Mobile IP—Mobile Router Multipath Support

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Mobile IP has increasingly become important in the public safety and public transportation markets. Customers in those markets are likely to adopt multiple wireless technologies to support their mission-critical applications and new services. Before the introduction of the Mobile IP—Mobile Router Multipath Support feature, the Cisco implementation of Mobile IP supported only one tunnel between the mobile router and the home agent. Because of this implementation, only one tunnel and one wireless technology could be used at a given time. This feature provides support for multiple paths, and thus multiple wireless technologies, between the mobile router and the home agent and allows user traffic to be load-balanced over all available interfaces.

Finding Feature Information in This Module

Your Cisco IOS software release may not support all of the features documented in this module. To reach links to specific feature documentation in this module and to see a list of the releases in which each feature is supported, use the "Feature Information for Mobile IP—Mobile Router Multipath Support" section on page 38.

Finding Support Information for Platforms and Cisco IOS and Catalyst OS Software Images

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

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Restrictions for Mobile Router Multipath Support

In a single-tunnel scenario, you can configure a default route through an interface to the home agent to help with collocated care-of address registrations. Do not use this configuration if your mobile router is configured for multipath support because it would defeat the purpose of multipath support.

Information About Mobile Router Multipath Support

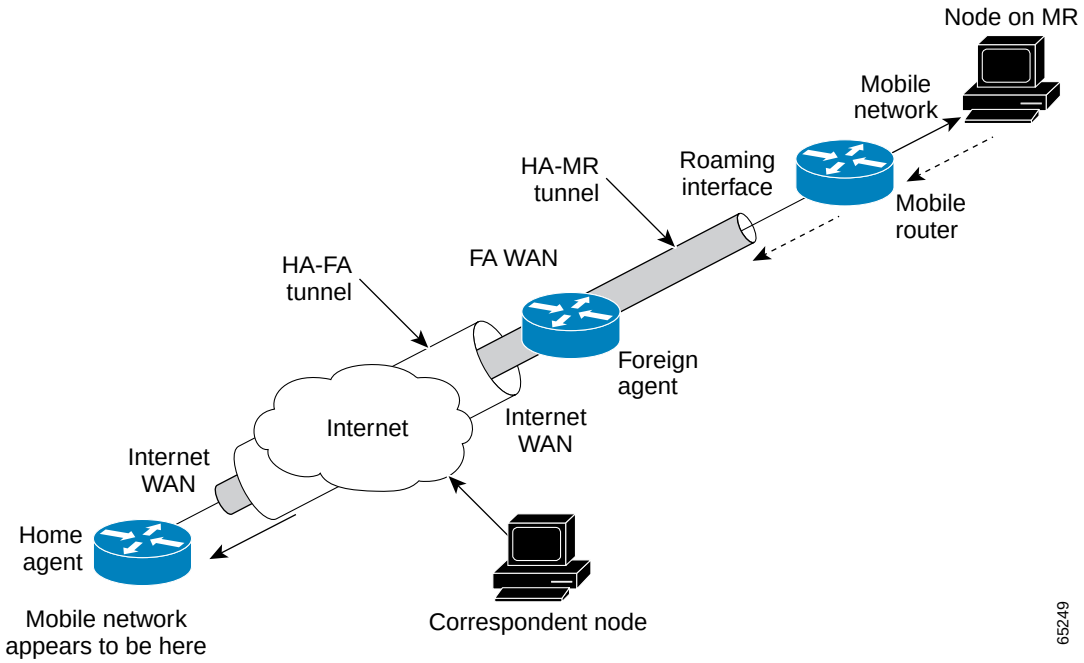
Before you configure the Mobile Router Multipath Support feature, you should understand the following concepts:

- Mobile Router Multipath Support Feature Design
- Mobile Router Multipath Load Balancing Behavior
- Benefits of Mobile Router Multipath Support

Mobile Router Multipath Support Feature Design

The Mobile Router Multipath Support feature extends the mobile router functionality to multiple interfaces. Before the introduction of this feature, the mobile router received agent advertisements on multiple roaming interfaces. However, it would register through only one interface and set up the tunnel and routes based on that registration. During the routing or tunneling phase, packets arrive at the home agent. The home agent performs two encapsulations of the packets and tunnels them to the foreign agent. The foreign agent performs one de-encapsulation and forwards the packets to the mobile router, which performs another de-encapsulation. The mobile router then forwards the original packets to the IP devices on the mobile networks. See Figure 1 for an illustration of routing within a mobile network using a single tunnel.

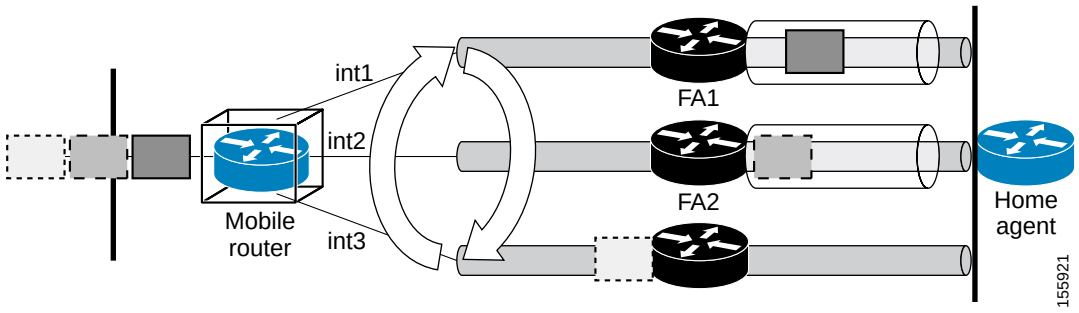
Figure 1 Routing Within the Mobile Network Using a Single Tunnel



With the introduction of the Mobile Router Multipath Support feature, the mobile router can register to the home agent through all of its available roaming interfaces. Each registration will be independent of the other registrations that occur on the other roaming interfaces. Once registered through more than one roaming interface, the mobile router will have multiple routes to the home agent. If reverse tunnel is configured, the mobile router will have multiple paths—each tunnel going out its respective interface. Because the mobile router is registering independently on each of its roaming interfaces, it can use a foreign agent to register on one interface and a collocated care-of address (CCoA) to register with on another interface.

See Figure 2 for an illustration of the mobile router registering through multiple interfaces.

Figure 2 Mobile Router Registering Through Multiple Interfaces to the Home Agent



Upon successful registration, the home agent will maintain multiple care-of addresses, mobility bindings, tunnels, and routes to the same mobile router. Multiple bindings are not the same as simultaneous bindings. With simultaneous bindings, the traffic to a mobile node is replicated on all tunnels. With multiple bindings, the traffic is not replicated on all tunnels but rather load-balanced across them.

Mobile Router Multipath Load Balancing Behavior

When there are multiple paths between the mobile router and the home agent, the traffic from the mobile networks that goes toward the home agent can be load-balanced by one of the following methods:

- Per-packet load balancing
- Per-destination load balancing

For both of these methods, traffic is load-balanced in a round-robin fashion among multiple paths.

Both of these methods support equal and unequal load balancing. Equal load balancing of packets (or sessions) among the multiple paths between the mobile router and the home agent can cause congestion because of the interfaces with lower bandwidth. To accommodate this situation, the Mobile Router Multipath Support feature uses the roaming interface bandwidth of the associated tunnel as the default metric. For example, if a mobile router registers to a home agent through two interfaces, one with a bandwidth of 1000 and the other with a bandwidth of 500, two packets will go through the first interface and the third packet will go through the second interface.

