IP Application Services Configuration Guide, Cisco IOS XE Release 3S

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# CONTENTS

## CHAPTER 1

<table>
<thead>
<tr>
<th>Configuring Enhanced Object Tracking</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finding Feature Information</td>
<td>1</td>
</tr>
<tr>
<td>Restrictions for Enhanced Object Tracking</td>
<td>2</td>
</tr>
<tr>
<td>Information About Enhanced Object Tracking</td>
<td>2</td>
</tr>
<tr>
<td>Feature Design of Enhanced Object Tracking</td>
<td>2</td>
</tr>
<tr>
<td>Interface State Tracking</td>
<td>2</td>
</tr>
<tr>
<td>Scaled Route Metrics</td>
<td>3</td>
</tr>
<tr>
<td>IP SLA Operation Tracking</td>
<td>4</td>
</tr>
<tr>
<td>Enhanced Object Tracking and Embedded Event Manager</td>
<td>4</td>
</tr>
<tr>
<td>Benefits of Enhanced Object Tracking</td>
<td>5</td>
</tr>
<tr>
<td>How to Configure Enhanced Object Tracking</td>
<td>5</td>
</tr>
<tr>
<td>Tracking the Line-Protocol State of an Interface</td>
<td>5</td>
</tr>
<tr>
<td>Tracking the IP-Routing State of an Interface</td>
<td>7</td>
</tr>
<tr>
<td>Tracking IP-Route Reachability</td>
<td>8</td>
</tr>
<tr>
<td>Tracking the Threshold of IP-Route Metrics</td>
<td>10</td>
</tr>
<tr>
<td>Tracking the State of an IP SLAs Operation</td>
<td>12</td>
</tr>
<tr>
<td>Tracking the Reachability of an IP SLAs IP Host</td>
<td>13</td>
</tr>
<tr>
<td>Configuring a Tracked List and Boolean Expression</td>
<td>15</td>
</tr>
<tr>
<td>Configuring a Tracked List and Threshold Weight</td>
<td>16</td>
</tr>
<tr>
<td>Configuring a Tracked List and Threshold Percentage</td>
<td>17</td>
</tr>
<tr>
<td>Configuring Track List Defaults</td>
<td>19</td>
</tr>
<tr>
<td>Configuring Tracking for Mobile IP Applications</td>
<td>20</td>
</tr>
<tr>
<td>Configuration Examples for Enhanced Object Tracking</td>
<td>21</td>
</tr>
<tr>
<td>Example: Interface Line Protocol</td>
<td>21</td>
</tr>
<tr>
<td>Example: Interface IP Routing</td>
<td>22</td>
</tr>
<tr>
<td>Example: IP-Route Reachability</td>
<td>23</td>
</tr>
</tbody>
</table>
Example: IP-Route Threshold Metric 23
Example: IP SLAs IP Host Tracking 24
Example: Boolean Expression for a Tracked List 25
Example: Threshold Weight for a Tracked List 25
Example: Threshold Percentage for a Tracked List 26
Additional References 26
Feature Information for Enhanced Object Tracking 27
Glossary 29

CHAPTER 2

Configuring IP Services 31
Finding Feature Information 31
Information About IP Services 31
IP Source Routing 31
ICMP Overview 32
ICMP Unreachable Error Messages 32
ICMP Mask Reply Messages 33
ICMP Redirect Messages 33
Denial of Service Attack 33
Path MTU Discovery 34
Show and Clear Commands for IOS Sockets 35
How to Configure IP Services 36
Protecting Your Network from DOS Attacks 36
Configuring ICMP Unreachable Rate Limiting User Feedback 37
Setting the MTU Packet Size 39
Configuring IP Accounting With NetFlow 40
Configuration Examples for IP Services 44
Example: Protecting Your Network from DOS Attacks 44
Example: Configuring ICMP Unreachable Destination Counters 45
Example: Setting the MTU Packet Size 45
Example: Configuring IP Accounting with NetFlow 45
Verifying IP Accounting with NetFlow 46
Additional References For IP Services 47
Feature Information for IP Services 48
Layer 2 Forwarding Redirection and Return 88
WCCP Mask Assignment 88
Hardware Acceleration 89
WCCPv1 Configuration 89
WCCPv2 Configuration 90
WCCPv2 Support for Services Other Than HTTP 92
WCCPv2 Support for Multiple Routers 92
WCCPv2 MD5 Security 92
WCCPv2 Web Cache Packet Return 92
WCCPv2 Load Distribution 93
WCCP VRF Support 93
WCCP VRF Tunnel Interfaces 93
WCCP Bypass Packets 96
WCCP Closed Services and Open Services 96
WCCP Outbound ACL Check 96
WCCP Service Groups 97
WCCP—Check All Services 98
WCCP Interoperability with NAT 98
WCCP Troubleshooting Tips 98
How to Configure WCCP 99
Configuring WCCP 99
Configuring Closed Services 101
Registering a Router to a Multicast Address 102
Using Access Lists for a WCCP Service Group 103
Enabling the WCCP Outbound ACL Check 105
Enabling WCCP Interoperability with NAT 106
Verifying and Monitoring WCCP Configuration Settings 108
Configuration Examples for WCCP 109
Example: Changing the Version of WCCP on a Router 109
Example: Configuring a General WCCPv2 Session 110
Example: Setting a Password for a Router and Content Engines 110
Example: Configuring a Web Cache Service 110
Example: Running a Reverse Proxy Service 111
Example: Registering a Router to a Multicast Address 111
CHAPTER 7  WCCP—Configurable Router ID  121
Finding Feature Information  121
Restrictions for WCCP—Configurable Router ID  121
Information About WCCP—Configurable Router ID  122
WCCP—Configurable Router ID Overview  122
How to Configure WCCP—Configurable Router ID  122
Configuring a Preferred WCCP Router ID  122
Configuration Examples for WCCP—Configurable Router ID  123
Example: Configuring a Preferred WCCP Router ID  123
Additional References for WCCP—Configurable Router ID  123
Feature Information for WCCP—Configurable Router ID  124

CHAPTER 8  WCCPv2—IPv6 Support  125
Finding Feature Information  125
Prerequisites for WCCPv2—IPv6 Support  125
Restrictions for WCCPv2—IPv6 Support  126
Information About WCCPv2—IPv6 Support  126
WCCP Overview  126
Layer 2 Forwarding Redirection and Return  127
WCCP Mask Assignment  127
WCCP Hash Assignment  128
WCCPv2 Configuration  128
WCCPv2 Support for Services Other Than HTTP  129
WCCPv2 Support for Multiple Routers  129
WCCPv2 MD5 Security  129
WCCPv2 Web Cache Packet Return  130
WCCPv2 Load Distribution  130
WCCP VRF Support 130
IPv6 WCCP Tunnel Interface 131
WCCP Bypass Packets 133
WCCP Closed Services and Open Services 133
WCCP Outbound ACL Check 134
WCCP Service Groups 134
WCCP—Check All Services 135
WCCP—Configurable Router ID Overview 136
WCCP Troubleshooting Tips 136
How to Configure WCCPv2—IPv6 Support 136
Configuring a General WCCPv2—IPv6 Session 136
Configuring Services for WCCPv2—IPv6 138
Registering a Router to a Multicast Address for WCCPv2—IPv6 140
Using Access Lists for WCCPv2—IPv6 Service Group 141
Enabling the WCCP—IPv6 Outbound ACL Check 143
Verifying and Monitoring WCCPv2—IPv6 Configuration Settings 144
Configuration Examples for WCCPv2—IPv6 Support 145
Example: Configuring a General WCCPv2—IPv6 Session 145
Example: WCCPv2—IPv6—Setting a Password for a Router and Content Engines 146
Example: WCCPv2—IPv6—Configuring a Web Cache Service 146
Example: WCCPv2—IPv6—Running a Reverse Proxy Service 146
Example: WCCPv2—IPv6—Registering a Router to a Multicast Address 146
Example: WCCPv2—IPv6—Using Access Lists for a WCCPv2 IPv6 Service Group 147
Example: WCCPv2—IPv6—Configuring Outbound ACL Check 147
Example: WCCPv2—IPv6—Verifying WCCP Settings 148
Example: WCCPv2—IPv6—Cisco ASR 1000 Platform Specific Configuration 149
Additional References 150
Feature Information for WCCPv2—IPv6 Support 151

CHAPTER 9

WCCP with Generic GRE Support 153
Finding Feature Information 153
Restrictions for WCCP with Generic GRE Support 153
Information About WCCP with Generic GRE Support 154
WCCP with Generic GRE Support 154
Configuring Enhanced Object Tracking

Before the introduction of the Enhanced Object Tracking feature, the Hot Standby Router Protocol (HSRP) had a simple tracking mechanism that allowed you to track the interface line-protocol state only. If the line-protocol state of the interface went down, the HSRP priority of the router was reduced, allowing another HSRP router with a higher priority to become active.

The Enhanced Object Tracking feature separates the tracking mechanism from HSRP and creates a separate standalone tracking process that can be used by other processes and HSRP. This feature allows tracking of other objects in addition to the interface line-protocol state.

A client process such as HSRP, Virtual Router Redundancy Protocol (VRRP), or Gateway Load Balancing Protocol (GLBP), can register its interest in tracking objects and then be notified when the tracked object changes state.

- Finding Feature Information, on page 1
- Restrictions for Enhanced Object Tracking, on page 2
- Information About Enhanced Object Tracking, on page 2
- How to Configure Enhanced Object Tracking, on page 5
- Configuration Examples for Enhanced Object Tracking, on page 21
- Additional References, on page 26
- Feature Information for Enhanced Object Tracking, on page 27
- Glossary, on page 29

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and 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 table.

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

Enhanced Object Tracking is not stateful switchover (SSO)-aware and cannot be used with Hot Standby Routing Protocol (HSRP), Virtual Router Redundancy Protocol (VRRP), or Gateway Load Balancing Protocol (GLBP) in SSO mode.

Information About Enhanced Object Tracking

Feature Design of Enhanced Object Tracking

The Enhanced Object Tracking feature provides complete separation between the objects to be tracked and the action to be taken by a client when a tracked object changes. Thus, several clients such as HSRP, VRRP, or GLBP can register their interest with the tracking process, track the same object, and each take different action when the object changes.

Each tracked object is identified by a unique number that is specified on the tracking CLI. Client processes use this number to track a specific object.

The tracking process periodically polls the tracked objects and notes any change of value. The changes in the tracked object are communicated to interested client processes, either immediately or after a specified delay. The object values are reported as either up or down.

You can configure a combination of tracked objects in a list and a flexible method for combining objects using Boolean logic. This functionality includes the following capabilities:

- **Threshold**—The tracked list can be configured to use a weight or percentage threshold to measure the state of the list. Each object in a tracked list can be assigned a threshold weight. The state of the tracked list is determined by whether the threshold has been met.

- **Boolean "and" function**—When a tracked list has been assigned a Boolean "and" function, each object defined within a subset must be in an up state so that the tracked object can become up.

- **Boolean "or" function**—When the tracked list has been assigned a Boolean "or" function, at least one object defined within a subset must be in an up state so that the tracked object can become up.

With CSCtg75700, a maximum of 1000 objects can be tracked. Although 1000 tracked objects can be configured, each tracked object uses CPU resources. The amount of available CPU resources on a router depends on variables such as traffic load and how other protocols are configured and run. The ability to use 1000 tracked objects depends on the available CPU. Testing should be conducted on site to ensure that the service works under the specific site traffic conditions.

Interface State Tracking

An IP-routing object is considered up when the following criteria exist:

- IP routing is enabled and active on the interface.

- The interface line-protocol state is up.
• The interface IP address is known. The IP address is configured or received through Dynamic Host Configuration Protocol (DHCP) or IP Control Protocol (IPCP) negotiation.

Interface IP routing will go down when one of the following criteria exists:

• IP routing is disabled globally.
• The interface line-protocol state is down.
• The interface IP address is unknown. The IP address is not configured or received through DHCP or IPCP negotiation.

Tracking the IP-routing state of an interface using the `track interface ip routing` command can be more useful in some situations than just tracking the line-protocol state using the `track interface line-protocol` command, especially on interfaces for which IP addresses are negotiated. For example, on a serial interface that uses the PPP, the line protocol could be up (link control protocol [LCP] negotiated successfully), but IP could be down (IPCP negotiation failed).

The `track interface ip routing` command supports the tracking of an interface with an IP address acquired through any of the following methods:

• Conventional IP address configuration
• PPP/IPCP
• DHCP
• Unnumbered interface

You can configure Enhanced Object Tracking to consider the carrier-delay timer when tracking the IP-routing state of an interface by using the `carrier-delay` command in tracking configuration mode.

**Scaled Route Metrics**

The `track ip route` command enables tracking of a route in the routing table. If a route exists in the table, the metric value is converted into a number. To provide a common interface to tracking clients, normalize route metric values to the range from 0 to 255, where 0 is connected and 255 is inaccessible. Scaled metrics can be tracked by setting thresholds. Up and down state notification occurs when the thresholds are crossed. The resulting value is compared against threshold values to determine the tracking state as follows:

• State is up if the scaled metric for that route is less than or equal to the up threshold.
• State is down if the scaled metric for that route is greater than or equal to the down threshold.

Tracking uses a per-protocol configurable resolution value to convert the real metric to the scaled metric. The table below shows the default values used for the conversion. You can use the `track resolution` command to change the metric resolution default values.

**Table 1: Metric Conversion**

<table>
<thead>
<tr>
<th>Route Type</th>
<th>Metric Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static</td>
<td>10</td>
</tr>
<tr>
<td>Enhanced Interior Gateway Routing Protocol (EIGRP)</td>
<td>2560</td>
</tr>
</tbody>
</table>
### IP SLA Operation Tracking

Object tracking of IP Service Level Agreements (SLAs) operations allows tracking clients to track the output from IP SLAs objects and use the provided information to trigger an action.

Cisco IOS IP SLAs is a network performance measurement and diagnostics tool that uses active monitoring. Active monitoring is the generation of traffic in a reliable and predictable manner to measure network performance. The software uses IP SLAs to collect real-time metrics such as response time, network resource availability, application performance, jitter (interpacket delay variance), connect time, throughput, and packet loss.

These metrics can be used for troubleshooting, for proactive analysis before problems occur, and for designing network topologies.

Every IP SLAs operation maintains an operation return-code value. This return code is interpreted by the tracking process. The return code can return OK, OverThreshold, and several other return codes. Different operations can have different return-code values, so only values common to all operation types are used.

Two aspects of an IP SLAs operation can be tracked: state and reachability. The difference between these aspects is the acceptance of the OverThreshold return code. The table below shows the state and reachability aspects of IP SLAs operations that can be tracked.

<table>
<thead>
<tr>
<th>Tracking</th>
<th>Return Code</th>
<th>Track State</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>OK (all other return codes)</td>
<td>Up</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Down</td>
</tr>
<tr>
<td>Reachability</td>
<td>OK or OverThreshold (all other return codes)</td>
<td>Up</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Down</td>
</tr>
</tbody>
</table>

### Enhanced Object Tracking and Embedded Event Manager

Enhanced Object Tracking (EOT) is now integrated with Embedded Event Manager (EEM) to allow EEM to report on status change of a tracked object and to allow EOT to track EEM objects. A new type of tracking
object—a stub object—is created. The stub object can be modified by an external process through a defined
Application Programming Interface (API). See the Embedded Event Manager Overview document in the
Network Management Configuration Guide for more information on how EOT works with EEM.

Benefits of Enhanced Object Tracking

- Increases the availability and speed of recovery of a network.
- Decreases the number of network outages and their duration.
- Enables client processes such as VRRP and GLBP to track objects individually or as a list of objects.
  Prior to the introduction of this functionality, the tracking process was embedded within HSRP.

How to Configure Enhanced Object Tracking

Tracking the Line-Protocol State of an Interface

SUMMARY STEPS

1. enable
2. configure terminal
3. track timer interface \{seconds | msec milliseconds\}
4. track object-number interface type number line-protocol
5. carrier-delay
6. delay \{up seconds [down seconds] | [up seconds] down seconds\}
7. end
8. show track object-number

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1: enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Step 2: configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step 3: track timer interface {seconds</td>
<td>msec milliseconds}</td>
</tr>
<tr>
<td>Example:</td>
<td>• The default interval that the tracking process polls interface objects is 1 second.</td>
</tr>
<tr>
<td>Device(config)# track timer interface 5</td>
<td></td>
</tr>
</tbody>
</table>
### Purpose

All polling frequencies can be configured down to 500 milliseconds, overriding the minimum 1-second interval configured using the `msec` keyword and `milliseconds` argument.

