



Managing the Unicast RIB and FIB

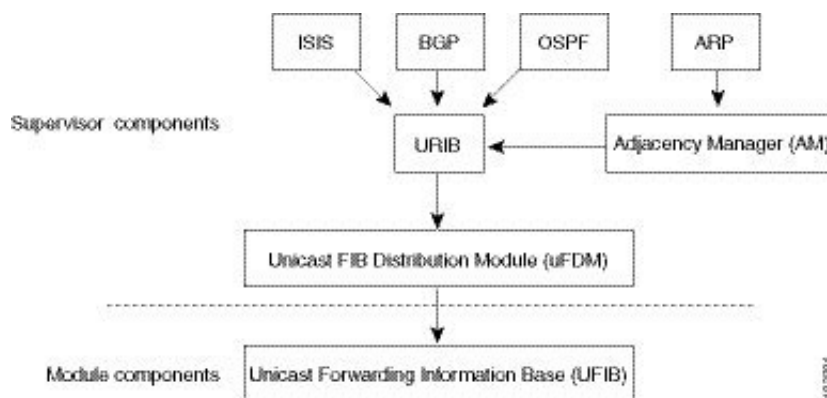
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About the Unicast RIB and FIB

The unicast Routing Information Base (IPv4 RIB and IPv6 RIB) and Forwarding Information Base (FIB) are part of the Cisco NX-OS forwarding architecture, as shown in the following figure.

Figure 1: Cisco NX-OS Forwarding Architecture



The unicast RIB exists on the active supervisor. It maintains the routing table with directly connected routes, static routes, and routes learned from dynamic unicast routing protocols. The unicast RIB also collects adjacency information from sources such as the Address Resolution Protocol (ARP). The unicast RIB determines the best next hop for a given route and populates the unicast forwarding information bases (FIBs) on the modules by using the services of the unicast FIB distribution module (FDM).

Each dynamic routing protocol must update the unicast RIB for any route that has timed out. The unicast RIB then deletes that route and recalculates the best next hop for that route (if an alternate path is available).

Layer 3 Consistency Checker

In rare instances, an inconsistency can occur between the unicast RIB and the FIB on each module. Cisco NX-OS supports the Layer 3 consistency checker. This feature detects inconsistencies between the unicast IPv4 RIB on the supervisor module and the FIB on each interface module. Inconsistencies include the following:

- Missing prefix
- Extra prefix
- Wrong next-hop address
- Incorrect Layer 2 rewrite string in the ARP or neighbor discovery (ND) cache

The Layer 3 consistency checker compares the FIB entries to the latest adjacency information from the Adjacency Manager (AM) and logs any inconsistencies. The consistency checker then compares the unicast RIB prefixes to the module FIB and logs any inconsistencies. See the [Triggering the Layer 3 Consistency Checker](#) section.

You can then manually clear any inconsistencies. See the [Clearing Forwarding Information in the FIB](#) section.

When more routes are learned exceeding the hardware limit, the **show consistency-checker forwarding ipv4** command is run, consistency may still show as pass. The same is true when it is transitioning from an inconsistent state to a consistent state. It may show as a failure. Until and unless the **test forwarding ipv4 inconsistency route** command is run again, it doesn't leave this state. This is an expected behavior.

Guidelines and Limitations for the Unicast RIB

The following guidelines and limitations apply to the URIB or U6RIB:

- In a virtual domain context (VDC), when modifying memory resource limits for the IPv4 or IPv6 unicast route, the modified limits do not take effect immediately.

You must issue the **copy running-config startup-config** command followed by the **reload** command to activate the modified limits

For example, if you issue either of the following commands, you will need to issue **copy running-config startup-config**, then reload the switch an extra time to activate the new setting:

- **limit-resource u4route-mem**
- **limit-resource u6route-mem**



Note If “feature pim” is configured for limit-resource, ensure that the value of **limit-resource u4route-mem** plus **limit-resource u6route-mem** is ≤ 1024 MB (1GB).

- Beginning with Cisco NX-OS Release 10.3(1)F, Unicast consistency checker is supported on Cisco Nexus 9808 platform switches.
 - Beginning with Cisco NX-OS Release 10.4(1)F, Unicast consistency checker is supported on Cisco Nexus X98900CD-A and X9836DM-A line cards with Cisco Nexus 9808 switches.

- Beginning with Cisco NX-OS Release 10.4(1)F, Unicast consistency checker is supported on Cisco Nexus 9804 platform switches, and Cisco Nexus X98900CD-A and X9836DM-A line cards.