Per-Packet Load Balancing

Per-packet load balancing allows the router to send data packets over successive paths without regard to individual destination hosts or user sessions. Path utilization is good, but packets destined for a given destination host might take different paths and might arrive out of order. This behavior has the disadvantage of causing packets in the same session to follow different routes through the network, causing the packet reordering and nonpredictive latency for that session.

Per-Destination Load Balancing

Per-destination load balancing is the default behavior for this feature and addresses the disadvantages of per-packet load balancing. Per-destination load balancing allows the router to use multiple, equal-cost paths to achieve load sharing. In per-destination load sharing, each tunnel is considered based on the destination or session. If the packet is destined for the same destination as taken previously, the same path is chosen. Packets in the same session stay in the same order and follow the same route across the network, which helps maintain the latency for each packet.

Benefits of Mobile Router Multipath Support

Because multiple access technologies can be deployed in mobile networks, the Mobile Router Multipath Support feature offers the ability to leverage all available links when Mobile IP is used. This multiple path support offers a good investment protection for existing legacy wireless connections or any newly purchased or deployed wireless technologies.

How to Configure Mobile Router Multipath Support

This section contains the following tasks:

The Mobile Router Multipath Support feature is enabled by default on the mobile router but is disabled by default on the home agent. For this feature to work, both the home agent and the mobile router should be configured for multipath support. Enabled by default on the mobile router means that the mobile router will try for multiple registrations. However, if the mobile router determines that the home agent is not configured for multipath support by receiving registration replies without multiple path support, the mobile router will switch to single-path mode. The feature is disabled by default on the home agent so that during deployments, upgrading the software does not surprise the deployment engineer with multiple registrations.

Configuring the Mobile Router for Multipath Support

This task shows how to configure the mobile router for multipath support.

Prerequisites

To enable per-packet load balancing, you must configure the **ip load-sharing per-packet** command on a tunnel template and configure the tunnel template to be applied to all Mobile IP tunnels. No configuration is needed for per-destination load balancing because it is the default behavior. See the "Mobile Router Multipath Load Balancing Behavior" section on page 4 section for more information on multipath load balancing.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ip address** *ip-address mask*
5. **exit**
6. **router mobile**
7. **exit**
8. **ip mobile router**
9. **address** *address mask*
10. **home-agent** *ip-address*
11. **mobile-network** *interface*
12. **multi-path** [**metric** {**bandwidth** | **hopcount**}]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface loopback0`	Configures an interface and enters interface configuration mode.
Step 4	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.1.1.10 255.255.255.255`	Sets a primary IP address of the interface. • This is the home address of the mobile router.
Step 5	**exit** **Example:** `Router(config-if)# exit`	Returns to global configuration mode.
Step 6	**router mobile** **Example:** `Router(config)# router mobile`	Enables Mobile IP on the router and enters router configuration mode.
Step 7	**exit** **Example:** `Router(config-router)# exit`	Returns to global configuration mode.
Step 8	**ip mobile router** **Example:** `Router(config)# ip mobile router`	Enables the mobile router and enters mobile router configuration mode.
Step 9	**address** *address mask* **Example:** `Router(mobile-router)# address 10.1.1.10 255.255.255.0`	Sets the home IP address and network mask of the mobile router.
Step 10	**home-agent** *ip-address* **Example:** `Router(mobile-router)# home-agent 192.168.1.2`	Specifies the home agent that the mobile router uses during registration.

	Command or Action	Purpose
Step 11	**mobile-network** *interface* **Example:** `Router(mobile-router)# mobile-network Ethernet3/0`	Specifies the mobile router interface that is connected to the mobile network.
Step 12	**multi-path** [**metric** {**bandwidth** | **hopcount**}] **Example:** `Router(mobile-router)# multi-path`	Enables the mobile router to request multiple path support. • Bandwidth is the default metric.

Configuring the Home Agent for Multipath Support

This task shows how to configure the home agent for multipath support.

You can configure and unconfigure multipath support globally on the home agent. Unconfiguring multiple paths takes the mobile router back to the existing single-path mode.

Prerequisites

To enable per-packet load balancing, you must configure the **ip load-sharing per-packet** command on a tunnel template and configure the tunnel template to be applied to all Mobile IP tunnels. No configuration is needed for per-destination load balancing because it is the default behavior. See the "Mobile Router Multipath Load Balancing Behavior" section on page 4 section for more information on multipath load balancing.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router mobile**
4. **exit**
5. **ip mobile home-agent multi-path** [**metric** {**bandwidth** | **hopcount**}]
6. **ip mobile virtual-network** *net mask* [**address** *address*]
7. **ip mobile host** *lower* [*upper*] {**interface** *name* | **virtual-network** *net mask*}
8. **ip mobile mobile-networks** *lower* [*upper*]
9. **register**
10. [**no**] **no multi-path** [**metric** {**bandwidth** | **hopcount**}]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**router mobile** **Example:** `Router(config)# router mobile`	Enables Mobile IP on the router and enters router configuration mode.
Step 4	**exit** **Example:** `Router(config-router)# exit`	Returns to global configuration mode.
Step 5	**ip mobile home-agent multi-path** [**metric** {**bandwidth** | **hopcount**}] **Example:** `Router(config)# ip mobile home-agent multi-path`	Enables the home agent to process registration requests with multiple path support for all mobile routers. • Bandwidth is the default metric.
Step 6	**ip mobile virtual-network** *net mask* [**address** *address*] **Example:** `Router(config)# ip mobile virtual-network 10.1.1.0 255.255.255.255`	Defines a virtual network. Specifies that the home network is a virtual network, which means that the mobile router is not physically attached to the home agent. Adds the network to the home agent's forwarding table so that routing protocols can redistribute the subnet.
Step 7	**ip mobile host** *lower* [*upper*] {**interface** *name* | **virtual-network** *net mask*} **Example:** `Router(config)# ip mobile host 10.1.1.10 10.1.1.15 virtual-network 10.1.1.0 255.255.255.0`	Configures the mobile router as a mobile host. The IP address is in the home network. The **interface** *name* option configures a physical connection from the home agent to the mobile router.
Step 8	**ip mobile mobile-networks** *lower* [*upper*] **Example:** `Router(config)# ip mobile mobile-networks 10.1.1.10 10.1.1.5`	Configures mobile networks for the mobile host and enters mobile networks configuration mode. The *upper* range can be used only with dynamically registered networks and allows you to configure multiple mobile routers at once. The range must be within the range configured in the **ip mobile host** command.

	Command or Action	Purpose
Step 9	**register** **Example:** `Router(mobile-networks)# register`	Dynamically registers the mobile networks with the home agent.
Step 10	[**no**]**multi-path** [**metric** {**bandwidth** | **hopcount**}] **Example:** `Router(mobile-networks)# no multi-path`	Overrides the global default setting and enables the home agent to process requests with multiple path support for a specific mobile router. • Bandwidth is the default metric. • The **no** version of the command disables multipath support for a specific mobile router.

Clearing the Mobility Binding on the Home Agent

Perform this task to manually clear the mobility binding associated with the mobile router IP address and its care-of address.

Restrictions

Use this clear command with care, because it will disrupt any sessions used by the mobile router. After you use this command, the mobile router will need to reregister to continue roaming.

SUMMARY STEPS

1. **enable**
2. **clear ip mobile binding** *mr-ip-address* [**coa** *care-of-address*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**clear ip mobile binding** *mr-ip-address* [**coa** *care-of-address*] **Example:** `Router# clear ip mobile binding 172.16.28.2`	Removes mobility bindings. • You can remove a specific care-of address or all care-of addresses associated with a mobile router.

