```

Router C is configured to track DECnet traffic according to the values specified with the DECnet commands. The accounting threshold is set to 1000, which means that DECnet accounting will track all traffic passing through the router for up to 1000 source and destination address pairs.

Configuration for Router C

```
decnet routing 10.4
decnet node-type area
interface serial 0
 decnet cost 20
 decnet accounting
 decnet accounting threshold 1000
interface ethernet 0
 decnet cost 4
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	*Cisco IOS Master Commands List, All Releases*
Cisco IOS DECnet Command Reference	*Cisco IOS DECnet Command Reference*

Standards and RFCs

Standard/RFC	Title
No new or modified standards or RFCs are supported, and support for existing standards or RFCs has not been modified.	—
None	—

MIBs

MIB	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Configuring DECnet

Table 2 lists the features in this module and provides links to specific configuration information.

Not all commands may be available in your Cisco IOS software release. For release information about a specific command, see the command reference documentation.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which Cisco IOS and Catalyst OS software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Note Table 2 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

Table 2 Feature Information for Configuring DECnet Features

Feature Name	Releases	Feature Information
Configuring Address Translation	12.0	Allows translation of entire areas, rather than individual hosts. The following sections provide information about this feature: • Configuring Address Translation, page 6 • Example: Address Translation, page 22
Configuring DECnet Accounting	11.3(1)	DECnet accounting allows you to collect information about DECnet packets and the number of bytes that are switched through the Cisco IOS software. The following sections provide information about this feature: • Configuring DECnet Accounting, page 15 • Example: DECnet Accounting Configuration, page 27