Managing the Unicast RIB and FIB



Note If you are familiar with the Cisco IOS CLI, be aware that the Cisco NX-OS commands for this feature might differ from the Cisco IOS commands that you would use.

Displaying Module FIB Information

To display the FIB information on a module, use the following commands in any mode:

Command	Purpose
show forwarding {ipv4 ipv6} adjacency module <i>slot</i> Example: <pre>switch# show forwarding ipv6 adjacency module 2</pre>	Displays the adjacency information for IPv4 or IPv6.
show forwarding {ipv4 ipv6} route module <i>slot</i> Example: <pre>switch# show forwarding ipv6 route module 2</pre>	Displays the route table for IPv4 or IPv6.

Configuring Load Sharing in the Unicast FIB

Dynamic routing protocols such as Open Shortest Path First (OSPF) support load balancing with equal-cost multipath (ECMP). The routing protocol determines its best routes based on the metrics configured for the protocol and installs up to the protocol-configured maximum paths in the unicast RIB. The unicast RIB compares the administrative distances of all routing protocol paths in the RIB and selects a best path set from all of the path sets installed by the routing protocols. The unicast RIB installs this best path set into the FIB for use by the forwarding plane.

The forwarding plane uses a load-sharing algorithm to select one of the installed paths in the FIB to use for a given data packet.



Note Load sharing uses the same path for all packets in a given flow. A flow is defined by the load-sharing method that you configure. For example, if you configure source-destination load sharing, then all packets with the same source IP address and destination IP address pair follow the same path.

To configure the unicast FIB load-sharing algorithm, use the following command in global configuration mode:

SUMMARY STEPS

1. **ip load-sharing address** {**destination port destination** | **source-destination** [**port source-destination**] | **source** } **hardware lb-keyshift** *value* **lb-2nd-heir-keyshift** *value* [**universal-id** *seed*] [**rotate** *rotate*] [**concatenation**]
2. (Optional) **show ip load-sharing**
3. (Optional) **show routing hash** *source-addr dest-addr* [*source-port dest-port*] [**vrf** *vrf-name*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	<p>ip load-sharing address {destination port destination source-destination [port source-destination] source } hardware lb-keyshift <i>value</i> lb-2nd-heir-keyshift <i>value</i> [universal-id <i>seed</i>] [rotate <i>rotate</i>] [concatenation]</p> <p>Example:</p> <pre>ip load-sharing address source-destination port source-destination hardware lb-keyshift 1 lb-2nd-hier-keyshift 10</pre>	<p>Configures the unicast FIB load-sharing algorithm for data traffic.</p> <p>Note On Cisco Nexus 9808/9804 switches, only address source-destination port source-destination option is supported during ip load-sharing address configuration.</p> <p>Beginning with Cisco NX-OS Release 10.3(3)F, the hardware keyword is added to support the following parameters in the IHB_ECMP_LB_KEY_CFG tables only on Cisco Nexus 9600-R/RX line cards:</p> <ul style="list-style-type: none"> • lb-keyshift: Sets the ECMP_LB_KEY_SHIFT value for load balancing. The range is 1-10. • lb-2nd-hier-keyshift: Sets the ECMP_2ND_HIER_LB_KEY_SHIFT value for load balancing. The range is 1-10. <p>The following options are available for all IP load sharing configurations:</p> <ul style="list-style-type: none"> • The universal-id option sets the random seed for the hash algorithm and shifts the flow from one link to another. <p>You do not need to configure the universal ID. Cisco NX-OS chooses the universal ID if you do not configure it. The <i>universal-id</i> range is from 1 to 4294967295.</p> <ul style="list-style-type: none"> • The rotate option causes the hash algorithm to rotate the link picking selection so that it does not continually choose the same link across all nodes in the network. It does so by influencing the bit pattern for the hash algorithm. This option shifts the flow from one link to another and load balances the already load-balanced (polarized) traffic from the first ECMP level across multiple links. <p>If you specify a <i>rotate</i> value, the 64-bit stream is interpreted starting from that bit position in a cyclic</p>