Verifying Mobile Router Multipath Support

Perform this task to verify mobile router multipath support.

SUMMARY STEPS

1. **enable**
2. **show ip mobile binding** [**home-agent** *ip-address* | **nai** *string* [**session-id** *string*] | **summary**]
3. **show ip mobile global**
4. **show ip mobile mobile-networks**
5. **show ip mobile tunnel** [*interface*]
6. **show ip route**
7. **show ip mobile router**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show ip mobile binding** [**home-agent** *ip-address* | **nai** *string* [**session-id** *string*] | **summary**] **Example:** `Router# show ip mobile binding`	Displays the mobility binding on the home agent.
Step 3	**show ip mobile global** **Example:** `Router# show ip mobile global`	Displays global information for mobile agents.
Step 4	**show ip mobile mobile-networks** **Example:** `Router# show ip mobile mobile-networks`	Displays a list of mobile networks associated with the mobile router.
Step 5	**show ip mobile tunnel** [*interface*] **Example:** `Router# show ip mobile tunnel`	Displays active tunnels.
Step 6	**show ip route** **Example:** `Router# show ip route`	Displays the current state of the routing table.
Step 7	**show ip mobile router** **Example:** `Router# show ip mobile router`	Displays configuration information and monitoring statistics about the mobile router.

Configuration Examples for Mobile Router Multipath Support

This section provides the following configuration examples:

- Multipath Support on the Mobile Router: Example, page 11
- Multipath Support on the Home Agent: Example, page 12

Multipath Support on the Mobile Router: Example

The following example shows how to configure multipath support on the mobile router:

```
interface Loopback0
! MR home address
 ip address 10.1.1.10 255.255.255.255
```

```
interface Tunnel101
 keep 5 3
interface Ethernet1/0
! MR roaming interface
 ip address 172.16.1.0 255.255.255.0
 ip mobile router-service roam
interface Ethernet2/0
! MR roaming interface
 ip address 172.17.1.0 255.255.255.0
 ip mobile router-service roam
interface Ethernet3/0
 ip address 172.18.1.0 255.255.255.0
router mobile
ip mobile router
 address 10.1.1.10 255.255.255.0
 home-agent 192.168.1.1
 mobile-network Ethernet3/0
 tunnel mode gre
 multi-path
 template Tunnel101
ip mobile secure home-agent 192.168.1.1 spi 101 key hex 12345678901234567890123456789012
```

Multipath Support on the Home Agent: Example

The following example shows how to configure multipath support on the home agent:

```
interface Ethernet 0/0
 ip address 192.168.1.1 255.255.255.0
!
router mobile
 exit
 ip mobile home-agent multi-path
 ip mobile virtual-network 10.1.1.0 255.255.255.0
 ip mobile host 10.1.1.10 10.1.1.15 virtual-network 10.1.1.0 255.255.255.0
 ip mobile secure host 10.1.1.10 10.1.1.15 spi 101 key hex
 12345678901234567890123456789012
ip mobile mobile-networks 10.1.1.10 10.1.1.12
 register
ip mobile mobile-networks 10.1.1.14
 register
 no multi-path
```

Additional References

The following sections provide references related to the Mobile Router Multipath Support feature.

Related Documents

Related Topic	Document Title
Mobile IP information and configuration tasks	*Cisco IOS IP Mobility Configuration Guide*, Release 12.4
Mobile IP commands: complete command syntax, command mode, command history, defaults, usage guidelines, and examples	*Cisco IOS IP Mobility Command Reference*, Release 12.4T

Standards

Standard	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—

MIBs

MIB	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	—

Technical Assistance

Description	Link
The Cisco Technical Support & Documentation website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, tools, and techncial documentation. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/techsupport

Command Reference

This section documents new and modified commands only.

New Commands

- **ip mobile home-agent multi-path**
- **multi-path (mobile networks)**
- **multi-path (mobile router)**

Modified

- **clear ip mobile binding**
- **show ip mobile binding**
- **show ip mobile globals**
- **show ip mobile mobile-networks**
- **show ip mobile router**
- **show ip mobile tunnel**

clear ip mobile binding

To remove mobility bindings, use the **clear ip mobile binding** command in privileged EXEC mode.

clear ip mobile binding {**all** [**load** *standby-group-name*] | *ip-address* [**coa** *care-of-address*] | **nai** *string* [**session-id** *string*]}

Syntax Description

all	Clears all mobility bindings.
load *standby-group-name*	(Optional) Downloads mobility bindings for a standby group after a clear operation.
ip-address	IP address of a mobile node or mobile router.
coa *care-of-address*	(Optional) The binding corresponding to the IP address and its care-of address.
nai *string*	Network access identifier (NAI) of the mobile node.
session-id *string*	(Optional) Session identifier. The string value must be fewer than 25 characters in length.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.0(1)T	This command was introduced.
12.1(3)T	The following keywords and argument were added: • **all** • **load** • *standby-group-name*
12.2(2)XC	The **nai** keyword was added.
12.2(13)T	This command was integrated into Cisco IOS Release 12.2(13)T.
12.3(4)T	The **session-id** keyword was added.
12.4(9)T	The **coa** *care-of-address* keyword and argument combination were added.

Usage Guidelines

The home agent creates a mobility binding for each roaming mobile node. Associated with the mobility binding is the tunnel to the visited network and a host route to forward packets destined for the mobile node. Typically, there should be no need to clear the binding because it expires after the lifetime is reached or when the mobile node deregisters.

When the mobility binding is removed through use of this command, the number of users on the tunnel is decremented and the host route is removed from the routing table. The mobile node is not notified.

If the **nai** *string* **session-id** *string* option is specified, only the binding entry with that session identifier is cleared. If the **session-id** keyword is not specified, all binding entries (potentially more than one, with different session identifiers) for that NAI are cleared. You can determine the **session-id** *string* value by using the **show ip mobile binding** command.

Use this command with care, because it will disrupt any sessions used by the mobile node. After you use this command, the mobile node will need to reregister to continue roaming.

Examples

The following example administratively stops mobile node 192.168.100.10 from roaming:

```
Router# show ip mobile binding

Mobility Binding List:
Total 1
192.168.100.10:
    Care-of Addr 192.168.6.1, Src Addr 192.168.4.2,
    Lifetime granted 02:46:40 (10000), remaining 02:46:32
    Flags SbdmGvt, Identification B750FAC4.C28F56A8,
    Tunnel100 src 192.168.1.2 dest 192.168.6.1 reverse-allowed
    Routing Options - (G)GRE

Router# clear ip mobile binding 10.2.0.1

Router# show ip mobile binding
```

Related Commands

Command	Description
show ip mobile binding	Displays the mobility binding table.

ip mobile home-agent multi-path

To enable the home agent to process registration requests with multiple path support for all mobile routers, use the **ip mobile home-agent multi-path** command in global configuration mode. To disable multipath support on the home agent, use the **no** form of this command.

ip mobile home-agent multi-path [**metric** {**bandwidth | hopcount**}]

no ip mobile home-agent multi-path [**metric** {**bandwidth | hopcount**}]

Related Commands

metric	(Optional) Metric for multipath load balancing.
bandwidth	(Optional) Specifies that bandwidth is used as the metric. Bandwidth is the default metric.
hopcount	(Optional) Specifies that hop count is used as the metric.

Command Default

Multiple path support is enabled by default on the mobile router.

Command Modes

Global configuration.