### Note

Tracks the line-protocol state of an interface and enters tracking configuration mode.

### Step 4

**track object-number interface type number line-protocol**

**Example:**

```
Device(config)# track 3 interface Gigabitethernet 0/0 line-protocol
```

Tracks the line-protocol state of an interface and enters tracking configuration mode.

### Step 5

**carrier-delay**

**Example:**

```
Device(config-track)# carrier-delay
```

(Optional) Enables EOT to consider the carrier-delay timer when tracking the status of an interface.

### Step 6

**delay {up seconds [down [seconds]] | [up seconds] down seconds}**

**Example:**

```
Device(config-track)# delay up 30
```

(Optional) Specifies a period of time (in seconds) to delay communicating state changes of a tracked object.

### Step 7

**end**

**Example:**

```
Device(config-track)# end
```

Exits to privileged EXEC mode.

### Step 8

**show track object-number**

**Example:**

```
Device# show track 3
```

(Optional) Displays tracking information.

- Use this command to verify the configuration.

---

### Example

The following example shows the state of the line protocol on an interface when it is tracked:

```
Device# show track 3

Track 3
  Interface GigabitEthernet 0/0 line-protocol
  Line protocol is Up
  1 change, last change 00:00:05
  Tracked by:
    HSRP GigabitEthernet 0/3 1
```
# Tracking the IP-Routing State of an Interface

## SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `track timer interface {seconds | msec milliseconds}`
4. `track object-number interface type number ip routing`
5. `carrier-delay`
6. `delay {up seconds [down seconds] | [up seconds] down seconds}`
7. `end`
8. `show track object-number`

## DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><code>enable</code></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device&gt; enable</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><code>configure terminal</code></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# configure terminal</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>(Optional) Specifies the interval in which the tracking process polls the tracked object.</td>
</tr>
<tr>
<td>`track timer interface {seconds</td>
<td>msec milliseconds}`</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# track timer interface 5</td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>All polling frequencies can be configured down to 500 milliseconds, overriding the minimum 1-second interval configured using the <code>msec</code> keyword and <code>milliseconds</code> argument.</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>Tracks the IP-routing state of an interface and enters tracking configuration mode.</td>
</tr>
<tr>
<td><code>track object-number interface type number ip routing</code></td>
<td>• IP-route tracking tracks an IP route in the routing table and the ability of an interface to route IP packets.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# track 1 interface Gigabitethernet 0/0 ip routing</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>(Optional) Enables EOT to consider the carrier-delay timer when tracking the status of an interface.</td>
</tr>
<tr>
<td><code>carrier-delay</code></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config-track)# carrier-delay</td>
</tr>
</tbody>
</table>
### Purpose

Command or Action | Purpose
--- | ---
**Step 6** delay {up seconds [down seconds] | [up seconds] down seconds} | (Optional) Specifies a period of time (in seconds) to delay communicating state changes of a tracked object.

**Example:**
```
Device(config-track)# delay up 30
```

**Step 7** end | Returns to privileged EXEC mode.

**Example:**
```
Device(config-track)# end
```

**Step 8** show track object-number | Displays tracking information.

**Example:**
```
Device# show track 1
```

---

### Example

The following example shows the state of IP routing on an interface when it is tracked:

```
Device# show track 1

Track 1
  Interface GigabitEthernet 0/1 ip routing
  IP routing is Up
  1 change, last change 00:01:08
  Tracked by:
    HSRP GigabitEthernet 0/3 1
```

### Tracking IP-Route Reachability

Perform this task to track the reachability of an IP route. A tracked object is considered up when a routing table entry exists for the route and the route is accessible.

### SUMMARY STEPS

1. enable
2. configure terminal
3. track timer ip route {seconds | msec milliseconds}
4. track object-number ip route ip-address/prefix-length reachability
5. delay {up seconds [down seconds] | [up seconds] down seconds}
6. ip vrf vrf-name
7. end
8. show track object-number
### DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| 1    | enable            | Enables privileged EXEC mode.  
Example:  
Device> enable  
- Enter your password if prompted. |
| 2    | configure terminal | Enters global configuration mode.  
Example:  
Device# configure terminal |
| 3    | track timer ip route `{seconds | msec milliseconds}` | (Optional) Specifies the interval in which the tracking process polls the tracked object.  
Example:  
Device(config)# track timer ip route 20 |
| 4    | track `object-number ip route ip-address/prefix-length reachability` | Tracks the reachability of an IP route and enters tracking configuration mode.  
Example:  
Device(config)# track 4 ip route 10.16.0.0/16 reachability |
| 5    | delay `{up seconds | down seconds}` | (Optional) Specifies a period of time (in seconds) to delay communicating state changes of a tracked object.  
Example:  
Device(config-track)# delay up 30 |
| 6    | ip vrf `vrf-name` | (Optional) Configures a VPN routing and forwarding (VRF) table.  
Example:  
Device(config-track)# ip vrf VRF2 |
| 7    | end               | Returns to privileged EXEC mode.  
Example:  
Device(config-track)# end |
| 8    | show track `object-number` | (Optional) Displays tracking information.  
Example:  
- Use this command to verify the configuration. |

**Note:** All polling frequencies can be configured down to 500 milliseconds, overriding the minimum 1-second interval configured using the `msec` keyword and `milliseconds` argument.
Tracking the Threshold of IP-Route Metrics

SUMMARY STEPS

1. enable
2. configure terminal
3. track timer ip route \{seconds | msec milliseconds\}
4. track resolution ip route \{eigrp | isis | ospf | static\} resolution-value
5. track object-number ip route ip-address/prefix-length metric threshold
6. delay \{up seconds \[down seconds\] | \[up seconds\] down seconds\}
7. ip vrf vrf-name
8. threshold metric \{up number \[down number\] | down number \[up number \}\}
9. end
10. show track object-number

DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td></td>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> track timer ip route {seconds</td>
<td>msec milliseconds}</td>
<td>(Optional) Specifies the interval in which the tracking process polls the tracked object.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Device(config)# track timer ip route 20</td>
<td>- The default interval that the tracking process polls IP-route objects is 15 seconds.</td>
<td></td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>All polling frequencies can be configured down to 500 milliseconds, overriding the minimum 1-second interval configured using the msec keyword and milliseconds argument.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> track resolution ip route {eigrp</td>
<td>isis</td>
<td>ospf</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Device(config)# track resolution ip route eigrp 300</td>
<td>- Use this command to change the default metric resolution values.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> track object-number ip route ip-address/prefix-length metric threshold</td>
<td>Tracks the scaled metric value of an IP route to determine if it is above or below a threshold and enters tracking configuration mode.</td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Device(config)# track 6 ip route 10.16.0.0/16 metric threshold</td>
<td>- The default down value is 255, which equates to an inaccessible route.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- The default up value is 254.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> delay {up seconds [down seconds]</td>
<td>[up seconds] down seconds}</td>
<td>(Optional) Specifies a period of time (in seconds) to delay communicating state changes of a tracked object.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Device(config-track)# delay up 30</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 7</strong> ip vrf vrf-name</td>
<td>(Optional) Configures a VRF table.</td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Device(config-track)# ip vrf VRF1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 8</strong> threshold metric {up number [down number]</td>
<td>down number [up number ]}</td>
<td>(Optional) Sets a metric threshold other than the default value.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Device(config-track)# threshold metric up 254 down 255</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 9</strong> end</td>
<td>Exits to privileged EXEC mode.</td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Device(config-track)# end</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Purpose

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| Step 10 | *(Optional)* Displays tracking information.  
- Use this command to verify the configuration. |

#### Example

The following example shows the metric threshold of an IP route when it is tracked:

```
Device# show track 6

Track 6
  IP route 10.16.0.0 255.255.0.0 metric threshold
  Metric threshold is Up (RIP/6/102)
  1 change, last change 00:00:08
  Metric threshold down 255 up 254
  First-hop interface is Ethernet0/1
  Tracked by:
    HSRP Ethernet0/3 1
```

---

### Tracking the State of an IP SLAs Operation

**SUMMARY STEPS**

1. enable
2. configure terminal
3. track object-number ip sla operation-number state
4. delay {up seconds [down seconds] | [up seconds] down seconds}
5. end
6. show track object-number

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** enable | Enables privileged EXEC mode.  
- Enter your password if prompted. |
| Example: Device> enable |
| **Step 2** configure terminal | Enters global configuration mode. |
| Example: Device# configure terminal |
| **Step 3** track object-number ip sla operation-number state | Tracks the state of an IP SLAs object and enters tracking configuration mode. |
| Example: | |
### Command or Action

<table>
<thead>
<tr>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>With CSCs08092, the <code>track rtr</code> command was replaced by the <code>track ip sla</code> command.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device(config)# track 2 ip sla 4 state</td>
<td><strong>Purpose</strong></td>
</tr>
</tbody>
</table>

**Step 4**

`delay {up seconds [down seconds] | [up seconds] down seconds}`

**Example:**

Device(config-track)# delay up 60 down 30

**Step 5**

`end`

**Example:**

Device(config-track)# end

**Step 6**

`show track object-number`

**Example:**

Device# show track 2

(Optional) Displays tracking information.

- Use this command to verify the configuration.

---

**Example**

The following example shows the state of the IP SLAs tracking:

Device# `show track 2`

```
Track 2
    IP SLA 1 state
    State is Down
    1 change, last change 00:00:47
    Latest operation return code: over threshold
    Latest RTT (milliseconds) 4
    Tracked by:
        HSRP Ethernet0/1 3
```

---

**Tracking the Reachability of an IP SLAs IP Host**

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `track object-number ip sla operation-number reachability`
4. `delay {up seconds [down seconds] | [up seconds] down seconds}`
5. `end`
6. `show track object-number`
### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** enable | Enables privileged EXEC mode.  
  - Enter your password if prompted. |
| Example: Device> enable | |
| **Step 2** configure terminal | Enters global configuration mode. |
| Example: Device# configure terminal | |
| **Step 3** track object-number ip sla operation-number reachability | Tracks the reachability of an IP SLAs IP host and enters tracking configuration mode.  
  **Note** With CScsf08092, the **track rtr** command was replaced by the **track ip sla** command. |
| Example: Device(config)# track 2 ip sla 4 reachability | |
| **Step 4** delay {up seconds} [down seconds] | (Optional) Specifies a period of time (in seconds) to delay communicating state changes of a tracked object. |
| Example: Device(config-track)# delay up 30 down 10 | |
| **Step 5** end | Exits to privileged EXEC mode. |
| Example: Device(config-track)# end | |
| **Step 6** show track object-number | (Optional) Displays tracking information.  
  - Use this command to verify the configuration. |
| Example: Device# show track 3 | |

### Example
The following example shows whether the route is reachable:

```
Device# show track 3
Track 3
  IP SLA 1 reachability
  Reachability is Up
  1 change, last change 00:00:47
  Latest operation return code: over threshold
  Latest RTT (milliseconds) 4
  Tracked by:
    HSRP Ethernet0/1 3
```
## Configuring a Tracked List and Boolean Expression

Perform this task to configure a tracked list of objects and a Boolean expression to determine the state of the list. A tracked list contains one or more objects. The Boolean expression enables two types of calculations by using either “and” or “or” operators. For example, when you configure tracking for two interfaces using the “and” operator up means that both interfaces are up, and down means that either interface is down.

You may configure a tracked list state to be measured using a weight or percentage threshold. See the Configuring a Tracked List and Threshold Weight section and the Configuring a Tracked List and Threshold Percentage section.

### Before you begin

An object must exist before it can be added to a tracked list.

<table>
<thead>
<tr>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>The “not” operator is specified for one or more objects and negates the state of the object.</td>
</tr>
</tbody>
</table>

### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `track track-number list boolean {and | or}`
4. `object object-number [not]`
5. `delay {up seconds [down seconds] | [up seconds] down seconds}`
6. `end`

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
</tr>
<tr>
<td>track track-number list boolean {and</td>
<td>or}</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config)# track 100 list boolean and</td>
<td></td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td></td>
</tr>
<tr>
<td>object object-number [not]</td>
<td>Specifies the object to be tracked.</td>
</tr>
<tr>
<td>Example:</td>
<td>• The object-number argument has a valid range from 1 to 500. There is no default. The optional not keyword negates the state of the object.</td>
</tr>
<tr>
<td>Device(config-track)# object 3 not</td>
<td>The example means that when object 3 is up, the tracked list detects object 3 as down.</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td></td>
</tr>
<tr>
<td>delay {up seconds [down seconds]</td>
<td>(Optional) Specifies a tracking delay in seconds between up and down states.</td>
</tr>
<tr>
<td>Example:</td>
<td>up seconds}</td>
</tr>
<tr>
<td>Device(config-track)# delay up 3</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td></td>
</tr>
<tr>
<td>end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config-track)# end</td>
<td></td>
</tr>
</tbody>
</table>

**Configuring a Tracked List and Threshold Weight**

Perform this task to configure a list of tracked objects, to specify that weight be used as the threshold, and to configure a weight for each of the objects in the list of tracked objects. A tracked list contains one or more objects. Enhanced object tracking uses a threshold weight to determine the state of each object by comparing the total weight of all objects that are up against a threshold weight for each object.

You can also configure a tracked list state to be measured using a Boolean calculation or threshold percentage. See the Configuring a Tracked List and Boolean Expression section and the Configuring a Tracked List and Threshold Percentage section.

**Before you begin**

An object must exist before it can be added to a tracked list.

**Summary Steps**

1. enable
2. configure terminal
3. track track-number list threshold weight
4. object object-number [weight weight-number]
5. threshold weight {up number down number | up number | down number}
6. delay {up seconds [down seconds] | [up seconds] down seconds}
7. end
## DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1**
  enable
  Example: Device> enable | Enables privileged EXEC mode.
  • Enter your password if prompted. |
| **Step 2**
  configure terminal
  Example: Device# configure terminal | Enters global configuration mode. |
| **Step 3**
  track track-number list threshold weight
  Example: Device(config)# track 100 list threshold weight | Configures a tracked list object and enters tracking configuration mode. The keywords are as follows:
  • threshold — Specifies that the state of the tracked list is based on a threshold.
  • weight — Specifies that the threshold is based on a specified weight. |
| **Step 4**
  object object-number [weight weight-number]
  Example: Device(config-track)# object 3 weight 30 | Specifies the object to be tracked. The object-number argument has a valid range from 1 to 500. There is no default. The optional weight keyword specifies a threshold weight for each object. |
| **Step 5**
  threshold weight {up number down number | up number | down number}
  Example: Device(config-track)# threshold weight up 30 | Specifies the threshold weight.
  • up number — Valid range is from 1 to 255.
  • down number — Range depends upon what you select for the up keyword. For example, if you configure 25 for up, you will see a range from 0 to 24 for down. |
| **Step 6**
  delay {up seconds [down seconds] | [up seconds] down seconds}
  Example: Device(config-track)# delay up 3 | (Optional) Specifies a tracking delay in seconds between up and down states. |
| **Step 7**
  end
  Example: Device(config-track)# end | Returns to privileged EXEC mode. |

### Configuring a Tracked List and Threshold Percentage

Perform this task to configure a tracked list of objects, to specify that a percentage will be used as the threshold, and to specify a percentage for each object in the list. A tracked list contains one or more objects. Enhanced
object tracking uses the threshold percentage to determine the state of the list by comparing the assigned percentage of each object to the list.

You may also configure a tracked list state to be measured using a Boolean calculation or threshold weight. See the Configuring a Tracked List and Boolean Expression section and the Configuring a Tracked List and Threshold Weight section.

---

**Note**

You cannot use the Boolean “not” operator in a weight or percentage threshold list.

---

**Before you begin**

An object must exist before it can be added to a tracked list.