	Command or Action	Purpose
		<p>rotation. The <i>rotate</i> range is from 1 to 63, and the default is 32.</p> <p>Note With multi-tier Layer 3 topology, polarization is possible. To avoid polarization, use a different rotate bit at each tier of the topology.</p> <p>Note To configure a rotation value for port channels, use the port-channel load-balance src-dst ip-l4port rotate rotate command. For more information on this command, see the <i>Cisco Nexus 9000 Series NX-OS Interfaces Configuration Guide</i>.</p> <ul style="list-style-type: none"> The concatenation option ties together the hash tag values for ECMP and the hash tag values for port channels in order to use a stronger 64-bit hash. If you do not use this option, you can control ECMP load-balancing and port-channel load-balancing independently. The default is disabled.
Step 2	<p>(Optional) show ip load-sharing</p> <p>Example:</p> <pre>switch(config)# show ip load-sharing address source-destination</pre>	Displays the unicast FIB load-sharing algorithm for data traffic.
Step 3	<p>(Optional) show routing hash source-addr dest-addr [source-port dest-port] [vrf vrf-name]</p> <p>Example:</p> <pre>switch(config)# show routing hash 192.0.2.1 10.0.0.1</pre>	Displays the route that the unicast RIB and unicast FIB use for a source and destination address pair. The source address and destination address format is x.x.x.x. The source port and destination port range is from 1 to 65535. The VRF name can be any case-sensitive, alphanumeric string up to 64 characters.

Example

This example shows how to display the route selected for a source/destination pair:

```
switch# show routing hash 10.0.0.5 192.0.0.2
Load-share parameters used for software forwarding:
load-share mode: address source-destination port source-destination
Universal-id seed: 0xe05e2e85
Hash for VRF "default"
Hashing to path *172.0.0.2 (hash: 0x0e), for route:
```

This example shows the output of **show ip load-sharing** command:

```
hardware lb-keyshift 1 lb-2nd-hier-keyshift 10
switch(config)# ip load-sharing address source-destination port source-destination
switch(config)# show ip load-sharing
IPv4/IPv6 ECMP load sharing:
```

```

Universal-id (Random Seed): 251533739
Load-share mode : address source-destination port source-destination
GRE-Outer hash is disabled
Concatenation is disabled
Rotate: 32

Lbkeyshift: 1
2ndHeirLbkeyshift: 10
switch(config)#

```

Displaying Routing and Adjacency Information

To display routing and adjacency information, use the following commands in any mode:

Command	Purpose
<pre> show {ip ipv6} route [<i>route-type</i> interface <i>interface-type number</i> next-hop] switch# show ip route </pre>	<p>Displays the unicast route table. The <i>route-type</i> argument can be a single route prefix or a direct, static, or dynamic route protocol. Use the ? command to see the supported interfaces.</p>
<pre> show {ip ipv6} adjacency [<i>prefix</i> <i>interface-type</i> <i>number</i> [summary] non-best] [detail] [vrf <i>vrf-id</i>] Example: switch# show ip adjacency </pre>	<p>Displays the adjacency table. The argument ranges are as follows:</p> <ul style="list-style-type: none"> • <i>prefix</i>—Any IPv4 or IPv6 prefix address. • <i>interface-type number</i>—Use the ? command to see the supported interfaces. • <i>vrf-id</i>—Any case-sensitive, alphanumeric string up to 64 characters.
<pre> show {ip ipv6} routing [<i>route-type</i> interface <i>interface-type number</i> next-hop recursive-next-hop summary updated {since until} <i>time</i>] Example: switch# show routing summary </pre>	<p>Displays the unicast route table. The <i>route-type</i> argument can be a single route prefix or a direct, static, or dynamic route protocol. Use the ? command to see the supported interfaces.</p>

This example shows how to display the unicast route table:

```

switch# show ip route
IP Route Table for Context "default"
'*' denotes best ucast next-hop '**' denotes best mcast next-hop
'[x/y]' denotes [preference/metric]

0.0.0.0/0, 1 ucast next-hops, 0 mcast next-hops
  *via 10.1.1.1, mgmt0, [1/0], 5d21h, static
0.0.0.0/32, 1 ucast next-hops, 0 mcast next-hops
  *via Null0, [220/0], 1w6d, local, discard
10.1.0.0/22, 1 ucast next-hops, 0 mcast next-hops, attached

```

```

    *via 10.1.1.55, mgmt0, [0/0], 5d21h, direct
10.1.0.0/32, 1 ucast next-hops, 0 mcast next-hops, attached
    *via 10.1.0.0, Null0, [0/0], 5d21h, local
10.1.1.1/32, 1 ucast next-hops, 0 mcast next-hops, attached
    *via 10.1.1.1, mgmt0, [2/0], 5d16h, am
10.1.1.55/32, 1 ucast next-hops, 0 mcast next-hops, attached
    *via 10.1.1.55, mgmt0, [0/0], 5d21h, local
10.1.1.253/32, 1 ucast next-hops, 0 mcast next-hops, attached
    *via 10.1.1.253, mgmt0, [2/0], 5d20h, am
10.1.3.255/32, 1 ucast next-hops, 0 mcast next-hops, attached
    *via 10.1.3.255, mgmt0, [0/0], 5d21h, local
255.255.255.255/32, 1 ucast next-hops, 0 mcast next-hops
    *via Eth Inband Port, [0/0], 1w6d, local