Command History

Release	Modification
12.4(9)T	This command was introduced.

Usage Guidelines

Multiple path support is enabled by default on the mobile router but disabled by default on the home agent. The **multi-path** command in mobile networks configuration mode overrides the global setting.

Examples

The following example shows how to configure the home agent to globally process registration requests for all mobile routers:

```
!
router mobile
exit
ip mobile home-agent multi-path
```

Related Commands

Command	Description
multi-path (mobile networks)	Overrides the global default setting and enables the home agent to process requests with multiple path support for a specific mobile router.
multi-path (mobile router)	Enables the mobile router to request multiple path support.

multi-path (mobile networks)

To override the global default setting and enable the home agent to process requests with multiple path support for a specific mobile router, use the **multi-path** command in mobile networks configuration mode. To disable this functionality, use the **no** form of this command.

multi-path [**metric** {**bandwidth** | **hopcount**}]

no multi-path [**metric** {**bandwidth** | **hopcount**}]

Syntax Description

metric	(Optional) Metric for multipath load balancing.
bandwidth	(Optional) Specifies that bandwidth is used as the metric. Bandwidth is the default metric.
hopcount	(Optional) Specifies that hop count is used as the metric.

Command Default

Multiple path support is disabled on the home agent.

Command Modes

Mobile networks configuration

Command History

Release	Modification
12.4(9)T	This command was introduced.

Usage Guidelines

Multiple path support is enabled by default on the mobile router but is disabled by default on the home agent.

Examples

The following example shows how to configure the home agent to disable multiple path support for a specific mobile router:

```
!
ip mobile mobile-networks 10.1.1.14
 no multi-path
```

Related Commands

Command	Description
ip mobile home-agent multi-path	Enables the home agent to process registration requests with multiple path support for all mobile routers.
multi-path (mobile router)	Enables the mobile router to request multiple path support.

multi-path (mobile router)

To enable the mobile router to request multiple path support, use the **multi-path** command in mobile router configuration mode. To disable this functionality, use the **no** form of this command.

multi-path [**metric** {**bandwidth | hopcount**}]

no multi-path [**metric** {**bandwidth | hopcount**}]

Syntax Description

metric	(Optional) Metric for multipath load balancing.
bandwidth	Specifies that bandwidth is used as the metric. Bandwidth is the default metric.
hopcount	Specifies that hop count is used as the metric.

Command Default

Multiple path support is enabled on the mobile router.

Command Modes

Mobile router configuration.

Command History

Release	Modification
12.4(9)T	This command was introduced.

Usage Guidelines

Multiple path support is enabled by default on the mobile router but disabled by default on the home agent.

Examples

The following example shows how to configure the mobile router to request multiple path support:

```
!
ip mobile router
 multi-path
```

Related Commands

Command	Description
ip mobile home-agent multi-path	Enables the home agent to process registration requests with multiple path support for all mobile routers.
multi-path (mobile networks)	Overrides the global default setting and enables the home agent to process requests with multiple path support for a specific mobile router.

show ip mobile binding

To display the mobility binding table on the home agent (HA), use the **show ip mobile binding** command in privileged EXEC mode.

show ip mobile binding [**home-agent** *ip-address* | **nai** *string* [**session-id** *string*] | **summary**]

Syntax Description

home-agent	(Optional) Mobility bindings for a specific home agent (HA).
ip-address	(Optional) IP address for the HA.
nai *string*	(Optional) Mobile node (MN) identified by the network access identifier (NAI).
session-id *string*	(Optional) Session identifier. The *string* argument must be fewer than 25 characters in length.
summary	(Optional) Total number of bindings in the table.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.0(1)T	This command was introduced.
12.0(2)T	The **home-agent** keyword and *ip-address* argument were added.
12.1(2)T	The **summary** keyword was added.
12.2(2)XC	The **nai** keyword was added.
12.2(13)T	This command was enhanced to display the service options field and to include information about the mobile networks registered on the home agent.
12.3(4)T	The **session-id** keyword was added.
12.3(8)T	The output was enhanced to display UDP tunneling information.
12.4(9)T	The output was enhanced to display multipath support.

Usage Guidelines

You can display a list of all bindings if you press enter. You can also specify an IP address for a specific home agent using the **show ip mobile binding home-agent** *ip-address* command.

If the **session-id** *string* combination is specified, only the binding entry for that session identifier is displayed. A session identifier is used to uniquely identify a Mobile IP flow. A Mobile IP flow is the set of {NAI, IP address}. The flow allows a single NAI to be associated with one or multiple IP addresses, for example, {NAI, ipaddr1}, {NAI, ipaddr2}, and so on. A single user can have multiple sessions for example, when logging through different devices such as a PDA, cellular phone, or laptop. If the session identifier is present in the initial registration, it must be present in all subsequent registration renewals from that MN.

Examples

The following is sample output from the **show ip mobile binding** command:

```
Router# show ip mobile binding

Mobility Binding List:
Total 1
10.0.0.1:
 Care-of Addr 10.0.0.31, Src Addr 10.0.0.31,
 Lifetime granted 02:46:40 (10000), remaining 02:46:32
 Flags SbdmGvt, Identification B750FAC4.C28F56A8,
 Tunnel100 src 10.0.0.5 dest 10.0.0.31 reverse-allowed
 Routing Options - (G)GRE
  Service Options:
  NAT detect
```

The following is sample output from the **show ip mobile binding** command when mobile networks are configured or registered on the home agent:

```
Router# show ip mobile binding

Mobility Binding List:
Total 1
10.0.4.1:
 Care-of Addr 10.0.0.5, Src Addr 10.0.0.5
 Lifetime granted 00:02:00 (120), remaining 00:01:56
 Flags sbDmgvT, Identification B7A262C5.DE43E6F4
 Tunnel0 src 10.0.0.3 dest 10.0.0.5 reverse-allowed
 MR Tunnel1 src 10.0.0.3 dest 10.0.4.1 reverse-allowed
 Routing Options - (D)Direct-to-MN (T)Reverse-tunnel
 Mobile Networks: 10.0.0.0/255.255.255.0(S)
  10.0.0.0/255.255.255.0 (D)
  10.0.0.0/255.0.0.0(D)
```

The following is sample output from the **show ip mobile binding** command with session identifier information:

```
Router# show ip mobile binding

Mobility Binding List:
Total 1
 10.100.100.19:
 Care-of Addr 10.70.70.2, Src Addr 10.100.100.1,
 Lifetime granted 00:33:20 (20000), remaining 00:30:56
 Flags SbdmGvt, Identification BC1C2A04.EA42659C,
 Tunnel0 src 10.100.100.100 dest 10.70.70.2 reverse-allowed
 Routing Options
 Session identifier 998811234
 SPI 333 (decimal 819) MD5, Prefix-suffix, Timestamp +/-255, root key
 Key 38a38987ad0a399cb80940835689da66
 SPI 334 (decimal 820) MD5, Prefix-suffix, Timestamp +/-255, session key
 Key 34c7635a313038611dec8c16681b55e0
```

The following sample output shows that the home agent is configured to detect network address translation (NAT):

```
Router# show ip mobile binding nai mn@cisco.com

Mobility Binding List:

 mn@cisco.com (Bindings 1):
 Home Addr 10.99.101.1
 Care-of Addr 192.168.1.202, Src Addr 192.168.157.1
 Lifetime granted 00:03:00 (180), remaining 00:02:20
 Flags sbDmg-T-, Identification BCF5F7FF.92C1006F
```

```
 Tunnel0 src 192.168.202.1 dest 192.168.157.1 reverse-allowed
 Routing Options - (D)Direct-to-MN (T)Reverse-tunnel
 Service Options:
 NAT detect
```

The following sample output shows that multipath support is enabled:

```
Router# show ip mobile binding

Mobility Binding List:
Total 1
10.1.1.1:
    Care-of Addr 10.1.1.11, Src Addr 10.1.1.11
    Lifetime granted 10:00:00 (36000), remaining 09:52:40
    Flags sbDmg-T-, Identification C5441314.61D36B14
    Tunnel1 src 12.1.1.10 dest 10.1.1.11 reverse-allowed
    MR Tunnel1 src 12.1.1.10 dest 10.1.1.11 reverse-allowed
    Routing Options - (D)Direct-to-MN (T)Reverse-tunnel
    Mobile Networks: 10.38.0.0/255.255.0.0 (D)
    Roaming IF Attributes: BW 10000 Kbit, ID 3247
     Description First Lan Interface
    Multi-path Metric bandwidth
```

Table 1 describes the significant fields shown in the display.