**SUMMARY STEPS**

1. enable
2. configure terminal
3. track track-number list threshold percentage
4. object object-number
5. threshold percentage {up number [down number] | down number [up number]}
6. delay {up seconds [down seconds] | [up seconds] down seconds}
7. end

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> track track-number list threshold percentage</td>
<td>Configures a tracked list object and enters tracking configuration mode. The keywords are as follows:</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# track 100 list threshold percentage</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> object object-number</td>
<td>Specifies the object to be tracked.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
</tbody>
</table>

- **threshold** — Specifies that the state of the tracked list is based on a threshold.
- **percentage** — Specifies that the threshold is based on a percentage.

- The **object-number** argument has a valid range from 1 to 500. There is no default.
Configuring Track List Defaults

Perform this task to configure a default delay value for a tracked list, a default object, and default threshold parameters for a tracked list.

**SUMMARY STEPS**

1. **enable**
2. **configure terminal**
3. **track track-number**
4. **default {delay | object object-number | threshold percentage}**
5. **end**

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
</tbody>
</table>
### Configuring Tracking for Mobile IP Applications

Perform this task to configure a tracked list of Mobile IP application objects.

#### SUMMARY STEPS

1. enable
2. configure terminal
3. track track-number application home-agent
4. exit
5. track track-number application pdsn
6. exit
7. track track-number application ggsn
8. end

#### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device# configure terminal</td>
<td>Enters tracking configuration mode.</td>
</tr>
<tr>
<td>Step 3 track track-number</td>
<td>Specifies a default delay value for a tracked list, a default object, and default threshold parameters for a tracked list.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config)# track 3</td>
<td></td>
</tr>
<tr>
<td>Step 4 default {delay</td>
<td>object object-number</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config-track)# default delay</td>
<td></td>
</tr>
<tr>
<td>Step 5 end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config-track)# end</td>
<td></td>
</tr>
</tbody>
</table>

---

**Purpose**

Command or Action

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device# configure terminal</td>
<td>Enters tracking configuration mode.</td>
</tr>
<tr>
<td>Step 3 track track-number</td>
<td>Specifies a default delay value for a tracked list, a default object, and default threshold parameters for a tracked list.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config)# track 3</td>
<td></td>
</tr>
<tr>
<td>Step 4 default {delay</td>
<td>object object-number</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config-track)# default delay</td>
<td></td>
</tr>
<tr>
<td>Step 5 end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config-track)# end</td>
<td></td>
</tr>
</tbody>
</table>
### Command or Action

**Step 2**

*configure terminal*  
**Example:**  
Device# configure terminal  

**Purpose:** Enters global configuration mode.

**Step 3**

*track track-number application home-agent*  
**Example:**  
Device(config)# track 100 application home-agent  

**Purpose:** (Optional) Tracks the presence of Home Agent traffic on a router and enters tracking configuration mode.

**Step 4**

*exit*  
**Example:**  
Device(config-track)# exit  

**Purpose:** Returns to global configuration mode.

**Step 5**

*track track-number application pdsn*  
**Example:**  
Device(config)# track 100 application pdsn  

**Purpose:** (Optional) Tracks the presence of Packet Data Serving Node (PDSN) traffic on a router tracking configuration mode.

**Step 6**

*exit*  
**Example:**  
Device(config-track)# exit  

**Purpose:** Returns to global configuration mode.

**Step 7**

*track track-number application ggsn*  
**Example:**  
Device(config)# track 100 application ggsn  

**Purpose:** (Optional) Tracks the presence of Gateway GPRS Support Node (GGSN) traffic on a router tracking configuration mode.

**Step 8**

*end*  
**Example:**  
Device(config)# end  

**Purpose:** Returns to privileged EXEC mode.

---

### Configuration Examples for Enhanced Object Tracking

#### Example: Interface Line Protocol

In the following example, the tracking process is configured to track the line-protocol state of GigabitEthernet interface 1/0/0. HSRP on GigabitEthernet interface 0/0/0 then registers with the tracking process to be informed of any changes to the line-protocol state of GigabitEthernet interface 1/0/0. If the line protocol on GigabitEthernet interface 1/0/0 goes down, the priority of the HSRP group is reduced by 10.
Example: Interface IP Routing

In the following example, the tracking process is configured to track the IP-routing capability of GigabitEthernet interface 1/0/0. HSRP on GigabitEthernet interface 0/0/0 then registers with the tracking process to be informed of any changes to the IP-routing state of GigabitEthernet interface 1/0/0. If the IP-routing state on GigabitEthernet interface 1/0/0 goes down, the priority of the HSRP group is reduced by 10.

If both serial interfaces are operational, Router A will be the HSRP active router because it has the higher priority. However, if IP on GigabitEthernet interface 1/0/0 in Router A fails, the HSRP group priority will be reduced and Router B will take over as the active router, thus maintaining a default virtual gateway service to hosts on the 10.1.0.0 subnet.

See the figure below for a sample topology.

---

Router A Configuration

```
Device(config)# track 100 interface GigabitEthernet1/0/0 line-protocol
Device(config)# interface GigabitEthernet0/0/0
Device(config-if)# ip address 10.1.0.21 255.255.0.0
Device(config-if)# standby 1 preempt
Device(config-if)# standby 1 ip 10.1.0.1
Device(config-if)# standby 1 priority 110
Device(config-if)# standby 1 track 100 decrement 10
```

Router B Configuration

```
Device(config)# track 100 interface GigabitEthernet1/0/0 line-protocol
Device(config)# interface GigabitEthernet0/0/0
Device(config-if)# ip address 10.1.0.22 255.255.0.0
Device(config-if)# standby 1 preempt
Device(config-if)# standby 1 ip 10.1.0.1
Device(config-if)# standby 1 priority 105
Device(config-if)# standby 1 track 100 decrement 10
```

---

See the figure below for a sample topology.

---

Figure 1: Topology for IP-Routing Support

---

Router A Configuration

```
Device(config)# track 100 interface GigabitEthernet1/0/0 ip routing
Device(config)# interface GigabitEthernet0/0/0
Device(config-if)# ip address 10.1.0.21 255.255.0.0
Device(config-if)# standby 1 preempt
Device(config-if)# standby 1 ip 10.1.0.1
```
Device(config-if)# standby 1 priority 110
Device(config-if)# standby 1 track 100 decrement 10

Router B Configuration

Device(config)# track 100 interface GigabitEthernet1/0/0 ip routing
Device(config)# interface GigabitEthernet0/0/0
Device(config-if)# ip address 10.1.0.22 255.255.255.0
Device(config-if)# standby 1 preempt
Device(config-if)# standby 1 ip 10.1.0.1
Device(config-if)# standby 1 priority 105
Device(config-if)# standby 1 track 100 decrement 10

Example: IP-Route Reachability

In the following example, the tracking process is configured to track the reachability of IP route 10.2.2.0/24:

Router A Configuration

Device(config)# track 100 ip route 10.2.2.0/24 reachability
Device(config)# interface GigabitEthernet0/0/0
Device(config-if)# ip address 10.1.1.21 255.255.255.0
Device(config-if)# standby 1 preempt
Device(config-if)# standby 1 ip 10.1.1.1
Device(config-if)# standby 1 priority 110
Device(config-if)# standby 1 track 100 decrement 10

Router B Configuration

Device(config)# track 100 ip route 10.2.2.0/24 reachability
Device(config)# interface GigabitEthernet0/0/0
Device(config-if)# ip address 10.1.1.22 255.255.255.0
Device(config-if)# standby 1 preempt
Device(config-if)# standby 1 ip 10.1.1.1
Device(config-if)# standby 1 priority 105
Device(config-if)# standby 1 track 100 decrement 10

Example: IP-Route Threshold Metric

In the following example, the tracking process is configured to track the threshold metric of IP route 10.2.2.0/24:

Router A Configuration

Device(config)# track 100 ip route 10.2.2.0/24 metric threshold
Device(config)# interface GigabitEthernet0/0/0
Device(config-if)# ip address 10.1.1.21 255.255.255.0
Device(config-if)# standby 1 preempt
Device(config-if)# standby 1 ip 10.1.1.1
Device(config-if)# standby 1 priority 110
Device(config-if)# standby 1 track 100 decrement 10
Router B Configuration

Device(config)# track 100 ip route 10.2.2.0/24 metric threshold
Device(config)# interface GigabitEthernet0/0
Device(config-if)# ip address 10.1.1.22 255.255.255.0
Device(config-if)# standby 1 preempt
Device(config-if)# standby 1 ip 10.1.1.1
Device(config-if)# standby 1 priority 105
Device(config-if)# standby 1 track 100 decrement 10

Example: IP SLAs IP Host Tracking

The following example shows how to configure IP host tracking for IP SLAs operation 1 prior to CSCs08092:

Device(config)# ip sla 1
Device(config-ip-sla)# icmp-echo 10.51.12.4
Device(config-ip-sla-echo)# timeout 1000
Device(config-ip-sla-echo)# threshold 2
Device(config-ip-sla-echo)# frequency 3
Device(config-ip-sla-echo)# request-data-size 1400
Device(config-ip-sla-echo)# exit
Device(config)# ip sla schedule 1 start-time now life forever
Device(config-ip-sla)# track 2 rtr 1 state
Device(config-ip-sla)# exit
Device(config)# track 3 rtr 1 reachability
Device(config-track)# exit
Device(config)# interface ethernet0/1
Device(config-if)# ip address 10.21.0.4 255.255.0.0
Device(config-if)# no shutdown
Device(config-if)# standby 3 ip 10.21.0.10
Device(config-if)# standby 3 priority 120
Device(config-if)# standby 3 preempt
Device(config-if)# standby 3 track 2 decrement 10
Device(config-if)# standby 3 track 3 decrement 10

The following example shows how to configure IP host tracking for IP SLAs operation 1 prior to CSCs08092:

Device(config)# ip sla 1
Device(config-ip-sla)# icmp-echo 10.51.12.4
Device(config-ip-sla-echo)# threshold 2
Device(config-ip-sla-echo)# timeout 1000
Device(config-ip-sla-echo)# frequency 3
Device(config-ip-sla-echo)# request-data-size 1400
Device(config-ip-sla-echo)# exit
Device(config)# ip sla schedule 1 start-time now life forever
Device(config)# track 2 ip sla 1 state
Device(config)# track 3 ip sla 1 reachability
Device(config)# exit
Device(config)# interface ethernet0/1
Device(config-if)# ip address 10.21.0.4 255.255.0.0
Device(config-if)# no shutdown
Device(config-if)# standby 3 ip 10.21.0.10
Device(config-if)# standby 3 priority 120
Device(config-if)# standby 3 preempt
Device(config-if)# standby 3 track 2 decrement 10
Device(config-if)# standby 3 track 3 decrement 10
Example: Boolean Expression for a Tracked List

In the following example, a track list object is configured to track two GigabitEthernet interfaces when both interfaces are up and when either interface is down:

```
Device(config)# track 1 interface GigabitEthernet2/0/0 line-protocol
Device(config)# track 2 interface GigabitEthernet2/1/0 line-protocol
Device(config-track)# exit
Device(config)# track 100 list boolean and
Device(config-track)# object 1
Device(config-track)# object 2
```

In the following example, a track list object is configured to track two GigabitEthernet interfaces when either interface is up and when both interfaces are down:

```
Device(config)# track 1 interface GigabitEthernet2/0/0 line-protocol
Device(config)# track 2 interface GigabitEthernet2/1/0 line-protocol
Device(config-track)# exit
Device(config)# track 101 list boolean or
Device(config-track)# object 1
Device(config-track)# object 2
```

The following configuration example shows that tracked list 4 has two objects and one object state is negated (if the list is up, the list detects that object 2 is down):

```
Device(config)# track 4 list boolean and
Device(config-track)# object 1
Device(config-track)# object 2 not
```

Example: Threshold Weight for a Tracked List

In the following example, three GigabitEthernet interfaces in tracked list 100 are configured with a threshold weight of 20 each. The down threshold is configured to 0 and the up threshold is configured to 40:

```
Device(config)# track 1 interface GigabitEthernet2/0/0 line-protocol
Device(config)# track 2 interface GigabitEthernet2/1/0 line-protocol
Device(config)# track 3 interface GigabitEthernet2/2/0 line-protocol
Device(config-track)# exit
Device(config)# track 100 list threshold weight
Device(config-track)# object 1 weight 20
Device(config-track)# object 2 weight 20
Device(config-track)# object 3 weight 20
Device(config-track)# threshold weight up 40 down 0
```

In the example above the track-list object goes down only when all three serial interfaces go down, and comes up again only when at least two interfaces are up (because 20 + 20 >= 40). The advantage of this configuration is that it prevents the track-list object from coming up if two interfaces are down and the third interface is flapping.

The following configuration example shows that if object 1 and object 2 are down, then track list 4 is up, because object 3 satisfies the up threshold value of up 30. But, if object 3 is down, both objects 1 and 2 need to be up in order to satisfy the threshold weight.

```
Device(config)# track 4 list threshold weight
Device(config-track)# object 1 weight 15
Device(config-track)# object 2 weight 20
```
Example: Threshold Percentage for a Tracked List

In the following example, four GigabitEthernet interfaces in track list 100 are configured for an up threshold percentage of 75. The track list is up when 75 percent of the interfaces are up and down when fewer than 75 percent of the interfaces are up.

```
Device(config)# track 1 interface GigabitEthernet2/0/0 line-protocol
Device(config)# track 2 interface GigabitEthernet2/1/0 line-protocol
Device(config)# track 3 interface GigabitEthernet2/2/0 line-protocol
Device(config)# track 4 interface GigabitEthernet2/3/0 line-prefix
Device(config-track)# exit
Device(config)# track 100 list threshold percentage
Device(config-track)# object 1
Device(config-track)# object 2
Device(config-track)# object 3
Device(config-track)# object 4
Device(config-track)# threshold percentage up 75
```

Additional References

### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Commands List, All Releases</td>
</tr>
<tr>
<td>Embedded Event Manager</td>
<td>Embedded Event Manager Overview</td>
</tr>
<tr>
<td>HSRP concepts and configuration tasks</td>
<td>Configuring HSRP</td>
</tr>
<tr>
<td>GLBP concepts and configuration tasks</td>
<td>Configuring GLBP</td>
</tr>
<tr>
<td>IP SLAs commands</td>
<td>Cisco IOS IP SLAs Command Reference</td>
</tr>
<tr>
<td>VRRP concepts and configuration tasks</td>
<td>Configuring VRRP</td>
</tr>
<tr>
<td>GLBP, HSRP, and VRRP commands</td>
<td>Cisco IOS IP Application Services Command Reference</td>
</tr>
</tbody>
</table>

### Standards

<table>
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<th>Title</th>
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<tr>
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MIBs

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

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</tr>
</tbody>
</table>

Technical Assistance

<table>
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<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
</tr>
</tbody>
</table>

Feature Information for Enhanced Object Tracking

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.
### Table 3: Feature Information for Enhanced Object Tracking

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhanced Tracking Support</td>
<td>15.0(1)SY</td>
<td>The Enhanced Tracking Support feature separates the tracking mechanism from HSRP and creates a separate standalone tracking process that can be used by other Cisco IOS processes and HSRP. This feature allows tracking of other objects in addition to the interface line-protocol state. The following commands were introduced or modified: <code>show track</code>, <code>standby track</code>, <code>threshold metric</code>, <code>track interface</code>, <code>track ip route</code>, <code>track timer</code>.</td>
</tr>
<tr>
<td>FHRP—Enhanced Object Tracking Integration with Embedded Event Manager</td>
<td>15.0(1)SY</td>
<td>EOT is integrated with Embedded Event Manager (EEM) to allow EEM to report on a status change of a tracked object and to allow EOT to track EEM objects. The following commands were introduced or modified by this feature: <code>default-state</code>, <code>event resource</code>, <code>event rf</code>, <code>event track</code>, <code>show track</code>, <code>track stub</code>.</td>
</tr>
<tr>
<td>FHRP—Enhanced Object Tracking of IP SLAs Operations</td>
<td>15.0(1)SY</td>
<td>This feature enables First Hop Redundancy Protocols (FHRPs) and other Enhanced Object Tracking (EOT) clients to track the output from IP SLAs objects and use the provided information to trigger an action. The following command was introduced by this feature: <code>track rtr</code>.</td>
</tr>
<tr>
<td>FHRP—EOT Deprecation of rtr Keyword</td>
<td>15.0(1)SY</td>
<td>This feature replaces the <code>track rtr</code> command with the <code>track ip sla</code> command.</td>
</tr>
</tbody>
</table>
**Feature Information**

**Releases**

**FHRP—Object Tracking List**  
15.0(1)SY  

- This feature enhances the tracking capabilities to enable the configuration of a combination of tracked objects in a list, and a flexible method of combining objects using Boolean logic.
- The following commands were introduced or modified by this feature: `show track`, `threshold percentage`, `threshold weight`, `track list`, `track resolution`.