```

This example shows how to display the adjacency information:

```

switch# show ip adjacency
IP Adjacency Table for context default
Total number of entries: 2
Address      Age      MAC Address      Pref  Source  Interface  Best
10.1.1.1     02:20:54  00e0.b06a.71eb   50   arp     mgmt0      Yes
10.1.1.253   00:06:27  0014.5e0b.81d1   50   arp     mgmt0      Yes

```

Triggering the Layer 3 Consistency Checker

You can manually trigger the Layer 3 consistency checker.

To manually trigger the Layer 3 consistency checker, use the following commands in global configuration mode:

SUMMARY STEPS

1. **test forwarding [ipv4 | ipv6] [unicast] inconsistency [vrf vrf-name] [module {slot | all}]**
2. **test forwarding [ipv4 | ipv6] [unicast] inconsistency [vrf vrf-name] [module {slot | all}] stop**
3. **show forwarding [ipv4 | ipv6] [unicast] inconsistency [vrf vrf-name] [module {slot | all}]**
4. **show consistency-checker forwarding unicast**

DETAILED STEPS

	Command or Action	Purpose
Step 1	test forwarding [ipv4 ipv6] [unicast] inconsistency [vrf vrf-name] [module {slot all}] Example: switch(config)# test forwarding inconsistency	Starts a Layer 3 consistency check. The <i>vrf-name</i> can be any case-sensitive, alphanumeric string up to 64 characters. The <i>slot</i> range is from 1 to 26.
Step 2	test forwarding [ipv4 ipv6] [unicast] inconsistency [vrf vrf-name] [module {slot all}] stop Example: switch(config)# test forwarding inconsistency stop	Stops a Layer 3 consistency check. The <i>vrf-name</i> can be any case sensitive, alphanumeric string up to 64 characters. The <i>slot</i> range is from 1 to 26.

	Command or Action	Purpose
Step 3	show forwarding [ipv4 ipv6] [unicast] inconsistency [vrf <i>vrf-name</i>] [module { <i>slot</i> all}] Example: switch(config)# show forwarding inconsistency	Displays the results of a Layer 3 consistency check. The <i>vrf-name</i> can be any case-sensitive, alphanumeric string up to 64 characters. The <i>slot</i> range is from 1 to 26.
Step 4	show consistency-checker forwarding unicast Example: switch(config)# show consistency-checker forwarding unicast	Displays the results of a Layer 3 consistency check for unicast routes.

Clearing Forwarding Information in the FIB

You can clear one or more entries in the FIB. Clearing a FIB entry does not affect the unicast RIB.



Caution The **clear forwarding** command disrupts forwarding on the device.

To clear an entry in the FIB, including a Layer 3 inconsistency, use the following command in any configuration mode:

Command	Purpose
clear forwarding {ipv4 ipv6} route {* <i>prefix</i>} [vrf <i>vrf-name</i>] module { <i>slot</i> all} Example: switch# clear forwarding ipv4 route * module 1	Clears one or more entries from the FIB. The route options are as follows: <ul style="list-style-type: none"> • *—All routes. • <i>prefix</i>—Any IP or IPv6 prefix. The <i>vrf-name</i> can be any case-sensitive, alphanumeric string up to 64 characters. The <i>slot</i> range is from 1 to 26.

Configuring Maximum Routes for the Unicast RIB

You can configure the maximum number of routes allowed in the routing table.