Table 1 show ip mobile binding Field Descriptions

Field	Description
Total	Total number of mobility bindings.
<IP Address>	Home IP address of the mobile node. The NAI is displayed if configured.
Care-of Addr	Care-of address of the mobile node.
Src Addr	IP source address of the registration request as received by the home agent. Will be either the colocated care-of address of a mobile node or an address on the foreign agent or the active HA address. If it is the active HA address, then this is a binding update from the active HA to the standby HA and not a registration directly received from the MN or FA.
Lifetime granted	The lifetime (in hh:mm:ss) granted to the mobile node for this registration. Number of seconds appears in parentheses.
remaining	The time (in hh:mm:ss) remaining until the registration expires. It has the same initial value as lifetime granted and is counted down by the home agent.
Flags	Services requested by the mobile node. The mobile node requests these services by setting bits in the registration request. Uppercase characters denote bit set.
Identification	Identification used in that binding by the mobile node. This field has two purposes: unique identifier for each request and replay protection.
Tunnel	The tunnel used by the mobile node is characterized by the source and destination addresses and reverse-allowed or reverse-off for reverse tunnel. The default encapsulation is IP-in-IP. The mobile node can request GRE.
Routing Options	Routing options identify the services that the home agent is currently providing. The mobile node must request these services in its registration request by setting the services flag (see Flags field description). For example, the V bit may have been requested by the mobile node (shown in the Flags field), but the home agent will not provide such service. Possible options are B (broadcast), D (direct-to-mobile node), G (GRE), and T (reverse-tunnel).

Table 1 show ip mobile binding Field Descriptions (continued)

Field	Description
Service Options	Service options configured.
NAT detect	Indicates that the mobile node is registering from behind a NAT-enabled router.
Mobile Networks	Mobile networks configured or registered on the home agent. D denotes dynamic (registered) mobile networks, and S denotes static (configured) mobile networks.
Session identifier	The ID used to uniquely identify a Mobile IP flow.
SPI	The security parameter index (SPI) is the 4-byte opaque index within the mobility security association that selects the specific security parameters to be used to authenticate the peer.
MD5	Message Digest 5 authentication algorithm. HMAC-MD5 is displayed if configured.
Prefix-suffix	Authentication mode.
Timestamp	Replay protection method.
root key	Dynamic key based on the Microsoft Windows password shared between the mobile node and AAA or Windows domain controller or active directory. Once a mobile node registers, this key is established until the binding persists on the home agent. Subsequent registration requests can be authenticated using the root key.
session key	Dynamic key that is derived using the root key. This key can be refreshed, and the refreshed keys are based off the root key. Subsequent registration renewal messages can be authenticated using the session key. The period or frequency for the session key refresh is determined by the mobile node. Registration requests that also request session key refresh are authenticated using the root key.
Roaming IF Attributes	Attributes associated with the roaming interface. BW denotes the bandwidth of the roaming interface.
Description	Description of the roaming interface on the mobile router.
Multi-path Metric bandwidth	Metric that the mobile router uses for multipath support.

Related Commands

Command	Description
debug ip mobile	Displays IP mobility activities.
ip mobile foreign-agent nat traversal	Enables NAT UDP traversal support for Mobile IP foreign agents.
ip mobile home-agent nat traversal	Enables NAT UDP traversal support for Mobile IP HAs.
show ip mobile globals	Displays global information about Mobile IP home agents, foreign agents, and mobile nodes.
show ip mobile tunnel	Displays information about UDP tunneling.
show ip mobile visitor	Displays the table that contains a visitor list of foreign agents.

show ip mobile globals

To display global information for mobile agents, use the **show ip mobile globals** command in privileged EXEC mode.

show ip mobile globals

Syntax Description

This command has no arguments or keywords.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.0(1)T	This command was introduced.
12.2(13)T	This command was enhanced to display the NAT detect field and the Strip realm domain field.
12.2(15)T	This command was enhanced to display the HA Accounting field.
12.3(7)T	This command was enhanced to display information about foreign agent route optimization.
12.3(8)T	This command was enhanced to display information about UDP tunneling.
12.4(9)T	This command was enhanced to display information about multipath support.

Usage Guidelines

This command shows the services provided by the home agent or foreign agent. Note the deviation from RFC 3344: the foreign agent will not display busy or registration required information. Both are handled on a per-interface basis (see the **show ip mobile interface** command), not at the global foreign agent level.

Examples

The following is sample output from the **show ip mobile globals** command:

```
Router# show ip mobile globals

IP Mobility global information:

Home Agent

    Registration lifetime: 10:00:00 (36000 secs)
    Broadcast enabled
    Replay protection time: 7 secs
    Reverse tunnel enabled
    ICMP Unreachable enabled
    Strip realm enabled
    NAT detect disabled
    HA Accounting enabled using method list: mylist
    Address 1.1.1.1
    Virtual networks
        10.0.0.0/8
```

```
Foreign Agent

    Pending registrations expire after 120 seconds
    Care-of address advertised
    Mobile network route injection enabled
    Mobile network route redistribution disabled
    Mobile network route injection access list mobile-net-list
    Ethernet2/2 (10.10.10.1) - up

Mobility Agent

1 interfaces providing service
Encapsulations supported: IPIP and GRE
Tunnel fast switching enabled, cef switching enabled
Discovered tunnel MTU aged out after 1:00:00
```

The following example shows that home agent UDP tunneling is enabled with a keepalive timer set at 60 seconds and forced UDP tunneling enabled.

```
Router# show ip mobile globals

IP Mobility global information:

Home agent

 Registration lifetime: 10:00:00 (36000 secs)
 Broadcast disabled
 Replay protection time: 7 secs
 Reverse tunnel enabled
 ICMP Unreachable enabled
 Strip realm disabled
 NAT Traversal disabled
 HA Accounting disabled
 NAT UDP Tunneling support enabled
 UDP Tunnel Keepalive 60
 Forced UDP Tunneling enabled
 Virtual networks
 10.99.101.0/24

Foreign agent is not enabled, no care-of address

0 interfaces providing service
Encapsulations supported: IPIP and GRE
Tunnel fast switching enabled, cef switching enabled
Tunnel path MTU discovery aged out after 10 min
```

The following example shows that NAT UDP tunneling support is enabled on the foreign agent with a keepalive timer set at 110 seconds and forced UDP tunneling disabled.

```
Router# show ip mobile globals

IP Mobility global information:

Foreign Agent

Pending registrations expire after 120 secs
Care-of addresses advertised
Mobile network route injection disabled

Ethernet2/2 (10.30.30.1) - up
```

```
1 interface providing service
Encapsulations supported: IPIP and GRE
Tunnel fast switching enabled, cef switching enabled
Tunnel path MTU discovery aged out after 10 min
NAT UDP Tunneling support enabled
UDP Tunnel Keepalive 110
Forced UDP Tunneling disabled
```

The following example output shows that multipath support is enabled:

```
Router# show ip mobile globals

IP Mobility global information:

Home Agent

    Registration lifetime: 10:00:00 (36000 secs)
    Broadcast disabled
    Replay protection time: 7 secs
    ….
    UDP Tunnel Keepalive 110
    Forced UDP Tunneling disabled
    Multiple Path Support enabled
```

Table 2 describes the significant fields shown in the sample output.