---

**Glossary**

**DHCP**—Dynamic Host Configuration Protocol. DHCP is a protocol that delivers IP addresses and configuration information to network clients.

**GGSN**—Gateway GPRS Support Node. A wireless gateway that allows mobile cell phone users to access the public data network (PDN) or specified private IP networks. The GGSN function is implemented on the Cisco routers.

**GLBP**—Gateway Load Balancing Protocol. Provides automatic router backup for IP hosts that are configured with a single default gateway on an IEEE 802.3 LAN. Multiple first-hop routers on the LAN combine to offer a single virtual first-hop IP router while sharing the IP packet forwarding load. Other routers on the LAN may act as redundant (GLBP) routers that will become active if any of the existing forwarding routers fail.

**GPRS**—General Packet Radio Service. A 2.5G mobile communications technology that enables mobile wireless service providers to offer their mobile subscribers with packet-based data services over GSM networks.

**GSM network**—Global System for Mobile Communications network. A digital cellular technology that is used worldwide, predominantly in Europe and Asia. GSM is the world’s leading standard in digital wireless communications.

**Home Agent**—A Home Agent is a router on the home network of the Mobile Node (MN) that maintains an association between the home IP address of the MN and its care-of address, which is the current location of the MN on a foreign or visited network. The HA redirects packets by tunneling them to the MN while it is away from the home network.

**HSRP**—Hot Standby Router Protocol. Provides high network availability and transparent network topology changes. HSRP creates a Hot Standby router group with a lead router that services all packets sent to the Hot Standby address. The lead router is monitored by other routers in the group, and if it fails, one of these standby routers inherits the lead position and the Hot Standby group address.

**IPCP**—IP Control Protocol. The protocol used to establish and configure IP over PPP.

**LCP**—Link Control Protocol. The protocol used to establish, configure, and test data-link connections for use by PPP.

**PDSN**—Packet Data Serving Node. The Cisco PDSN is a standards-compliant, wireless gateway that enables packet data services in a Code Division Multiplex Access (CDMA) environment. Acting as an access gateway,
the Cisco PDSN provides simple IP and Mobile IP access, foreign-agent support, and packet transport for Virtual Private Networks (VPN).

**PPP**—Point-to-Point Protocol. Provides router-to-router and host-to-network connections over synchronous and asynchronous circuits. PPP is most commonly used for dial-up Internet access. Its features include address notification, authentication via CHAP or PAP, support for multiple protocols, and link monitoring.

**VRF**—VPN routing and forwarding instance. A VRF consists of an IP routing table, a derived forwarding table, a set of interfaces that use the forwarding table, and a set of rules and routing protocols that determine what goes into the forwarding table. In general, a VRF includes the routing information that defines a customer VPN site that is attached to a provider edge router.

**VRRP**—Virtual Router Redundancy Protocol. Eliminates the single point of failure inherent in the static default routed environment. VRRP specifies an election protocol that dynamically assigns responsibility for a virtual router to one of the VRRP routers on a LAN. The VRRP router that controls the IP addresses associated with a virtual router is called the master, and forwards packets sent to these IP addresses. The election process provides dynamic failover in the forwarding responsibility should the master become unavailable. Any of the virtual router IP addresses on a LAN can then be used as the default first-hop router by end hosts.
Configuring IP Services

This module describes how to configure optional IP services. For a complete description of the IP services commands in this chapter, refer to the Cisco IOS IP Application Services Command Reference. To locate documentation of other commands that appear in this module, use the master command list, or search online.

- Finding Feature Information, on page 31
- Information About IP Services, on page 31
- How to Configure IP Services, on page 36
- Configuration Examples for IP Services, on page 44
- Additional References For IP Services, on page 47
- Feature Information for IP Services, on page 48

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and 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 table.

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

Information About IP Services

IP Source Routing

The software examines IP header options on every packet. It supports the IP header options Strict Source Route, Loose Source Route, Record Route, and Time Stamp, which are defined in RFC 791. If the software finds a packet with one of these options enabled, it performs the appropriate action. If it finds a packet with an invalid option, it sends an Internet Control Message Protocol (ICMP) parameter problem message to the source of the packet and discards the packet.

IP provides a provision known as source routing that allows the source IP host to specify a route through the IP network. Source routing is specified as an option in the IP header. If source routing is specified, the software forwards the packet according to the specified source route. IP source routing is employed when you want to force a packet to take a certain route through the network. The default is to perform source routing. IP source
routing is rarely used for legitimate purposes in networks. Some older IP implementations do not process source-routed packets properly, and it may be possible to crash devices running these implementations by sending them datagrams with source routing options. Disable IP source routing whenever possible. Disabling IP source routing will cause a Cisco router to never forward an IP packet that carries a source routing option.

ICMP Overview

Originally created for the TCP/IP suite in RFC 792, the Internet Control Message Protocol (ICMP) was designed to report a small set of error conditions. ICMP can also report a wide variety of error conditions and provide feedback and testing capabilities. Each message uses a common format and is sent and received by using the same protocol rules.

ICMP enables IP to perform addressing, datagram packaging, and routing by allowing encapsulated messages to be sent and received between IP devices. These messages are encapsulated in IP datagrams just like any other IP message. When the message is generated, the original IP header is encapsulated in the ICMP message and these two pieces are encapsulated within a new IP header to be returned as an error report to the sending device.

ICMP messages are sent in several situations: when a datagram cannot reach its destination, when the gateway does not have the buffering capacity to forward a datagram, and when the gateway can direct the host to send traffic on a shorter route. To avoid the infinite regress of messages about messages, no ICMP messages are sent about ICMP messages.

ICMP does not make IP reliable or ensure the delivery of datagrams or the return of a control message. Some datagrams may be dropped without any report of their loss. The higher-level protocols that use IP must implement their own reliability procedures if reliable communication is required.

ICMP Unreachable Error Messages

Type 3 error messages are sent when a message cannot be delivered completely to the application at a destination host. Six codes contained in the ICMP header describe the unreachable condition as follows:

- 0—Network unreachable
- 1—Host unreachable
- 2—Protocol unreachable
- 3—Port unreachable
- 4—Fragmentation needed and the “don’t fragment” (DF) bit is set
- 5—Source route failed

Software can suppress the generation of ICMP unreachable destination error messages, which is called rate-limiting. The default is no unreachable messages more often than once every half second. Separate intervals can be configured for code 4 and all other unreachable destination error messages. However, there is no method of displaying how many ICMP messages have not been sent.

The ICMP Unreachable Destination Counters feature provides a method to count and display the unsent Type 3 messages. This feature also provides console logging with error messages when there are periods of excessive rate limiting that would indicate a Denial of Service (DoS) attack against the router.

If the software receives a nonbroadcast packet destined for itself that uses an unknown protocol, it sends an ICMP protocol unreachable message back to the source. Similarly, if the software receives a packet that it is
unable to deliver to the final destination because it knows of no route to the destination address, it sends an ICMP host unreachable message to the source. This functionality is enabled by default.

Disable ICMP host unreachable messages whenever possible. ICMP supports IP traffic by relaying information about paths, routes, and network conditions. These messages can be used by an attacker to gain network mapping information.

Because the null interface is a packet sink, packets forwarded there will always be discarded and, unless disabled, will generate host unreachable messages. In that case, if the null interface is being used to block a Denial-of-Service attack, these messages flood the local network with these messages. Disabling these messages prevents this situation. In addition, because all blocked packets are forwarded to the null interface, an attacker receiving host unreachable messages could use those messages to determine Access Control List (ACL) configuration. If the “null 0” interface is configured on your router, disable ICMP host unreachable messages for discarded packets or packets routed to the null interface.

**ICMP Mask Reply Messages**

Occasionally, network devices must know the subnet mask for a particular subnetwork in the internetwork. To obtain this information, such devices can send ICMP mask request messages. ICMP mask reply messages are sent in reply from devices that have the requested information. The software can respond to ICMP mask request messages if this function is enabled.

These messages can be used by an attacker to gain network mapping information.

**ICMP Redirect Messages**

Routes are sometimes less than optimal. For example, it is possible for the router to be forced to resend a packet through the same interface on which it was received. If the router resends a packet through the same interface on which it was received, the software sends an ICMP redirect message to the originator of the packet telling the originator that the router is on a subnet directly connected to the receiving device, and that it must forward the packet to another system on the same subnet. The software sends an ICMP redirect message to the originator of the packet because the originating host presumably could have sent that packet to the next hop without involving this device at all. The redirect message instructs the sender to remove the receiving device from the route and substitute a specified device representing a more direct path. This functionality is enabled by default.

In a properly functioning IP network, a router will send redirects only to hosts on its own local subnets, no end node will ever send a redirect, and no redirect will ever be traversed more than one network hop. However, an attacker may violate these rules; some attacks are based on this. Disabling ICMP redirects will cause no operational impact to the network, and it eliminates this possible method of attack.

**Denial of Service Attack**

Denial of service has become a growing concern, especially when considering the associated costs of such an attack. DoS attacks can decrease the performance of networked devices, disconnect the devices from the network, and cause system crashes. When network services are unavailable, enterprises and service providers suffer the loss of productivity and sales.

The objective of a DoS attack is to deprive a user or organization access to services or resources. If a Website is compromised by a DoS attack, millions of users could be denied access to the site. DoS attacks do not typically result in intrusion or the illegal theft of information. Instead of providing access to unauthorized users, DoS attacks can cause much aggravation and cost to the target customer by preventing authorized
access. Distributed DoS (DDoS) attacks amplify DoS attacks in that a multitude of compromised systems coordinate to flood targets with attack packets, thereby causing denial of service for users of the targeted systems.

A DoS attack occurs when a stream of ICMP echo requests (pings) are broadcast to a destination subnet. The source addresses of these requests are falsified to be the source address of the target. For each request sent by the attacker, many hosts on the subnet will respond flooding the target and wasting bandwidth. The most common DoS attack is called a “smurf” attack, named after an executable program and is in the category of network-level attacks against hosts. DoS attacks can be easily detected when error-message logging of the ICMP Unreachable Destination Counters feature is enabled.

Path MTU Discovery

The software supports the IP Path MTU Discovery mechanism, as defined in RFC 1191. IP Path MTU Discovery allows a host to dynamically discover and cope with differences in the maximum allowable maximum transmission unit (MTU) size of the various links along the path. Sometimes a router is unable to forward a datagram because it requires fragmentation (the packet is larger than the MTU you set for the interface with the `ip mtu` interface configuration command), but the “don’t fragment” (DF) bit is set. The software sends a message to the sending host, alerting it to the problem. The host will need to fragment packets for the destination so that they fit the smallest packet size of all the links along the path. This technique is shown in the figure below.

**Figure 2: IP Path MTU Discovery**

IP Path MTU Discovery is useful when a link in a network goes down, forcing the use of another, different MTU-sized link (and different routers). As shown in the figure above, suppose a router is sending IP packets over a network where the MTU in the first router is set to 1500 bytes, but the second router is set to 512 bytes. If the “don’t fragment” bit of the datagram is set, the datagram would be dropped because the 512-byte router is unable to forward it. All packets larger than 512 bytes are dropped in this case. The second router returns an ICMP destination unreachable message to the source of the datagram with its Code field indicating “Fragmentation needed and DF set.” To support IP Path MTU Discovery, it would also include the MTU of the next hop network link in the low-order bits of an unused header field.

IP Path MTU Discovery is also useful when a connection is being established and the sender has no information at all about the intervening links. It is always advisable to use the largest MTU that the links will bear; the larger the MTU, the fewer packets the host must send.
Note

IP Path MTU Discovery is a process initiated by end hosts. If an end host does not support IP Path MTU Discovery, the receiving device will have no mechanism to avoid fragmenting datagrams generated by the end host.

If a router that is configured with a small MTU on an outbound interface receives packets from a host that is configured with a large MTU (for example, receiving packets from a Token Ring interface and forwarding them to an outbound Ethernet interface), the router fragments received packets that are larger than the MTU of the outbound interface. Fragmenting packets slows the performance of the router. To keep routers in your network from fragmenting received packets, run IP Path MTU Discovery on all hosts and routers in your network, and always configure the largest possible MTU for each router interface type.

Show and Clear Commands for IOS Sockets

The Show and Clear Commands for IOS Sockets feature introduces the `show udp`, `show sockets`, and `clear sockets` commands. These new commands are useful for monitoring and managing the Cisco IOS Socket library.

In Cisco IOS software, sockets are a per process entity. This means that the maximum number of sockets is per process and all sockets are managed on a per process basis. For example, each Cisco IOS process could have a socket with file descriptor number 1. This is unlike UNIX or other operating systems that have per system file descriptor allocations.

The `show` and `clear` commands operate on a per process basis to be consistent with the current functionality. Thus, any action taken by the commands will be applicable only to a particular process at a time as selected by the process ID entered on the CLI.

Many applications have a need for `show` and `clear` commands, which primarily aid in debugging. The following scenarios provide examples of when these commands might be useful:

- The application H.323 is using sockets for voice calls. According to the current number of calls, there is still space for more sockets. However, no more sockets can be opened. You can now use the `show sockets` command to find out if the socket space is indeed exhausted or if there are unused sockets available.

- An application is waiting for a particular socket event to happen. A UDP segment was seen, but the application never became active. You can use the `show udp` command to display the list of events being monitored to determine if a UDP socket event is being monitored or if the socket library failed to activate the application.

- An application wants to forcibly close all the sockets for a particular process. You can use the `clear sockets` command to close both the sockets and the underlying TCP or UDP connection or Stream Control Transmission Protocol (SCTP) association.
How to Configure IP Services

Protecting Your Network from DOS Attacks

ICMP supports IP traffic by relaying information about paths, routes, and network conditions. ICMP messages can be used by an attacker to gain network mapping information. IP source routing allows the source IP host to specify a route through the IP network and is rarely used for legitimate purposes in networks. Some older IP implementations do not process source-routed packets properly, and it may be possible to crash devices running these implementations by sending them datagrams with source routing options.

Whenever possible, ICMP messages and IP source routing should be disabled.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `no ip source-route`
4. `interface type/number/slot`
5. `no ip unreachables`
6. `no ip redirects`
7. `no ip mask-reply`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> no ip source-route</td>
<td>Disables IP source routing.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# no ip source-route</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> interface type/number/slot</td>
<td>Specifies the interface to configure and enters interface configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# interface GigabitEthernet 0/0/0</td>
<td></td>
</tr>
</tbody>
</table>
Configuring ICMP Unreachable Rate Limiting User Feedback

Perform this task to clear all of the unreachable destination packet statistics and to specify an interval number for unreachable destination messages. This task also configures a packet counter (threshold) and interval to trigger a logging message to a console. This task is beneficial to begin a new log after the thresholds have been set.

### SUMMARY STEPS

1. **enable**
2. **clear ip icmp rate-limit [interface-type interface-number]**
3. **configure terminal**
4. **ip icmp rate-limit unreachable [df] [ms] [log [packets] [interval-ms]]**
5. **exit**
6. **show ip icmp rate-limit [interface-type interface-number]**

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td></td>
<td>Router&gt; enable</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 2</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>clear ip icmp rate-limit [interface-type interface-number]</td>
<td>Clears all current ICMP unreachable statistics for all configured interfaces. The optional interface-type and</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>---------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Router# clear ip icmp rate-limit ethernet 2/3</td>
<td><strong>interface-number</strong> arguments clear the statistics for only one interface.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Router# configure terminal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> ip icmp rate-limit unreachable [df] [ms] [log [packets] [interval-ms]]</td>
<td>Specifies the rate limitation of ICMP unreachable destination messages and the error message log threshold for generating a message. The default is no unreachable messages are sent more often than once every half second. The arguments and keywords are as follows:</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Router(config)# ip icmp rate-limit unreachable df log 1100 12000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> exit</td>
<td>Exits to privileged EXEC mode.</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Router# exit</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> show ip icmp rate-limit [interface-type interface-number]</td>
<td>(Optional) Displays all current ICMP unreachable statistics for all configured interfaces. The optional <strong>interface-type</strong> and <strong>interface-number</strong> arguments display the statistics for only one interface.</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Router# show ip icmp rate-limit ethernet 2/3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Example

The following output using the `show ip icmp rate-limit` command displays the unreachable destinations by interface:

```
Router# show ip icmp rate-limit
   DF bit unreachables  All other unreachables
Interval (millisecond)  500      500
Interface   # DF bit unreachables   # All other unreachables
--------- --------------------- ------------------------
Ethernet0/0 0 0
Ethernet0/2 0 0
Serial3/0/3 0 19
```

The greatest number of unreachables is on serial interface 3/0/3.