SUMMARY STEPS

1. **configure terminal**
2. **vrf context** *vrf-name*
3. **address-family** {*ipv4* | *ipv6*} **unicast**
4. **maximum routes** *max-routes* [*threshold* [*reinstall threshold*] | **warning -only**]
5. (Optional) **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure terminal Example: <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.
Step 2	vrf context <i>vrf-name</i> Example: <pre>switch(config)# vrf context management2 switch(config-vrf)#</pre>	Creates a VRF and enters VRF configuration mode.
Step 3	address-family {ipv4 ipv6} unicast Example: <pre>switch(config-vrf)# address-family ipv4 unicast switch(config-vrf-af-ipv4)</pre>	Enters the address-family configuration mode.
Step 4	maximum routes <i>max-routes</i> [<i>threshold</i> [reinstall <i>threshold</i>] warning -only] Example: <pre>switch(config-vrf-af-ipv4)# maximum routes 300000</pre>	<p>Configures the maximum number of routes allowed in the routing table. The range is from 1 to 4294967295.</p> <p>You can optionally specify the following:</p> <ul style="list-style-type: none"> • threshold—Percentage of maximum routes that triggers a warning message. The range is from 1 to 100. • warning-only—Logs a warning message when the maximum number of routes is exceeded. • reinstall <i>threshold</i>—Reinstalls routes that previously exceeded the maximum route limit and were rejected and specifies the threshold value at which to reinstall them. The threshold range is from 1 to 100.
Step 5	(Optional) copy running-config startup-config Example: <pre>switch(config-vrf-af-ipv4)# copy running-config startup-config</pre>	Saves this configuration change.

Estimating Memory Requirements for Routes

You can estimate the memory that a number of routes and next-hop addresses will use.

To estimate the memory requirements for routes, use the following command in any mode:

Command	Purpose
<pre>show routing {ipv6} memory estimate routes num-routes next-hops num-nexthops</pre> <p>Example:</p> <pre>switch# show routing memory estimate routes 5000 next-hops 2</pre>	<p>Displays the memory requirements for routes. The <i>num-routes</i> range is from 1000 to 1000000. The <i>num-nexthops</i> range is from 1 to 16.</p>

Clearing Routes in the Unicast RIB

You can clear one or more routes from the unicast RIB.



Caution The * keyword is severely disruptive to routing.

To clear one or more entries in the unicast RIB, use the following commands in any configuration mode:

Command	Purpose
<pre>clear {ip ip4 ipv6} route {* {route prefix/length} [next-hop interface]} [vrf vrf-name]</pre> <p>Example:</p> <pre>switch(config)# clear ip route 10.2.2.2</pre>	<p>Clears one or more routes from both the unicast RIB and all the module FIBs. The route options are as follows:</p> <ul style="list-style-type: none"> • *—All routes. • <i>route</i>—An individual IP or IPv6 route. • <i>prefix/length</i>—Any IP or IPv6 prefix. • <i>next-hop</i>—The next-hop address. • <i>interface</i>—The interface to reach the next-hop address. <p>The <i>vrf-name</i> can be an case-sensitive, alphanumeric string up to 64 characters.</p>
<pre>clear routing [multicast unicast] [ip ip4 ipv6] {* {route prefix/length} [next-hop interface]} [vrf vrf-name]</pre> <p>Example:</p> <pre>switch(config)# clear routing ip 10.2.2.2</pre>	<p>Clears one or more routes from the unicast RIB. The route options are as follows:</p> <ul style="list-style-type: none"> • *—All routes. • <i>route</i>—An individual IP or IPv6 route. • <i>prefix/length</i>—Any IP or IPv6 prefix. • <i>next-hop</i>—The next-hop address. • <i>interface</i>—The interface to reach the next-hop address. <p>The <i>vrf-name</i> can be an case-sensitive, alphanumeric string up to 64 characters.</p>

Verifying the Unicast RIB and FIB Configuration

To display the unicast RIB and FIB configuration information, perform one the following tasks:

Command	Purpose
<code>show forwarding adjacency</code>	Displays the adjacency table on a module.
<code>show forwarding distribution {clients fib-state}</code>	Displays the FIB distribution information.
<code>show forwarding interfaces module slot</code>	Displays the FIB information for a module.
<code>show forwarding {ip ipv4 ipv6} route</code>	Displays routes in the FIB.
<code>show {ip ipv6} adjacency</code>	Displays the adjacency table.
<code>show {ip ipv6} route</code>	Displays the IPv4 or IPv6 routes from the unicast RIB.
<code>show routing</code>	Displays routes from the unicast RIB.
<code>show system internal access-list dest-miss stats</code>	<p>Displays statistics for packets dropped due to missing the FIB routes for the destinations, also called as DEST MISS. The output displays increment in the DEST MISS counters.</p> <p>Note Beginning with Cisco NX-OS Release 10.1(1), this feature is supported on Cisco Nexus 9300-FX3 platform switches.</p>

Additional References

For additional information related to managing unicast RIB and FIB, see the following sections:

- [Related Documents](#)

Related Documents

Related Topic	Document Title
Configuring EEM	Cisco Nexus 9000 Series NX-OS System Management Configuration Guide