Table 2 show ip mobile globals Field Descriptions

Field	Description
Home Agent	
Registration lifetime	Default lifetime (in hh:mm:ss) for all mobile nodes. Number of seconds given in parentheses.
Roaming access list	Determines which mobile nodes are allowed to roam. Displayed if defined.
Care-of access list	Determines which care-of addresses are allowed to be accepted. Displayed if defined.
Broadcast	Whether broadcast is enabled or disabled.
Replay protection time	Time, in seconds, that the time stamp on a registration request (RRQ) from a mobile node may differ from the router's internal clock.
Reverse tunnel	Whether reverse tunnel is enabled or disabled.
ICMP Unreachable	Sends ICMP unreachable messages, which are enabled or disabled for the virtual network.
Strip realm	Whether strip realm is enabled or disabled.
NAT detect	Whether NAT detect is enabled or disabled. If NAT detect is enabled, the home agent can detect a registration request that has traversed a NAT-enabled device and can apply a tunnel to reach the Mobile IP client.
HA Accounting	Whether home agent accounting is enabled or disabled.
NAT UDP Tunneling support	Whether NAT UDP tunneling is enabled or disabled on the home agent.
UDP Tunnel Keepalive	Keepalive interval, in seconds, configured on the home agent that avoids a NAT translation entry on a NAT device from expiring when there is no active Mobile IP data traffic going through the UDP tunnel.

Table 2 show ip mobile globals Field Descriptions (continued)

Field	Description
Forced UDP Tunneling	Whether the home agent is configured to accept forced UDP tunneling.
Address	Home agent address.
Virtual networks	Lists virtual networks serviced by the home agent. Displayed if defined.
Multiple Path Support	Whether multiple path support is enabled or disabled.
Foreign Agent	
Pending registrations expire after	The amount of time, in seconds, before a pending registration will time out.
Care-of addresses advertised	Displayed if care-of addresses are defined.
Mobile network route injection	Mobile network route injection can be enabled or disabled.
Mobile network route redistribution	Mobile network route redistribution can be enabled or disabled.
Mobile network route injection access list	The name of the access list used if mobile network route injection is enabled.
NAT UDP Tunneling support	Whether NAT UDP tunneling is enabled or disabled on the foreign agent
UDP Tunnel Keepalive	Keepalive interval, in seconds, configured on the foreign agent that avoids a NAT translation entry on a NAT device from expiring when there is no active Mobile IP data traffic going through the UDP tunnel.
Forced UDP Tunneling	Whether the foreign agent is configured to force UDP tunneling.
up, interface-only, transmit-only	Up status is displayed if the foreign agent is configured to function in an asymmetric link environment. Interface-only status is displayed if the foreign agent is configured to advertise only its own address as the care-of address in an asymmetric link environment. Transmit-only status is displayed if the foreign agent is configured to transmit only from the interface in an asymmetric link environment.
Mobility Agent	
Number of interfaces providing service	See the **show ip mobile interface** command for more information on the interfaces providing service. Agent advertisements are sent when ICMP Router Discovery Protocol (IRDP) is enabled.
Encapsulations supported	The encapsulation types that are supported. Possible encapsulation types are IPIP and GRE.
Tunnel fast switching	Whether tunnel fast switching is enabled or disabled.

Table 2 show ip mobile globals Field Descriptions (continued)

Field	Description
cef switching	Whether CEF switching is enabled or disabled.
Discovered tunnel MTU	Aged out after amount of time (in hh:mm:ss).

Related Commands

Command	Description
show ip mobile interface	Displays advertisement information for interfaces that are providing foreign agent service or that are home links for mobile nodes.

show ip mobile mobile-networks

To display a list of mobile networks associated with the mobile router, use the **show ip mobile mobile-networks** command in privileged EXEC mode.

show ip mobile mobile-networks [*ip-address*]

Syntax Description

ip-address	(Optional) Address of a specific mobile router. If not specified, information for all mobile networks is displayed.

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.2(4)T	This command was introduced.
12.2(13)T	This command was enhanced to display information about the dynamically registered mobile networks.
12.4(9)T	This command was enhanced to display information about multipath support.

Usage Guidelines

The home agent maintains a list of static and dynamic mobile networks associated with mobile routers.

Examples

The following is sample output from the **show ip mobile mobile-networks** command:

```
Router# show ip mobile mobile-networks

Mobile Networks:
MR 20.0.4.1:
Dynamic registration
    Configured:10.2.0.0/255.255.255.0
    Registered:10.3.0.0/255.255.255.0
               10.4.0.0/255.0.0.0
               10.5.0.0/255.255.255.0
```

The following is sample output from the **show ip mobile mobile-networks** command when multipath support is enabled:

```
Router# show ip mobile mobile-networks

Mobile Networks:
MR 10.1.1.1:
    Multiple Paths Support Enabled
    Dynamic registration
    Registered:10.2.0.0/255.255.255.0
```

Table 3 describes the significant fields in the display.

Table 3 show ip mobile mobile-networks Field Descriptions

Field	Description
MR	IP address of the mobile router.
Multiple Paths Support Enabled	Configured for multiple path support between the mobile router and the home agent.
Dynamic registration	Configured for dynamic registration of mobile networks.
Configured	Mobile networks statically configured on the home agent.
Registered	Mobile networks dynamically registered on the home agent.

Related Commands

Command	Description
ip mobile mobile-networks	Associates one or more networks with a mobile router configured as a mobile host and enters mobile networks configuration mode.

show ip mobile router

To display configuration information and monitoring statistics about the mobile router, use the **show ip mobile router** command in privileged EXEC mode.

show ip mobile router

Syntax Description

This command has no arguments or keywords.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.2(4)T	This command was introduced.
12.2(13)T	This command was enhanced to display information about the mobile network interfaces.
12.2(15)T	This command was enhanced to display information about collocated care-of addresses (CCoAs).
12.3(7)T	This command was enhanced to display information about requests for generic routing encapsulation (GRE).
12.4(9)T	The command was enhanced to display information about multipath support.

Usage Guidelines

The display includes the mobile router configuration information such as the home address and network mask, home agent, and registration settings, and operational information such as status, tunnel interface, active foreign agent, and care-of address.