Setting the MTU Packet Size

All interfaces have a default MTU packet size. You can adjust the IP MTU size so that the software will fragment any IP packet that exceeds the MTU set for an interface.

Changing the MTU value (with the `mtu` interface configuration command) can affect the IP MTU value. If the current IP MTU value is the same as the MTU value and you change the MTU value, the IP MTU value will be modified automatically to match the new MTU. However, the reverse is not true; changing the IP MTU value has no effect on the value for the `mtu` interface configuration command.

All devices on a physical medium must have the same protocol MTU in order to operate.

Perform this task to set the MTU packet size for a specified interface.

**SUMMARY STEPS**

1. enable
2. configure terminal
3. interface type/number/slot
4. ip mtu bytes
5. end

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
</tbody>
</table>
Configuring IP Accounting With NetFlow

IP Accounting collects the number of bytes and packets processed by the network element based on the source or destination IP address, or the configured IP precedence. The information collected can be used to identify users for network usage billing, monitoring, and troubleshooting.

Cisco ASR 1000 Series Aggregation Services Routers do not support the IP Accounting feature; however, support Flexible Netflow as the recommended method to collect network information. For more information on Flexible NetFlow configuration see the Flexible NetFlow Configuration Guide.

The following steps are performed in this task:

1. Create a flow record based on the IP address and define the counters to be collected.
2. Create a flow record based on IP precedence and define the counters to be collected.
3. Create a flow monitor, define the monitor parameters, and link it with the IP address-based flow record.
4. Create a flow monitor, define the monitor parameters, and link it with IP precedence-based flow record.
5. Attach the IP address-based flow monitor and IP precedence-based flow monitor to an interface where the traffic is monitored.
6. Monitor the flow cache and statistics.
7. Clean the flow cache and statistics.
8. Export the flow cache to external source in .csv format.

SUMMARY STEPS

1. enable
2. configure terminal
3. flow record record-name
4. match ipv4 source address
5. match ipv4 destination address
6. collect counter packets long
7. exit
8. flow record record-name
9. match ipv4precedence
10. collect counter packets long
11. exit
12. flow monitor flow-monitor-name
13. record record-name
14. cache timeout active seconds
15. cache entries number
16. exit
17. flow monitor flow-monitor-name
18. record record-name
19. cache timeout active seconds
20. cache entries number
21. exit
22. interface type number
23. ip flow monitor monitor-name input
24. ip flow monitor monitor-name input
25. exit
26. show flow monitor monitor-name cache
27. show flow monitor monitor-name cache
28. clear flow monitor monitor-name cache
29. clear flow monitor monitor-name statistics
30. show flow monitor monitor-name cache format csv

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>Enters your password if prompted.</td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
</tr>
<tr>
<td>flow record record-name</td>
<td>Creates or modifies an existing Flexible NetFlow flow record, and enters Flexible NetFlow flow record configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config)# flow record ip-acct</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td></td>
</tr>
<tr>
<td>match ipv4 source address</td>
<td>Configures the IPv4 source address as a key field for a flow record.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config-flow-record)# match ipv4 source address</td>
<td></td>
</tr>
<tr>
<td>Step</td>
<td>Command or Action</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------</td>
</tr>
<tr>
<td>5</td>
<td><strong>match ipv4 destination address</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config-flow-record)# match ipv4 destination address</td>
</tr>
<tr>
<td>6</td>
<td><strong>collect counter packets long</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config-flow-record)# collect counter packets long</td>
</tr>
<tr>
<td>7</td>
<td><strong>exit</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config-flow-record)# exit</td>
</tr>
<tr>
<td>8</td>
<td><strong>flow record</strong> record-name</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# flow record prec-acct</td>
</tr>
<tr>
<td>9</td>
<td><strong>match ipv4 precedence</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config-flow-record) match ipv4 precedence</td>
</tr>
<tr>
<td>10</td>
<td><strong>collect counter packets long</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config-flow-record)# collect counter packets long</td>
</tr>
<tr>
<td>11</td>
<td><strong>exit</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config-flow-record)# exit</td>
</tr>
<tr>
<td>12</td>
<td><strong>flow monitor</strong> flow-monitor-name</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# flow monitor ip-acct</td>
</tr>
<tr>
<td>13</td>
<td><strong>record</strong> record-name</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config-flow-monitor)# record ip-acct</td>
</tr>
<tr>
<td>14</td>
<td><strong>cache timeout active</strong> seconds</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config-flow-monitor)# cache timeout active 604800</td>
</tr>
</tbody>
</table>

**Note**
Cisco IOS XE Releases do not support permanent cache, but allow cache timeout up to 7 days by configuring this command.
<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| 15   | `cache entries number` | Specifies the maximum number of entries in the flow monitor cache.  
Example:  
Device(config-flow-monitor)# cache entries 200000 |
| 16   | `exit` | Exits Flexible NetFlow flow monitor configuration mode and returns to global configuration mode.  
Example:  
Device(config-flow-monitor)# exit |
| 17   | `flow monitor flow-monitor-name` | Create or modifies an existing Flexible NetFlow flow monitor, and enters Flexible NetFlow flow monitor configuration mode.  
Example:  
Device(config)# flow monitor prec-acct |
| 18   | `record record-name` | Configures a user-defined flow record that was previously configured for a Flexible NetFlow flow monitor.  
Example:  
Device(config-flow-monitor)# record prec-acct |
| 19   | `cache timeout active seconds` | Specifies the active flow timeout, in seconds for the flow monitor.  
Example:  
Device(config-flow-monitor)# cache timeout active 604800  
**Note** Cisco IOS XE Releases do not support permanent cache, but allow cache timeout up to 7 days by configuring this command. |
| 20   | `cache entries number` | Specifies the maximum number of entries in the flow monitor cache.  
Example:  
Device(config-flow-monitor)# cache entries 200000 |
| 21   | `exit` | Exits Flexible NetFlow flow monitor configuration mode and returns to global configuration mode.  
Example:  
Device(config-flow-monitor)# exit |
| 22   | `interface type number` | Configures an interface and enters interface configuration mode.  
Example:  
Device(config)# interface GigabitEthernet 0/0/4 |
| 23   | `ip flow monitor monitor-name input` | Enables a Flexible NetFlow flow monitor for IPv4 traffic that the router is transmitting.  
Example:  
Device(config-if)# ip flow monitor ip-acct input |
| 24   | `ip flow monitor monitor-name input` | Enables a Flexible NetFlow flow monitor for IPv4 traffic that the router is transmitting.  
Example:  
Device(config-if)# ip flow monitor prec-acct input |
| 25   | `exit` | Exits interface configuration mode and returns to privileged EXEC mode.  
Example:  
Device(config-if)# exit |
### Configuration Examples for IP Services

#### Example: Protecting Your Network from DOS Attacks

The following example shows how to change some of the ICMP defaults for Gigabit Ethernet interface 0/0/0 to prevent ICMP from relaying information about paths, routes, and network conditions, which can be used by an attacker to gain network mapping information.

Disabling the unreachable messages will have a secondary effect: it will also disable IP Path MTU Discovery, because path discovery works by having the software send Unreachable messages. If you have a network segment with a small number of devices and an absolutely reliable traffic pattern—which could easily happen on a segment with a small number of rarely used user devices—you would be disabling options that your device would be unlikely to use anyway.

```
Device(config)# no ip source-route
Device(config)# interface GigabitEthernet 0/0/0
Device(config-if)# no ip unreachables
Device(config-if)# no ip redirects
Device(config-if)# no ip mask-reply
```
Example: Configuring ICMP Unreachable Destination Counters

The following example shows how to clear all of the unreachable destination packet statistics and to specify an interval number for unreachable destination messages. This example also shows how to configure a packet counter threshold and interval to trigger a logging message to a console.

Router# clear ip icmp rate-limit ethernet 0/0
Router# configure terminal
Router(config)# ip icmp rate-limit unreachable df log 1100 12000

Example: Setting the MTU Packet Size

The following example shows how to change the default MTU packet size for Gigabit Ethernet interface 0/0/0:

Device(config)# interface GigabitEthernet 0/0/0
Device(config-if)# ip mtu 300

Example: Configuring IP Accounting with NetFlow

The following example shows how to use NetFlow for IP Accounting:

! Created flow record and flow monitor for IP address accounting
Device(config)# configure terminal
Device(config)# flow record ip-acct
Device(config-flow-record)# match ipv4 source address
Device(config-flow-record)# match ipv4 destination address
Device(config-flow-record)# collect counter packets long
Device(config-flow-record)# exit
Device(config)# flow monitor ip-acct
Device(config-flow-monitor)# record ip-acct
Device(config-flow-monitor)# cache timeout active 604800
Device(config-flow-monitor)# cache entries 200000
Device(config-flow-monitor)# exit

! Created flow record and flow monitor for precedence accounting
Device(config)# flow record prec-acct
Device(config-flow-record)# match ipv4 precedence
Device(config-flow-record)# collect counter packets long
Device(config-flow-record)# exit
Device(config)# flow monitor prec-acct
Device(config-flow-monitor)# record prec-acct
Device(config-flow-monitor)# cache timeout active 604800
Device(config-flow-monitor)# cache entries 200000
Device(config-flow-monitor)# exit

! Apply both ip-acct and prec-acct on an interface
Device(config)# interface GigabitEthernet 0/0/4
Device(config-if)# ip address 192.0.2.1 255.255.255.0
Device(config-if)# ip flow monitor ip-acct input
Device(config-if)# ip flow monitor prec-acct input
Device(config-if)# negotiation auto
Device(config-if)# end
Verifying IP Accounting with NetFlow

SUMMARY STEPS

1. `show flow monitor monitor-name cache`
2. `show flow monitor monitor-name cache`
3. `clear flow monitor monitor-name {cache | force-export | statistics}`
4. `show flow monitor monitor-name format csv | append bootflash:monitor-name`

DETAILED STEPS

Step 1

`show flow monitor monitor-name cache`
Displays the contents of the cache for the flow monitor.

**Example:**

```
Device# show flow monitor prec-acct cache
```

<table>
<thead>
<tr>
<th>Cache type: Normal (Platform cache)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cache size: 200000</td>
</tr>
<tr>
<td>Current entries: 3</td>
</tr>
<tr>
<td>Flows added: 3</td>
</tr>
<tr>
<td>Flows aged: 0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IP PREC</th>
<th>pkts long</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>8117679</td>
</tr>
<tr>
<td>1</td>
<td>8118233</td>
</tr>
<tr>
<td>2</td>
<td>8118761</td>
</tr>
</tbody>
</table>

Step 2

`show flow monitor monitor-name cache`
Displays the contents of the cache for the flow monitor.

**Example:**

```
Device# show flow monitor ip-acct cache
```

<table>
<thead>
<tr>
<th>Cache type: Normal (Platform cache)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cache size: 200000</td>
</tr>
<tr>
<td>Current entries: 10</td>
</tr>
<tr>
<td>Flows added: 10</td>
</tr>
<tr>
<td>Flows aged: 0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IPV4 SRC ADDR</th>
<th>IPV4 DST ADDR</th>
<th>pkts long</th>
</tr>
</thead>
<tbody>
<tr>
<td>192.168.0.1</td>
<td>192.168.2.2</td>
<td>5987314</td>
</tr>
<tr>
<td>192.168.0.1</td>
<td>192.168.3.2</td>
<td>5987314</td>
</tr>
<tr>
<td>192.168.0.1</td>
<td>192.168.10.2</td>
<td>5987354</td>
</tr>
<tr>
<td>192.168.0.1</td>
<td>192.168.1.2</td>
<td>5987363</td>
</tr>
<tr>
<td>192.168.0.1</td>
<td>192.168.8.2</td>
<td>5987384</td>
</tr>
<tr>
<td>192.168.0.1</td>
<td>192.168.7.2</td>
<td>5987387</td>
</tr>
<tr>
<td>192.168.0.1</td>
<td>192.168.6.2</td>
<td>5987420</td>
</tr>
<tr>
<td>192.168.0.1</td>
<td>192.168.9.2</td>
<td>5987606</td>
</tr>
<tr>
<td>192.168.0.1</td>
<td>192.168.5.2</td>
<td>5987645</td>
</tr>
</tbody>
</table>
### Step 3

**clear flow monitor monitor-name {cache | force-export | statistics}**

Clears the flow monitor cache information.

**Example:**

```
Device# clear flow monitor ip-acct cache
```

### Step 4

**show flow monitor monitor-name format csv | append bootflash:monitor-name**

Displays output of statistics from the flows in a flow monitor cache in comma-separated variables (CSV) format.

**Example:**

```
Device# show flow monitor ip-acct cache format csv | append bootflash:ip-acct
```

---

### Additional References For IP Services

#### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Commands List, All Releases</td>
</tr>
<tr>
<td>IP application services commands</td>
<td>Cisco IOS IP Application Services Command Reference</td>
</tr>
</tbody>
</table>

#### Standards and RFCs

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFC 1256</td>
<td>ICMP Router Discovery Messages</td>
</tr>
</tbody>
</table>

#### Technical Assistance

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
</tr>
</tbody>
</table>
Feature Information for IP Services

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.
Object Tracking: IPv6 Route Tracking

The Object Tracking: IPv6 Route Tracking feature expands the Enhanced Object Tracking (EOT) functionality to allow the tracking of IPv6 routes.

- Finding Feature Information, on page 49
- Restrictions for Object Tracking: IPv6 Route Tracking, on page 49
- Information About Object Tracking: IPv6 Route Tracking, on page 50
- How to Configure Object Tracking: IPv6 Route Tracking, on page 50
- Configuration Examples for Object Tracking: IPv6 Route Tracking, on page 54
- Additional References for Object Tracking: IPv6 Route Tracking, on page 55
- Feature Information for Object Tracking: IPv6 Route Tracking, on page 56

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and 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 table.

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

Restrictions for Object Tracking: IPv6 Route Tracking

Object Tracking: IPv6 Route Tracking is not Stateful Switchover (SSO)-aware and cannot be used with Hot Standby Router Protocol (HSRP), Virtual Router Redundancy Protocol (VRRP), or Gateway Load Balancing Protocol (GLBP) in SSO mode.
Information About Object Tracking: IPv6 Route Tracking

Enhanced Object Tracking and IPv6 Route Tracking

Enhanced Object Tracking (EOT) provides complete separation between the objects to be tracked and the action to be taken by a client when a tracked object changes. Thus, several clients such as Hot Standby Router Protocol (HSRP), Virtual Router Redundancy Protocol (VRRP), or Gateway Load Balancing Protocol (GLBP) can register interest with a tracking process, track the same object, and each take different action when the object changes.

Each tracked object is identified by a unique number that is specified on the tracking CLI. Client processes use this number to track a specific object.

A tracking process periodically polls tracked objects and notes any change in value. The changes in the tracked object are communicated to interested client processes, either immediately or after a specified delay. The object values are reported as either up or down.

The Object Tracking: IPv6 Route Tracking feature expands EOT functionality to allow the tracking of IPv6 routes.

How to Configure Object Tracking: IPv6 Route Tracking

Tracking the IPv6-Routing State of an Interface

SUMMARY STEPS

1. track timer interface {seconds | msec milliseconds}
2. track object-number interface type number ipv6 routing
delay
4. delay {up seconds [down seconds] | [up seconds] down seconds}
5. end
6. show track object-number

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> track timer interface {seconds</td>
<td>msec milliseconds}</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# track timer interface 5</td>
<td>• The default interval that the tracking process polls interface objects is 1 second.</td>
</tr>
</tbody>
</table>

**Note** All polling frequencies can be configured down to 500 milliseconds, overriding the minimum 1-second interval configured using the msec keyword and milliseconds argument.
### Purpose

Command or Action | Purpose
--- | ---
**Step 2** | **track object-number interface type number ipv6 routing**
**Example:**
Device(config)# track 1 interface GigabitEthernet 0/0/1 ipv6 routing

Tracks the IPv6-routing state of an interface and enters tracking configuration mode.

- IPv6-router tracking tracks an IPv6 route in the routing table and the ability of an interface to route IPv6 packets.

**Step 3** | **carrier-delay**
**Example:**
Device(config-track)# carrier-delay

(Optional) Enables enhanced object tracking to consider the carrier-delay timer when tracking the status of an interface.

**Step 4** | **delay {up seconds [down seconds] | [up seconds] down seconds}**
**Example:**
Device(config-track)# delay up 30

(Optional) Specifies a period of time (in seconds) to delay communicating state changes of a tracked object.

**Note**

The **up** keyword specifies the time to delay the notification of an up event. The **down** keyword specifies the time to delay the notification of a down event.

**Step 5** | **end**
**Example:**
Device(config-track)# end

Returns to privileged EXEC mode.

**Step 6** | **show track object-number**
**Example:**
Device# show track 1

Displays tracking information.

- Use this command to verify the configuration.

### Tracking the Threshold of IPv6-Route Metrics

**SUMMARY STEPS**

1. **track timer ipv6 route** `{seconds | msec milliseconds}`
2. **track resolution ipv6 route** `{bgp | eigrp | isis | ospf | static}` `{resolution-value}`
3. **track object-number ipv6 route ipv6-address/prefix-length metric threshold**
4. **delay {up seconds [down seconds] | [up seconds] down seconds}**
5. **ipv6 vrf vrf-name**
6. **threshold metric** `{up number [down number] | down number [up number ]}`
7. **end**
8. **show track object-number**
**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> track timer ipv6 route {seconds | msec milliseconds}</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td>(Optional) Specifies the interval that a tracking process polls the tracked object.</td>
</tr>
<tr>
<td>Device(config)# track timer ipv6 route 20</td>
<td>• The default interval that the tracking process polls IPv6-route objects is 15 seconds.</td>
</tr>
<tr>
<td><strong>Step 2</strong> track resolution ipv6 route {bgp | eigrp | isis | ospf | static} resolution-value</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td>(Optional) Specifies resolution parameters for a tracked object.</td>
</tr>
<tr>
<td>Device(config)# track resolution ipv6 route eigrp 300</td>
<td>• Use this command to change the default metric resolution values.</td>
</tr>
<tr>
<td><strong>Step 3</strong> track object-number ipv6 route ipv6-address/prefix-length metric threshold</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td>Tracks the scaled metric value of an IPv6 route to determine if it is above or below a threshold and enters tracking configuration mode.</td>
</tr>
<tr>
<td>Device(config)# track 6 ipv6 route 2001:DB8:0:ABCD::1/10 metric threshold</td>
<td>• The default down value is 255, which equates to an inaccessible route.</td>
</tr>
<tr>
<td></td>
<td>• The default up value is 254.</td>
</tr>
<tr>
<td><strong>Step 4</strong> delay {up seconds [down seconds]\</td>
<td>[up seconds] down seconds}</td>
</tr>
<tr>
<td>Example:</td>
<td>(Optional) Specifies a period of time (in seconds) to delay communicating state changes of a tracked object.</td>
</tr>
<tr>
<td>Device(config-track)# delay up 30</td>
<td>Note The up keyword specifies the time to delay the notification of an up event. The down keyword specifies the time to delay the notification of a down event.</td>
</tr>
<tr>
<td><strong>Step 5</strong> ipv6 vrf vrf-name</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td>(Optional) Tracks an IPv6 route in a specific VPN virtual routing and forwarding (VRF) table.</td>
</tr>
<tr>
<td>Device(config-track)# ipv6 vrf VRF1</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> threshold metric {up number [down number]\</td>
<td>down number [up number]}</td>
</tr>
<tr>
<td>Example:</td>
<td>(Optional) Sets a metric threshold other than the default value.</td>
</tr>
</tbody>
</table>
```
Device(config-track)# threshold metric up 254 down 255
```

The `up` keyword specifies the up threshold. The state is up if the scaled metric for that route is less than or equal to the up threshold. The default up threshold is 254. The `down` keyword specifies the down threshold. The state is down if the scaled metric for that route is greater than or equal to the down threshold. The default down threshold is 255.

### Step 7

**end**

**Example:**
```
Device(config-track)# end
```

Returns to privileged EXEC mode.

### Step 8

**show track object-number**

**Example:**
```
Device# show track 6
```

(Optional) Displays tracking information.

- Use this command to verify the configuration.

---

## Tracking IPv6-Route Reachability

Perform this task to track the reachability of an IPv6 route. A tracked object is considered up when a routing table entry exists for the route and the route is accessible.

### SUMMARY STEPS

1. `track timer ipv6 route {seconds | msec milliseconds}`
2. `track object-number ip route ip-address/prefix-length reachability`
3. `delay {up seconds [down seconds] | [up seconds] down seconds}`
4. `ipv6 vrf vrf-name`
5. `end`
6. `show track object-number`

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> `track timer ipv6 route {seconds</td>
<td>msec milliseconds}`</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# track timer ipv6 route 20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The default interval that the tracking process polls IPv6-route objects is 15 seconds.</td>
</tr>
<tr>
<td></td>
<td><strong>Note</strong> All polling frequencies can be configured down to 500 milliseconds, overriding the minimum 1-second interval configured using the <code>msec</code> keyword and <code>milliseconds</code> argument.</td>
</tr>
</tbody>
</table>
### Configuration Examples for Object Tracking: IPv6 Route Tracking

#### Example: Tracking the IPv6-Routing State of an Interface

The following example shows how to configure tracking for IPv6 routing on the GigabitEthernet 0/0/1 interface:

```plaintext
Device(config)# track timer interface 5
Device(config)# track 1 interface GigabitEthernet 0/0/1 ipv6 routing
Device(config-track)# carrier-delay
Device(config-track)# delay up 30
Device(config-track)# end
```
Example: Tracking the Threshold of IPv6-Route Metrics

The following example shows how to configure tracking for IPv6 metric thresholds:

```plaintext
Device(config)# track timer ipv6 route 20
Device(config)# track resolution ipv6 route eigrp 300
Device(config)# track 6 ipv6 route 2001:DB8:0:ABCD::1/10 metric threshold
Device(config-track)# delay up 30
Device(config-track)# ipv6 vrf VRF1
Device(config-track)# threshold metric up 254 down 255
Device(config-track)# end
```

Example: Tracking IPv6-Route Reachability

The following example shows how to configure tracking for IPv6-route reachability:

```plaintext
Device(config)# track timer ipv6 route 20
Device(config)# track 4 ipv6 route 2001:DB8:0:AB82::1/10 reachability
Device(config-track)# delay up 30
Device(config-track)# ipv6 vrf VRF2
Device(config-track)# end
```

Additional References for Object Tracking: IPv6 Route Tracking

### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Command List, All Releases</td>
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<tr>
<td>Object tracking</td>
<td>Configuring Enhanced Object Tracking</td>
</tr>
<tr>
<td>IP Application Services commands</td>
<td>Cisco IOS IP Application Services Command Reference</td>
</tr>
</tbody>
</table>

### Technical Assistance

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Cisco Support website provides extensive online resources, including</td>
<td><a href="http://www.cisco.com/support">http://www.cisco.com/support</a></td>
</tr>
<tr>
<td>documentation and tools for troubleshooting and resolving technical issues</td>
<td></td>
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<tr>
<td>with Cisco products and technologies.</td>
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<tr>
<td>To receive security and technical information about your products, you</td>
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<tr>
<td>can subscribe to various services, such as the Product Alert Tool (accessed</td>
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<tr>
<td>from Field Notices), the Cisco Technical Services Newsletter, and Really</td>
<td></td>
</tr>
<tr>
<td>Simple Syndication (RSS) Feeds.</td>
<td></td>
</tr>
<tr>
<td>Access to most tools on the Cisco Support website requires a Cisco.com user</td>
<td></td>
</tr>
<tr>
<td>ID and password.</td>
<td></td>
</tr>
</tbody>
</table>
Feature Information for Object Tracking: IPv6 Route Tracking

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

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

Table 4: Feature Information for Object Tracking: IPv6 Route Tracking

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object Tracking: IPv6 Route Tracking</td>
<td></td>
<td>This feature expands Enhanced Object Tracking (EOT) functionality to allow the tracking of IPv6 routes.</td>
</tr>
</tbody>
</table>
IPv6 Static Route Support for Object Tracking

The IPv6 Static Route Support for Object Tracking feature allows an IPv6 static route to be associated with a tracked-object. A static route is only inserted into the routing information base (RIB) when the tracked object is reachable.

This module provides an overview of the feature and explains how to configure it.

- Finding Feature Information, on page 57
- Information About IPv6 Static Route Support for Object Tracking, on page 57
- How to Configure IPv6 Static Route Support for Object Tracking, on page 58
- Configuration Examples for IPv6 Static Route Support for Object Tracking, on page 60
- Additional References for IPv6 Static Route Support for Object Tracking, on page 60
- Feature Information for IPv6 Static Route Support for Object Tracking, on page 61

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and 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 table.

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Information About IPv6 Static Route Support for Object Tracking

IPv6 Static Route Support for Object Tracking Overview

Object tracking allows you to track specific objects on a device, such as the interface line protocol state, IP routing, and route reachability, and to take action when the tracked object's state changes. Tracking allows software clients to register interest in the behavior of an object, and receive notifications of changes. This object represents the state of the system functionality such as the status of an interface (up or down), the existence of an IP prefix in the Routing Information Base (RIB) and so on.

An IPv6 static route creates a tracked object-context for each tracked object. Tracked object contexts are stored in an AVL list that is maintained by the IPv6 static route and indexed by the object number. A
tracked-object context is removed from the AVL list when the object is no longer associated with any IPv6 static routes. All IPv6 static routes associated with a tracked object is linked to the tracked object context by an indirect list. An IPv6 static route becomes a client of the tracked objects, and this allows the IPv6 static route to track the state of a tracked object. The `ipv6 route` command allows an IPv6 static route to be associated with a tracked object.

**Routing Table Insertion**

An IPv6 static route associated with a tracked-object is inserted into the IPv6 routing table if the state of the tracked-object is up and all other routing-table-insertion criteria are met.

The IPv6 Static Route Object Tracking feature uses the IPv6 static deferred state check mechanism to insert or delete a static route into or from the Routing Information Base (RIB). A change in the state of the tracked object is signaled from tracked objects and this causes IPv6 static to insert all IPv6 static routes associated with the tracked object into the state check queue (unless they are already in it). A separate process removes IPv6 static routes from the state check queue and determines whether these routes should be inserted into the RIB or removed from the RIB using the RIB insertion criteria.

**Routing Table Insertion Criteria**

The following insertion criteria must be met for an IPv6 static route to be inserted into the IPv6 routing table:

1. Interface is up.
2. Next-hop address is not the device's own address.
3. Next-hop address is resolved.
4. Bidirectional Forwarding Detection (BFD) session is up, if BFD tracking is configured.
5. Tracked object state is up.

An IPv6 static route in the routing table is removed if any of the insertion criteria becomes false.

**How to Configure IPv6 Static Route Support for Object Tracking**

**Configuring the IPv6 Static Routing Support for Object Tracking**

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `ipv6 route vrf table-name-id ipv6-prefix {interface-type interface-number [next-hop-ipv6-address] | next-hop-ipv6-address} [admin-distance [multicast-vrf-distance]] [multicast] [nexthop-vrf table-name-id] [unicast] [tag tag-value] [track object-number] name static-route`
### IPv6 Static Route Support for Object Tracking

#### Configuring the IPv6 Static Routing Support for Object Tracking

4. `end`
5. `show track object-number`
6. `show ipv6 static vrf id`

#### Detailed Steps

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> ipv6 route vrf</td>
<td>Establishes static IPv6 routes for all VPN routing and forwarding (VRF) instance tables or a specific VRF table for IPv4 or IPv6 address.</td>
</tr>
<tr>
<td>Table-name-id ipv6-prefix interface-type</td>
<td>• Configure the IPv6 static route object tracking to the static route configuration by using the <code>track</code> command.</td>
</tr>
<tr>
<td>interface-number next-hop-ipv6-address</td>
<td></td>
</tr>
<tr>
<td>[admin-distance [multicast-vrf-distance]]</td>
<td></td>
</tr>
<tr>
<td>[multicast] [nexthop-vrf table-name-id]</td>
<td></td>
</tr>
<tr>
<td>[unicast] [tag tag-value] [track object-number] namestate-route</td>
<td></td>
</tr>
<tr>
<td>Example: Device(config)# ipv6 route vrf 3 2001:DB8:1:2::/64 GigabitEthernet0/0 2001:DB8:3:4::1 track 42</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> end</td>
<td>Exits global configuration mode and returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device(config)# end</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> show track object-number</td>
<td>Displays information about objects that are tracked by the tracking process.</td>
</tr>
<tr>
<td>Example: Device# show track 42</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> show ipv6 static vrf id</td>
<td>Displays static routes that are added to the routing-table, and the reasons if a static route is not added.</td>
</tr>
<tr>
<td>Example: Device(config)# show ipv6 static vrf 3</td>
<td></td>
</tr>
</tbody>
</table>

#### Example

The following is sample output from the `show track` command:

Device# show track 42
Track 42
IP route 10.21.12.0 255.255.255.0 reachability
  Reachability is Down (no ip route), delayed Up (1 sec remaining) (connected)
  1 change, last change 00:00:24
  Delay up 20 secs, down 10 secs
  First-hop interface is unknown (was GigabitEthernet1/0)
  Tracked by:
    HSRP GigabitEthernet0/0 3

Configuration Examples for IPv6 Static Route Support for Object Tracking

Example: IPv6 Static Route Object Tracking

The following example associates the static route 2001:DB8:1:2::/64 with the state of tracked-object number 42. The static route is inserted in the IPv6 routing table if the state of tracked-object number 42 is up.

Device> enable
Device# configure terminal
Device(config)# ipv6 route vrf 3 2001:DB8:1:2::/64 GigabitEthernet0/0 2001:DB8:3:4::1 track 42
Device(config)# end

Additional References for IPv6 Static Route Support for Object Tracking

Related Documents

<table>
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<tr>
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</tr>
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</tbody>
</table>
Technical Assistance

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</td>
<td><a href="http://www.cisco.com/support">http://www.cisco.com/support</a></td>
</tr>
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Feature Information for IPv6 Static Route Support for Object Tracking

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<table>
<thead>
<tr>
<th>Feature Name</th>
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</tr>
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<tbody>
<tr>
<td>IPv6 Static Route Support for Object Tracking</td>
<td></td>
<td>This feature expands Enhanced Object Tracking (EOT) functionality to allow the object tracking for IPv6 static routes.</td>
</tr>
</tbody>
</table>
Configuring TCP

TCP is a protocol that specifies the format of data and acknowledgments used in data transfer. TCP is a connection-oriented protocol because participants must establish a connection before data can be transferred. By performing flow control and error correction, TCP guarantees reliable, in-sequence delivery of packets. TCP is considered a reliable protocol because it will continue to request an IP packet that is dropped or received out of order until it is received. This module explains concepts related to TCP and how to configure TCP in a network.

- Finding Feature Information, on page 63
- Prerequisites for TCP, on page 63
- Information About TCP, on page 64
- How to Configure TCP, on page 68
- Configuration Examples for TCP, on page 76
- Additional References, on page 80
- Feature Information for TCP, on page 81

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and 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 table.