Examples

The following is sample output from the **show ip mobile router** command:

```
Router# show ip mobile router

Mobile Router
  Enabled 05/30/02 11:16:03
  Last redundancy state transition 05/30/02 11:15:01

Configuration:
  Home Address 10.0.4.1 Mask 255.255.255.0
  Home Agent 10.0.0.3 Priority 100 (best) (current)
  Registration lifetime 120 sec
  Retransmit Init 1000, Max 5000 msec, Limit 3
  Extend Expire 120, Retry 3, Interval 10
  Redundancy group AlwaysUp (active)
  Mobile Networks:Ethernet5 (10.0.0.0/255.255.255.248)
    Ethernet2 (10.0.0.0/255.0.0.0)
    Ethernet3 (10.1.0.0/255.255.255.0)

Monitor:
  Status -Registered-
```

```
  Active foreign agent 10.0.1.2, Care-of 10.0.1.2
  On interface Serial0
  Tunnel0 mode IP/IP
```

The following is sample output from the **show ip mobile router** command when a mobile router is registered using a CCoA:

```
Router# show ip mobile router

Mobile Router
  Enabled 02/12/02 18:29:13
  Last redundancy state transition NEVER
Configuration:
  Home Address 10.0.4.1 Mask 255.255.255.0
  Home Agent 10.0.0.3 Priority 100 (best)
  Registration lifetime 120 sec
  Retransmit Init 1000, Max 5000 msec, Limit 3
  Extend Expire 120, Retry 3, Interval 10
Monitor:
  Status -Registered-
  Using Collocated Care-of Address 10.0.0.1
  On interface Ethernet1
  Tunnel0 mode IP/IP
```

The following is sample output from the **show ip mobile router** command when GRE encapsulation is globally configured on the mobile router. When GRE encapsulation is enabled, the line “Request GRE tunnel” is displayed in the output and the tunnel mode is shown as “GRE/IP.”

```
Router# show ip mobile router

Mobile Router
    Enabled 01/11/00 06:59:19
    Last redundancy state transition NEVER

Configuration:
    Home Address 10.80.80.1 Mask 255.255.255.0
    Home Agent 10.40.40.1 Priority 100 (best) (current)
    Registration lifetime 65534 sec
    Retransmit Init 1000, Max 5000 msec, Limit 3
    Extend Expire 20, Retry 10, Interval 1
    Request GRE tunnel
    Mobile Networks:Ethernet1/3 (172.16.143.0/255.255.255.0)
                    TokenRing4/3 (172.16.153.0/255.255.255.0)

Monitor:
    Status -Registered-
    Active foreign agent 10.52.52.1, Care-of 10.52.52.1
    On interface TokenRing4/2
    Tunnel0 mode GRE/IP
```

The following is sample output when the mobile router is configured for multipath support:

```
Router# show ip mobile router

Mobile Router
    Enabled 11/22/05 05:37:17
    Last redundancy state transition NEVER

Configuration:
    Home Address 10.1.1.10 Mask 255.255.255.0
    Home Agent 10.1.1.2 Priority 100 (best) (current)
    Registration lifetime 90 sec
    Retransmit Init 1000, Max 5000 msec, Limit 3
```

```
    Extend Expire 120, Retry 3, Interval 10
    Reverse tunnel required
    Multi-path active, Requested metric: bandwidth, Using metric: bandwidth
    Mobile Networks: Ethernet3/0 (172.16.1.0/255.255.255.0)
                     Loopback44 (192.168.1.0/255.255.255.0)

Monitor:
    Status -Registered-
    Foreign Agent 172.20.1.1, Care-of 172.20.1.1
         On interface Ethernet1/0
         Tunnel0 mode IP/IP
    Collocated care-of address 172.30.1.11
         On interface Ethernet2/0
         Tunnel2 mode IP/IP
    Collocated care-of address 172.40.1.11
         On interface Ethernet3/0
         Tunnel3 mode GRE/IP
```

Table 4 describes the significant fields shown in the display.

Table 4 show ip mobile router Field Descriptions

Field	Description
Enabled	Date and time (in hh:mm:ss) when the mobile router was enabled.
Last redundancy state transition	Date and time (in hh:mm:ss) when the redundancy state of the mobile router changed.
Home Address/Mask	Home IP address of the mobile router, including the network mask.
Home Agent	Home agent that the mobile router registers with. The mobile router registers only to the home agent with the highest priority when multiple addresses are configured.
Registration lifetime	Registration lifetime (in seconds) granted by the home agent for the mobile router.
Retransmit Init/Max/Limit	Registration request retransmission settings. When registration requests are not responded to, the mobile router will resend. Displays the initial and maximum transmission timers and the limit on the number of retries allowed.
Extend Expire/ Retry/Interval	Extend registration lifetime. After the mobile router has registered, reregister before the lifetime expires. Retry is the number of attempts to reregister between intervals.
Request GRE tunnel	The mobile router requests GRE encapsulation when it registers.
Redundancy group	Name of the redundancy group used to provide mobile router redundancy. Mobile router is either “active” or “passive.” If redundancy is enabled or disabled, this information is displayed or absent, respectively. Active means that the mobile router is functioning fully, and passive means that the mobile router is idle.
Reverse tunnel required	If reverse tunnel is enabled or disabled, this information is displayed or absent, respectively.
Multi-path active	Multiple path support is active between the mobile router and the home agent.
Multi-path enabled	Multiple path support is enabled, but the mobile router is not registered yet.
Multi-path denied by HA	Multiple path support is disabled on the home agent.

Table 4 show ip mobile router Field Descriptions (continued)

Field	Description
Requested metric: bandwidth	Requested metric to use to load balance traffic among multiple paths. The metric is either bandwidth or hop count. Bandwidth is the default.
Using metric: bandwidth	Metric that is being used to load balance traffic among multiple paths. The metric is either bandwidth or hopcount. Bandwidth is the default.
Mobile Networks	Mobile networks associated with the mobile router.
Status	Indication of the state of the mobile router. Options are as follows: • Home—Connected to home network. • Registered—Registered on foreign network. • Pending—Sent registration and waiting for reply. • Isolated—Mobile router has heard an agent advertisement but is isolated from the network. • Unknown—Cannot determine status.
Active foreign agent/Care-of	Foreign agent and care-of address used by the registered mobile router.
Using Collocated Care-of Address	Displayed if a mobile router is registered using a CCoA.
On interface	Mobile router registered on this interface.
Tunnel	Tunnel number between mobile router and the home agent.
mode	The type of encapsulation being used. The encapsulation type can be one of the following: • GRE/IP—GRE encapsulation is being used. • IP/IP—IP-in-IP encapsulation is being used.

Related Commands

Command	Description
ip mobile router	Enables the mobile router and enters mobile router configuration mode.

show ip mobile tunnel

To display active tunnels, use the **show ip mobile tunnel** command in EXEC mode.

show ip mobile tunnel [*interface*]

Syntax Description

interface	(Optional) Displays a particular tunnel interface. The *interface* argument is tunnel *x*.

Command Modes

EXEC

Command History

Release	Modification
12.0(1)T	This command was introduced.
12.2(13)T	The output was enhanced to display route maps configured on the home agent.
12.2(15)T	The output was enhanced to display tunnel templates for multicast configured on the home agent or mobile router.
12.3(8)T	The output was enhanced to display UDP tunneling.
12.4(9)T	The command was enhanced to display information about multipath support.

Usage Guidelines

This command displays active tunnels created by Mobile IP. When no more users are on the tunnel, the tunnel is released.