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Prerequisites for TCP

TCP Time Stamp, TCP Selective Acknowledgment, and TCP Header Compression

Because TCP time stamps are always sent and echoed in both directions and the time-stamp value in the header is always changing, TCP header compression will not compress the outgoing packet. To allow TCP header compression over a serial link, the TCP time-stamp option is disabled. If you want to use TCP header compression over a serial line, TCP time stamp and TCP selective acknowledgment must be disabled. Both features are disabled by default. Use the no ip tcp selective-ack command to disable the TCP selective acknowledgment once it is enabled.
Information About TCP

TCP Services

TCP provides reliable transmission of data in an IP environment. TCP corresponds to the transport layer (Layer 4) of the Open Systems Interconnection (OSI) reference model. Among the services that TCP provides are stream data transfer, reliability, efficient flow control, full-duplex operation, and multiplexing.

With stream data transfer, TCP delivers an unstructured stream of bytes that are identified by sequence numbers. This service benefits applications because they do not have to divide data into blocks before handing it off to TCP. Instead, TCP groups bytes into segments and passes them to IP for delivery.

TCP offers reliability by providing connection-oriented, end-to-end reliable packet delivery through an internetwork. It does this by sequencing bytes with a forwarding acknowledgment number that indicates to the destination the next byte that the source expects to receive. Bytes that are not acknowledged within a specified time period are retransmitted. The reliability mechanism of TCP allows devices to handle lost, delayed, duplicate, or misread packets. A timeout mechanism allows devices to detect lost packets and request retransmission.

TCP offers efficient flow control, which means that the receiving TCP process indicates the highest sequence number that it can receive without overflowing its internal buffers when sending acknowledgments back to the source.

TCP offers full-duplex operation, and TCP processes can both send and receive data at the same time.

TCP multiplexing allows numerous simultaneous upper-layer conversations to be multiplexed over a single connection.

TCP Connection Establishment

To use reliable transport services, TCP hosts must establish a connection-oriented session with one another. Connection establishment is performed by using a “three-way handshake” mechanism.

A three-way handshake synchronizes both ends of a connection by allowing both sides to agree upon the initial sequence numbers. This mechanism guarantees that both sides are ready to transmit data. The three-way handshake is necessary so that packets are not transmitted or retransmitted during session establishment or after session termination.

Each host randomly chooses a sequence number, which is used to track bytes within the stream that the host is sending. The three-way handshake proceeds in the following manner:

- The first host (Host A) initiates a connection by sending a packet with the initial sequence number (X) and the synchronize/start (SYN) bit set to indicate a connection request.
- The second host (Host B) receives the SYN, records the sequence number X, and replies by acknowledging (ACK) the SYN (with an ACK = X + 1). Host B includes its own initial sequence number (SEQ = Y). An ACK = 20 means that the host has received bytes 0 through 19 and expects byte 20 next. This technique is called forward acknowledgment.
- Host A acknowledges all bytes that Host B has sent with a forward acknowledgment indicating the next byte Host A expects to receive (ACK = Y + 1). Data transfer can then begin.
TCP Connection Attempt Time

You can set the amount of time the software will wait before attempting to establish a TCP connection. The connection attempt time is a host parameter and pertains to traffic that originated at the device and not to traffic going through the device. To set the TCP connection attempt time, use the `ip tcp synwait-time` command in global configuration mode. The default is 30 seconds.

TCP Selective Acknowledgment

The TCP Selective Acknowledgment feature improves performance if multiple packets are lost from one TCP window of data.

Prior to this feature, because of limited information available from cumulative acknowledgments, a TCP sender could learn about only one lost packet per-round-trip time. An aggressive sender could choose to resend packets early, but such re-sent segments might have already been successfully received.

The TCP selective acknowledgment mechanism helps improve performance. The receiving TCP host returns selective acknowledgment packets to the sender, informing the sender of data that has been received. In other words, the receiver can acknowledge packets received out of order. The sender can then resend only missing data segments (instead of everything since the first missing packet).

Prior to selective acknowledgment, if TCP lost packets 4 and 7 out of an 8-packet window, TCP would receive acknowledgment of only packets 1, 2, and 3. Packets 4 through 8 would need to be re-sent. With selective acknowledgment, TCP receives acknowledgment of packets 1, 2, 3, 5, 6, and 8. Only packets 4 and 7 must be re-sent.

TCP selective acknowledgment is used only when multiple packets are dropped within one TCP window. There is no performance impact when the feature is enabled but not used. Use the `ip tcp selective-ack` command in global configuration mode to enable TCP selective acknowledgment.

Refer to RFC 2018 for more details about TCP selective acknowledgment.

TCP Time Stamp

The TCP time-stamp option provides improved TCP round-trip time measurements. Because the time stamps are always sent and echoed in both directions and the time-stamp value in the header is always changing, TCP header compression will not compress the outgoing packet. To allow TCP header compression over a serial link, the TCP time-stamp option is disabled. Use the `ip tcp timestamp` command to enable the TCP time-stamp option.

Refer to RFC 1323 for more details on TCP time stamps.

TCP Maximum Read Size

The maximum number of characters that TCP reads from the input queue for Telnet and relogin at one time is very large (the largest possible 32-bit positive number) by default. To change the TCP maximum read size value, use the `ip tcp chunk-size` command in global configuration mode.

Note

We do not recommend that you change this value.
TCP Path MTU Discovery

Path MTU Discovery is a method for maximizing the use of the available bandwidth in the network between endpoints of a TCP connection, which is described in RFC 1191. IP Path MTU Discovery allows a host to dynamically discover and cope with differences in the maximum allowable maximum transmission unit (MTU) size of the various links along the path. Sometimes a device is unable to forward a datagram because it requires fragmentation (the packet is larger than the MTU that you set for the interface with the `interface configuration` command), but the “do not fragment” (DF) bit is set. The intermediate gateway sends a “Fragmentation needed and DF bit set” Internet Control Message Protocol (ICMP) message to the sending host, alerting the host to the problem. On receiving this message, the host reduces its assumed path MTU and consequently sends a smaller packet that will fit the smallest packet size of all links along the path.

By default, TCP Path MTU Discovery is disabled. Existing connections are not affected irrespective of whether this feature is enabled or disabled.

Customers using TCP connections to move bulk data between systems on distinct subnets would benefit most by enabling this feature. Customers using remote source-route bridging (RSRB) with TCP encapsulation, serial tunnel (STUN), X.25 Remote Switching (also known as XOT or X.25 over TCP), and some protocol translation configurations might also benefit from enabling this feature.

Use the `ip tcp path-mtu-discovery` global configuration command to enable Path MTU Discovery for connections initiated by the device when the device is acting as a host.

For more information about Path MTU Discovery, refer to the “Configuring IP Services” module of the IP Application Services Configuration Guide.

TCP Window Scaling

The TCP Window Scaling feature adds support for the Window Scaling option in RFC 1323, TCP Extensions for High Performance. A larger window size is recommended to improve TCP performance in network paths with large bandwidth-delay product characteristics that are called Long Fat Networks (LFNs). The TCP Window Scaling enhancement provides LFN support.

The window scaling extension expands the definition of the TCP window to 32 bits and then uses a scale factor to carry this 32-bit value in the 16-bit window field of the TCP header. The window size can increase to a scale factor of 14. Typical applications use a scale factor of 3 when deployed in LFNs.

The TCP Window Scaling feature complies with RFC 1323. The maximum window size was increased to 1,073,741,823 bytes. The larger scalable window size will allow TCP to perform better over LFNs. Use the `ip tcp window-size` command in global configuration mode to configure the TCP window size.

TCP Sliding Window

A TCP sliding window provides an efficient use of network bandwidth because it enables hosts to send multiple bytes or packets before waiting for an acknowledgment.

In TCP, the receiver specifies the current window size in every packet. Because TCP provides a byte-stream connection, window sizes are expressed in bytes. A window is the number of data bytes that the sender is allowed to send before waiting for an acknowledgment. Initial window sizes are indicated at connection setup, but might vary throughout the data transfer to provide flow control. A window size of zero means “Send no data.” The default TCP window size is 4128 bytes. We recommend that you keep the default value unless your device is sending large packets (greater than 536 bytes). Use the `ip tcp window-size` command to change the default window size.
In a TCP sliding-window operation, for example, the sender might have a sequence of bytes to send (numbered 1 to 10) to a receiver who has a window size of five. The sender then places a window around the first five bytes and transmits them together. The sender then waits for an acknowledgment.

The receiver responds with an ACK = 6, indicating that it has received bytes 1 to 5 and is expecting byte 6 next. In the same packet, the receiver indicates that its window size is 5. The sender then moves the sliding window five bytes to the right and transmits bytes 6 to 10. The receiver responds with an ACK = 11, indicating that it is expecting sequenced byte 11 next. In this packet, if the receiver indicates that its window size is 0, the sender cannot send any more bytes until the receiver sends another packet with a window size greater than 0.

**TCP Outgoing Queue Size**

The default TCP outgoing queue size per connection is five segments if the connection has a TTY associated with it (such as a Telnet connection). If no TTY connection is associated with a connection, the default queue size is 20 segments. Use the `ip tcp queuemax` command to change the five-segment default value.

**TCP MSS Adjustment**

The TCP MSS Adjustment feature enables the configuration of the maximum segment size (MSS) for transient packets that traverse a device, specifically TCP segments with the SYN bit set. Use the `ip tcp adjust-mss` command in interface configuration mode to specify the MSS value on the intermediate device of the SYN packets to avoid truncation.

When a host (usually a PC) initiates a TCP session with a server, the host negotiates the IP segment size by using the MSS option field in the TCP SYN packet. The value of the MSS field is determined by the MTU configuration on the host. The default MSS value for a PC is 1500 bytes.

The PPP over Ethernet (PPPoE) standard supports a Maximum Transmission Unit (MTU) of only 1492 bytes. The disparity between the host and PPPoE MTU size can cause the device in between the host and the server to drop 1500-byte packets and terminate TCP sessions over the PPPoE network. Even if the path MTU (which detects the correct MTU across the path) is enabled on the host, sessions may be dropped because system administrators sometimes disable ICMP error messages that must be relayed from the host for path MTU to work.

The `ip tcp adjust-mss` command helps prevent TCP sessions from being dropped by adjusting the MSS value of the TCP SYN packets.

The `ip tcp adjust-mss` command is effective only for TCP connections passing through the device.

In most cases, the optimum value for the `max-segment-size` argument of the `ip tcp adjust-mss` command is 1452 bytes. This value plus the 20-byte IP header, the 20-byte TCP header, and the 8-byte PPPoE header add up to a 1500-byte packet that matches the MTU size for the Ethernet link.

See the “Configuring the MSS Value and MTU for Transient TCP SYN Packets” section for configuration instructions.

**TCP Applications Flags Enhancement**

The TCP Applications Flags Enhancement feature enables the user to display additional flags with reference to TCP applications. There are two types of flags: status and option. The status flags indicate the status of TCP connections such as passive open, active open, retransmission timeout, and app closed for listening. The additional flags indicate the state of set options such as whether a VPN routing and forwarding instance (VRF)
is set, whether a user is idle, and whether a keepalive timer is running. Use the `show tcp` command to display TCP application flags.

**TCP Show Extension**

The TCP Show Extension feature introduces the capability to display addresses in IP format instead of the hostname format and to display the VRF table associated with the connection. To display the status for all endpoints with addresses in IP format, use the `show tcp brief numeric` command.

**TCP MIB for RFC 4022 Support**

The TCP MIB for RFC 4022 Support feature introduces support for RFC 4022, *Management Information Base for the Transmission Control Protocol (TCP)*. RFC 4022 is an incremental change of the TCP MIB to improve the manageability of TCP.

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

**Zero-Field TCP Packets**

Prior to Cisco IOS XE Release 2.5, when a zero-field TCP packet is received on the router, the TCP packet counter is incremented.

In Cisco IOS XE Release 2.5 and later releases, when a zero-field TCP packet is received on the router, the TCP packet counter is not incremented.

When a zero-field TCP packet is received, it is displayed as 0 under the TCP statistics field when the `show ip traffic` command is configured. When the `debug ip tcp packet` command is configured, and a zero-field TCP packet is received, a debug message similar to the following is displayed:


**How to Configure TCP**

**Configuring TCP Performance Parameters**

**Before you begin**

Both sides of the network link must be configured to support window scaling or the default of 65,535 bytes will be applied as the maximum window size. To support Explicit Congestion Notification (ECN), the remote peer must be ECN-enabled because the ECN capability is negotiated during a three-way handshake with the remote peer.

**SUMMARY STEPS**

1. `enable`
2. configure terminal
3. ip tcp synwait-time *seconds*
4. ip tcp path-mtu-discovery [age-timer {minutes | infinite}]
5. ip tcp selective-ack
6. ip tcp timestamp
7. ip tcp chunk-size *characters*
8. ip tcp window-size *bytes*
9. ip tcp ecn
10. ip tcp queuemax *packets*
11. end

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** enable | Enables privileged EXEC mode.  
Example:  
Device> enable |  
| **Step 2** configure terminal | Enters global configuration mode.  
Example:  
Device# configure terminal |  
| **Step 3** ip tcp synwait-time *seconds* | (Optional) Sets the amount of time the Cisco software will wait before attempting to establish a TCP connection.  
Example:  
Device(config)# ip tcp synwait-time 60 |  
| **Step 4** ip tcp path-mtu-discovery [age-timer {minutes | infinite}] | (Optional) Enables Path MTU Discovery.  
Example:  
Device(config)# ip tcp path-mtu-discovery age-timer 11 |  
| **Step 5** ip tcp selective-ack | (Optional) Enables TCP selective acknowledgment.  
Example:  
Device(config)# ip tcp selective-ack |  
| **Step 6** ip tcp timestamp | (Optional) Enables the TCP time stamp.  
Example:  
Device(config)# ip tcp timestamp |  
| **Step 7** ip tcp chunk-size *characters* | (Optional) Sets the TCP maximum read size for Telnet or rlogin.  
Example: |
### Configuring the MSS Value and MTU for Transient TCP SYN Packets

Perform this task to configure the maximum size segment (MSS) for transient packets that traverse a device, specifically TCP segments with the SYN bit set, and to configure the MTU size of IP packets.

If you are configuring the `ip mtu` command on the same interface as the `ip tcp adjust-mss` command, we recommend that you use the following commands and values:

- `ip tcp adjust-mss 1452`
- `ip mtu 1492`

### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `interface type number`
4. `ip tcp adjust-mss max-segment-size`
5. `ip mtu bytes`
6. `end`
**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** enable | Enables privileged EXEC mode.  
  Example:  
  Device> enable |
| **Step 2** configure terminal | Enters global configuration mode.  
  Example:  
  Device# configure terminal |
| **Step 3** interface type number | Configures an interface type and enters interface configuration mode.  
  Example:  
  Device(config)# interface GigabitEthernet 1/0/0 |
| **Step 4** ip tcp adjust-mss max-segment-size | Adjusts the MSS value of TCP SYN packets going through a device.  
  Example:  
  Device(config-if)# ip tcp adjust-mss 1452  
  • The max-segment-size argument is the maximum segment size, in bytes. The range is from 500 to 1460. |
| **Step 5** ip mtu bytes | Sets the MTU size of IP packets, in bytes, sent on an interface.  
  Example:  
  Device(config-if)# ip mtu 1492 |
| **Step 6** end | Exits to global configuration mode.  
  Example:  
  Device(config-if)# end |

**Configuring the MSS Value for IPv6 Traffic**

Perform this task to configure the maximum size segment (MSS) for transient packets that traverse a device, specifically TCP segments with the DF bit set in IPv6 network layer (IP) header.

**SUMMARY STEPS**

1. enable  
2. configure terminal  
3. interface type number  
4. ipv6 tcp adjust-mss max-segment-size  
5. end

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
</tbody>
</table>
### Command or Action

<table>
<thead>
<tr>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Enter your password if prompted.</td>
</tr>
</tbody>
</table>

**Step 2**

**Example:**

Device> enable

Enters global configuration mode.

<table>
<thead>
<tr>
<th>Command or Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>configure terminal</td>
</tr>
</tbody>
</table>

**Step 3**

**Example:**

Device# configure terminal

Configures an interface type and enters interface configuration mode.

<table>
<thead>
<tr>
<th>Command or Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>interface type number</td>
</tr>
</tbody>
</table>

**Step 4**

**Example:**

Device(config)# interface GigabitEthernet 1/0/0

Adjusts the MSS value of TCP DF packets going through a device.