Examples

The following is sample output from the **show ip mobile tunnel** command:

```
Router# show ip mobile tunnel

Mobile Tunnels:

Tunnel0:
 src 10.0.0.32, dest 10.0.0.48
 encap IP/IP, mode reverse-allowed, tunnel-users 1
 IP MTU 1480 bytes
 HA created, fast switching enabled, ICMP unreachable enabled
 0 packets input, 0 bytes, 0 drops
 1591241 packets output, 1209738478 bytes
 Route Map is: MoIPMap
Running template configuration for this tunnel:
ip pim sparse-dense-mode
```

The following is sample output from the **show ip mobile tunnel** command that verifies that UDP tunneling is established:

```
Router# show ip mobile tunnel

Mobile Tunnels:
Total mobile ip tunnels 1
Tunnel0:
```

```
    src 10.30.30.1, dest 10.10.10.100
    src port 434, dest port 434
    encap MIPUDP/IP, mode reverse-allowed, tunnel-users 1
    IP MTU 1480 bytes
    Path MTU Discovery, mtu: 0, ager: 10 mins, expires: never
    outbound interface Ethernet2/3
    FA created, fast switching disabled, ICMP unreachable enabled
    5 packets input, 600 bytes, 0 drops
    7 packets output, 780 bytes
```

The following is sample output from the **show ip mobile tunnel** command that shows that the mobile node-home agent tunnel is still IP-in-IP, but that the foreign agent-home agent tunnel is UDP:

```
Router# show ip mobile tunnel

Mobile Tunnels:
Total mobile ip tunnels 2
Tunnel0:
 src 10.2.1.1, dest 10.99.100.2
 encap IP/IP, mode reverse-allowed, tunnel-users 1
 IP MTU 1460 bytes
 Path MTU Discovery, mtu: 0, ager: 10 mins, expires: never
 outbound interface Tunnel1
 HA created, fast switching enabled, ICMP unreachable enabled
 11 packets input, 1002 bytes, 0 drops
 5 packets output, 600 bytes

Tunnel1:
 src 10.2.1.1, dest 100.3.1.5
 src port 434, dest port 434
 encap MIPUDP/IP, mode reverse-allowed, tunnel-users 1
 IP MTU 1480 bytes
 Path MTU Discovery, mtu: 0, ager: 10 mins, expires: never
 outbound interface GigabitEthernet0/2
 HA created, fast switching disabled, ICMP unreachable enabled
 11 packets input, 1222 bytes, 0 drops
 7 packets output, 916 bytes
```

The following is sample output from the **show ip mobile tunnel** command that shows that the mobile node has UDP tunneling established with the home agent:

```
Router# show ip mobile tunnel

Total mobile ip tunnels 1
Tunnel0:
 src 10.10.10.100, dest 10.10.10.50
 src port 434, dest port 434
 encap MIPUDP/IP, mode reverse-allowed, tunnel-users 1
 IP MTU 1480 bytes
 Path MTU Discovery, mtu: 0, ager: 10 mins, expires: never
 outbound interface Ethernet2/1
 HA created, fast switching disabled, ICMP unreachable enabled
 5 packets input, 600 bytes, 0 drops
 5 packets output, 600 bytes
```

The following is sample output when the mobile router is configured for multipath support:

```
Router# show ip mobile tunnel

Mobile Tunnels:

Total mobile ip tunnels 1
Tunnel0:
    src 10.1.1.11, dest 10.1.1.10 Key 6
```

```
encap IP/IP, mode reverse-allowed, tunnel-users 1
IP MTU 1480 bytes
Path MTU Discovery, mtu: 0, ager: 10 mins, expires: never
outbound interface Ethernet1/0
MR created, fast switching enabled, ICMP unreachable enabled
4 packets input, 306 bytes, 0 drops
6 packets output, 436 bytes
Template configuration:
    ip pim sparse-dense-mode
```

Table 5 describes the significant fields shown in the display.

Table 5 show ip mobile tunnel Field Descriptions

Field	Description
src	Tunnel source IP address.
dest	Tunnel destination IP address.
Key	Identifies the tunnel when there are multiple tunnels between the same end points (source address and destination address) for multipath support. This situation can occur if a mobile router registers through foreign agents on different interfaces. All of the HA-MR tunnels would have the same end points.
encap	Tunnel encapsulation type.
mode	Either reverse-allowed or reverse-off for reverse tunnel mode.
tunnel-users	Number of users on the tunnel.
HA created	Entity that created the tunnel. This field can be one of three values: HA created, FA created, or MR created.
fast switching	Enabled or disabled.
ICMP unreachable	Enabled or disabled.
packets input	Number of packets in.
bytes	Number of bytes in.
drops	Number of packets dropped. Packets are dropped when there are no visitors to send to after the foreign agent deencapsulates incoming packets. This prevents loops because the foreign agent will otherwise route the de-encapsulated packets back to the home agent.
packets output	Number of packets output.
bytes	Number of bytes output.
Route Map is	Name of the route map.
Running template configuration	If tunnel templates for multicast are enabled or disabled, this information is displayed or absent, respectively.

Related Commands

Command	Description
show ip mobile binding	Displays the mobility binding table.
show ip mobile host	Displays mobile node information.
show ip mobile visitor	Displays the table that contains a visitor list of foreign agents.

Feature Information for Mobile IP—Mobile Router Multipath Support

Table 6 lists the release history for this feature.

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/fn. An account on Cisco.com is not required.

Note Table 6 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 6 Feature Information for Mobile IP Mobile Router Multipath Support

Feature Name	Releases	Feature Information
Mobile IP—Mobile Router Multipath Support	12.4(9)T	This Mobile IP—Mobile Router Multipath Support feature provides support for multiple paths, and thus multiple wireless technologies, between the mobile router and the home agent and allows user traffic to be load-balanced over all available interfaces.

Glossary

agent advertisement—An advertisement message constructed by an attachment of a special extension to a ICMP Router Discovery Protocol (IRDP).

care-of address—The termination point of the tunnel to a mobile node or mobile router. This can be a collocated care-of address, by which the mobile node or mobile router acquires a local address and detunnels its own packets, or a foreign agent care-of address, by which a foreign agent detunnels packets and forwards them to the mobile node or mobile router.

foreign agent—A router on the visited network of a foreign network that provides routing services to the mobile node while registered. The foreign agent detunnels and delivers packets to the mobile node or mobile router that were tunneled by the home agent of the mobile node. For packets sent by a mobile node, the foreign agent may serve as a default router for registered mobile nodes.

home agent—A router on a home network of the mobile node or that tunnels packets to the mobile node or mobile router while they are away from home. It keeps current location information for registered mobile nodes called a *mobility binding*.

home network—The network, possibly virtual, whose network prefix equals the network prefix of the home address of a mobile node.

mobile network—A network that moves with the mobile router. A mobile network is a collection of hosts and routes that are fixed with respect to each other but are mobile, as a unit, with respect to the rest of the Internet.

mobile node—A host or router that changes its point of attachment from one network or subnet to another. A mobile node may change its location without changing its IP address; it may continue to communicate with other Internet nodes at any location using its home IP address, assuming that link-layer connectivity to a point of attachment is available.

mobile router—A mobile node that is a router. It provides for the mobility of one or more entire networks moving together, perhaps on an airplane, a ship, a train, an automobile, a bicycle, or a kayak. The nodes connected to a network served by the mobile router may themselves be fixed nodes or mobile nodes or routers.

mobility binding—The association of a home address with a care-of address and the remaining lifetime.

registration—The process by which the mobile node is associated with a care-of address on the home agent while it is away from home. Registration may happen directly from the mobile node to the home agent or through a foreign agent.

roaming interface—An interface used by the mobile router to detect foreign agents and home agents while roaming. Registration and traffic occur on the interface.

tunnel—The path followed by a packet while it is encapsulated from the home agent to the mobile node. The model is that, while it is encapsulated, a packet is routed to a knowledgeable decapsulating agent, which de-encapsulates the datagram and then correctly delivers it to its ultimate destination.

Note See *Internetworking Terms and Acronyms* for terms not included in this glossary.

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