<table>
<thead>
<tr>
<th>Command or Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>ip6 tcp adjust-mss max-segment-size</td>
</tr>
</tbody>
</table>

**Step 5**

**Example:**

Device(config-if)# end

Exits interface configuration mode and returns to privileged EXEC mode.

<table>
<thead>
<tr>
<th>Command or Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>end</td>
</tr>
</tbody>
</table>

### Verifying TCP Performance Parameters

**SUMMARY STEPS**

1. show tcp [line-number] [tcb address]
2. show tcp brief [all | numeric]
3. debug ip tcp transactions
4. debug ip tcp congestion

**DETAILED STEPS**

**Step 1**

**Example:**

Device# show tcp tcb 0x62CD2BB8

Displays the status of TCP connections. The arguments and keyword are as follows:

- **line-number**—(Optional) Absolute line number of the Telnet connection status.
- **tcb**—(Optional) Transmission control block (TCB) of the Explicit Congestion Notification (ECN)-enabled connection.
- **address**—(Optional) TCB hexadecimal address. The valid range is from 0x0 to 0xFFFFFFFF.
Connection state is LISTEN, I/O status: 1, unread input bytes: 0
Connection is ECN enabled
Local host: 10.10.10.1, Local port: 179
Foreign host: 10.10.10.2, Foreign port: 12000
Enqueued packets for retransmit: 0, input: 0 mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x4F31940):

<table>
<thead>
<tr>
<th>Timer</th>
<th>Starts</th>
<th>Wakeups</th>
<th>Next</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrans</td>
<td>0</td>
<td>0</td>
<td>0x0</td>
</tr>
<tr>
<td>TimeWait</td>
<td>0</td>
<td>0</td>
<td>0x0</td>
</tr>
<tr>
<td>AckHold</td>
<td>0</td>
<td>0</td>
<td>0x0</td>
</tr>
<tr>
<td>SendWnd</td>
<td>0</td>
<td>0</td>
<td>0x0</td>
</tr>
<tr>
<td>KeepAlive</td>
<td>0</td>
<td>0</td>
<td>0x0</td>
</tr>
<tr>
<td>GiveUp</td>
<td>0</td>
<td>0</td>
<td>0x0</td>
</tr>
<tr>
<td>PmtuAger</td>
<td>0</td>
<td>0</td>
<td>0x0</td>
</tr>
<tr>
<td>DeadWait</td>
<td>0</td>
<td>0</td>
<td>0x0</td>
</tr>
</tbody>
</table>

iss: 0, snduna: 0, sndnxt: 0, sndwnd: 0
irs: 0, rcvmax: 0, rcvwnd: 4128, delrcvwnd: 0
SRTT: 0 ms, RTTO: 2000 ms, RTV: 2000 ms, KRTT: 0 ms
minRTT: 60000 ms, maxRTT: 0 ms, ACK hold: 200 ms
Flags: passive open, higher precedence, retransmission timeout
TCB is waiting for TCP Process (67)
Datagrams (max data segment is 516 bytes):
Rcvd: 6 (out of order: 0), with data: 0, total data bytes: 0
Sent: 0 (retransmit: 0, fastretransmit: 0), with data: 0, total data bytes: 0

Cisco Software Modularity

The following sample output from the `show tcp tcb` command displays a Software Modularity image:

**Example:**

```
Device# show tcp tcb 0x1059C10
```

Connection state is ESTAB, I/O status: 0, unread input bytes: 0
Local host: 10.4.2.32, Local port: 23
Foreign host: 10.4.2.39, Foreign port: 11000
VRF table id is: 0
Current send queue size: 0 (max 65536)
Current receive queue size: 0 (max 32768) mis-ordered: 0 bytes
Event Timers (current time is 0xB9ACB9):

<table>
<thead>
<tr>
<th>Timer</th>
<th>Starts</th>
<th>Wakeups</th>
<th>Next (msec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrans</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SendWnd</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TimeWait</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>AckHold</td>
<td>8</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>KeepAlive</td>
<td>11</td>
<td>0</td>
<td>7199992</td>
</tr>
<tr>
<td>PmtuAger</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>GiveUp</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Throttle</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

iss: 1633857851, rcvmax: 1633857890, rcvadv: 1633890620, rcvwnd: 32730
iss: 4231531315, snduna: 4231531392, sndnxt: 4231531392, sndwnd: 4052
sndmax: 4231531392, sndcwnd: 10220
SRTT: 84 ms, RTTO: 650 ms, RTV: 69 ms, KRTT: 0 ms
minRTT: 0 ms, maxRTT: 200 ms, ACK hold: 200 ms
Keepalive time: 7200 sec, SYN wait time: 75 sec
Giveup time: 0 ms, Retransmission retries: 0, Retransmit forever: FALSE
State flags: none
Feature flags: Nagle
Request flags: none
Window scales: rcv 0, snd 0, request rcv 0, request snd 0
Timestamp option: recent 0, recent age 0, last ACK sent 0
Datagrams (in bytes): MSS 1460, peer MSS 1460, min MSS 1460, max MSS 1460
Rcvd: 14 (out of order: 0), with data: 10, total data bytes: 38
Sent: 10 (retransmit: 0, fastretransmit: 0), with data: 5, total data bytes: 76
Step 2  
**show tcp brief [all | numeric]**

(Optional) Displays addresses in IP format.

Use the `show tcp brief` command to display a concise description of TCP connection endpoints. Use the optional `all` keyword to display the status for all endpoints with addresses in a Domain Name System (DNS) hostname format. If this keyword is not used, endpoints in the LISTEN state are not shown. Use the optional `numeric` keyword to display the status for all endpoints with addresses in IP format.

**Note** If the `ip domain-lookup` command is enabled on the device, and you execute the `show tcp brief` command, the response time of the device to display the output will be very slow. To get a faster response, you should disable the `ip domain-lookup` command.

The following is sample output from the `show tcp brief` command while a user is connected to the system by using Telnet:

**Example:**

```
Device# show tcp brief

TCB  Local Address     Foreign Address   (state)
609789AC  Device.cisco.com.23   cider.cisco.com.3733 ESTAB
```

The following example shows the IP activity after the `numeric` keyword is used to display addresses in IP format:

**Example:**

```
Device# show tcp brief numeric

TCB  Local Address     Foreign Address   (state)
6523A4FC  10.1.25.3.11000   10.1.25.3.23 ESTAB
65239A84  10.1.25.3.23     10.1.25.3.11000 ESTAB
653FCBBC  *.1723           *.* LISTEN
```

Step 3  
**debug ip tcp transactions**

Use the `debug ip tcp transactions` command to display information about significant TCP transactions such as state changes, retransmissions, and duplicate packets. The TCP/IP network isolated above the data link layer might encounter performance issues. The `debug ip tcp transactions` command can be useful in debugging these performance issues.

The following is sample output from the `debug ip tcp transactions` command:

**Example:**

```
Device# debug ip tcp transactions

TCP: sending SYN, seq 168108, ack 88655553
TCP0: Connection to 10.9.0.13:22530, advertising MSS 966
TCP0: state was LISTEN -> SYNRCVD [23 -> 10.9.0.13(22530)]
TCP0: state was SYNSENT -> SYNRCVD [23 -> 10.9.0.13(22530)]
TCP0: Connection to 10.9.0.13:22530, received MSS 956
TCP0: restart retransmission in 5996
TCP0: state was SYNRCVD -> ESTAB [23 -> 10.9.0.13(22530)]
TCP2: restart retransmission in 10689
TCP2: restart retransmission in 10641
TCP2: restart retransmission in 10633
```
TCP2: restart retransmission in 13384 -> 10.0.0.13(16151)
TCP0: restart retransmission in 5996 [23 -> 10.0.0.13(16151)]

The following line from the **debug ip tcp transactions** command sample output shows that TCP has entered Fast Recovery mode:

**Example:**

```
fast re-transmit - sndcwnd = 512, snd_last = 33884268765
```

The following lines from the **debug ip tcp transactions** command sample output show that a duplicate acknowledgment is received when TCP is in Fast Recovery mode (first line) and a partial acknowledgment has been received (second line):

**Example:**

```
TCP0:ignoring second congestion in same window sndcwn - 512, snd_1st - 33884268765
TCP0:partial ACK received sndcwnd:33842495
```

### Step 4  **debug ip tcp congestion**

Use the **debug ip tcp congestion** command to display information about TCP congestion events. The TCP/IP network isolated above the data link layer might encounter performance issues. The **debug ip tcp congestion** command can be used to debug these performance issues. The command also displays information related to variations in the TCP send window, congestion window, and congestion threshold window.

The following is sample output from the **debug ip tcp congestion** command:

**Example:**

```
Device# debug ip tcp congestion
*May 20 22:49:49.091: Setting New Reno as congestion control algorithm
*May 22 05:21:47.281: Advance cwnd by 12
*May 22 05:21:47.281: TCP85FD0C10: sndcwnd: 1472
*May 22 05:21:47.285: Advance cwnd by 3
*May 22 05:21:47.285: TCP85FD0C10: sndcwnd: 1475
*May 22 05:21:47.285: Advance cwnd by 3
*May 22 05:21:47.285: Advance cwnd by 9
```

For Cisco TCP, New Reno is the default congestion control algorithm. However, an application can also use Binary Increase Congestion Control (BIC) as the congestion control algorithm. The following is sample output from the **debug ip tcp congestion** command using BIC:

**Example:**

```
Device# debug ip tcp congestion
*May 20 22:50:32.559: [New Reno] sndcwnd: 8388480 to 2514841, ssthresh from 65535 to 2514841
```

```
*May 22 05:21:47.281: Setting BIC as congestion control algorithm
*May 22 05:21:47.281: Advance cwnd by 12
*May 22 05:21:47.281: TCP85FD0C10: sndcwnd: 1472
*May 22 05:21:47.285: Advance cwnd by 3
*May 22 05:21:47.285: TCP85FD0C10: sndcwnd: 1475
*May 22 05:21:47.285: Advance cwnd by 3
*May 22 05:21:47.285: Advance cwnd by 9
```


```
```
Configuration Examples for TCP

Example: Verifying the Configuration of TCP ECN

The following example shows how to verify whether TCP ECN is configured:

Device# show running-config

Building configuration...
.
.
.
ip tcp ecn ! ECN is configured.
.
.

The following example shows how to verify whether TCP is ECN-enabled on a specific connection (local host):

Device# show tcp tcb 123456A

!Local host
!
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Enabled
Local host: 10.1.25.31, Local port: 11002
Foreign host: 10.1.25.34, Foreign port: 23

The following example shows how to display concise information about one address:

Device# show tcp brief

!
TCB Local address Foreign Address (state)
609789C Router.example.com.23 cider.example.com.3733 ESTAB

The following example shows how to enable IP TCP ECN debugging:

Device# debug ip tcp ecn
!
TCP ECN debugging is on
!
Device# telnet 10.1.25.31

Trying 10.1.25.31 ...
Before a TCP connection can use ECN, a host sends an ECN-setup SYN (synchronization) packet to a remote end that contains an Echo Congestion Experience (ECE) and Congestion window reduced (CWR) bit set in the header. Setting the ECE and CWR bits indicates to the remote end that the sending TCP is ECN capable, rather than an indication of congestion. The remote end sends an ECN-setup SYN-ACK (acknowledgment) packet to the sending host.

In this example the “out ECN-setup SYN” text means that a SYN packet with the ECE and CWR bit set was sent to the remote end. The “in non-ECN-setup SYN-ACK” text means that the remote end did not favorably acknowledge the ECN request and, therefore, the session is not ECN capable.

The following output shows that ECN capabilities are enabled at both ends. In response to the ECN-setup SYN, the other end favorably replied with an ECN-setup SYN-ACK message. This connection is now ECN capable for the rest of the session.

```
Device# telnet 10.10.10.10

Trying 10.10.10.10 ... Open
Password required, but none set
!
1d20h: 10.1.25.34:11003 <--- 10.1.25.35:23 out ECN-setup SYN
1d20h: 10.1.25.34:11003 <--- 10.1.25.35:23 in ECN-setup SYN-ACK
```

The following example shows how to verify that the hosts are connected:

```
Device# show debugging
!
TCP:
    TCP Packet debugging is on
    TCP ECN debugging is on
!
Device# telnet 10.1.25.234
!
Trying 10.1.25.234 ...
!
00:02:48: 10.1.25.31:11001 <--- 10.1.25.234:23 out ECN-setup SYN
00:02:48: tcp0: O CLOSED 10.1.25.234:11001 10.1.25.31:23 seq 1922220018
    OPTS 4 ECE CWR SYN WIN 4128
00:02:50: 10.1.25.31:11001 <--- 10.1.25.234:23 congestion window changes
00:02:50: cwnd from 1460 to 1460, ssthresh from 65535 to 2920
00:02:50: tcp0: R SYNSENT 10.1.25.234:11001 10.1.25.31:23 seq 1922220018
    OPTS 4 ECE CWR SYN WIN 4128
00:02:54: 10.1.25.31:11001 <--- 10.1.25.234:23 congestion window changes
00:02:54: cwnd from 1460 to 1460, ssthresh from 2920 to 2920
00:02:54: tcp0: R SYNSENT 10.1.25.234:11001 10.1.25.31:23 seq 1922220018
    OPTS 4 ECE CWR SYN WIN 4128
00:03:02: 10.1.25.31:11001 <--- 10.1.25.234:23 congestion window changes
00:03:02: cwnd from 1460 to 1460, ssthresh from 2920 to 2920
00:03:02: tcp0: R SYNSENT 10.1.25.234:11001 10.1.25.31:23 seq 1922220018
    OPTS 4 ECE CWR SYN WIN 4128
00:03:18: 10.1.25.31:11001 <--- 10.1.25.234:23 SYN with ECN disabled
00:03:18: tcp0: O SYNSENT 10.1.25.234:11001 10.1.25.31:23 seq 1922220018
    OPTS 4 SYN WIN 4128
00:03:20: 10.1.25.31:11001 <--- 10.1.25.234:23 congestion window changes
00:03:20: cwnd from 1460 to 1460, ssthresh from 2920 to 2920
00:03:20: tcp0: R SYNSENT 10.1.25.234:11001 10.1.25.31:23 seq 1922220018
    OPTS 4 SYN WIN 4128
00:03:24: 10.1.25.31:11001 <--- 10.1.25.234:23 congestion window changes
00:03:24: cwnd from 1460 to 1460, ssthresh from 2920 to 2920
00:03:24: tcp0: R SYNSENT 10.1.25.234:11001 10.1.25.31:23 seq 1922220018
```
**Example: Configuring the TCP MSS Adjustment**

The following example shows how to configure and verify the interface adjustment value for the example topology displayed in the figure below:

*Figure 3: Example Topology for TCP MSS Adjustment*

Configure the interface adjustment value on router B:

```
Router_B(config)# interface GigabitEthernet 2/0/0
Router_B(config-if)# ip tcp adjust-mss 500
```

Telnet from router A to router C with B having the Maximum Segment Size (MSS) adjustment configured:

```
Router_A# telnet 192.168.1.1
Trying 192.168.1.1... Open
```

Observe the debug output from router C:

```
Router_C# debug ip tcp transactions
```

```
Sep 5 18:42:46.247: TCP0: state was LISTEN -> SYNRCVD [23 -> 10.0.1.1(38437)]
Sep 5 18:42:46.247: TCP: tcb 32290C0 connection to 10.0.1.1:38437, peer MSS 500, MSS is 500
Sep 5 18:42:46.247: TCP0: sending SYN, seq 580539401, ack 6015751
Sep 5 18:42:46.247: TCP0: Connection to 10.0.1.1:38437, advertising MSS 500
Sep 5 18:42:46.251: TCP0: state was SYNRCVD -> ESTAB [23 -> 10.0.1.1(38437)]
```

The MSS gets adjusted to 500 on Router B as configured.

The following example shows the configuration of a Point-to-Point Protocol over Ethernet (PPPoE) client with the MSS value set to 1452:

```
Device(config)# vpdn enable
Device(config)# no vpdn logging
Device(config)# vpdn-group 1
Device(config-vpdn)# request-dialin
Device(config-vpdn-req-in)# protocol pppoe
Device(config-vpdn-req-in)# exit
Device(config-vpdn)# exit
Device(config)# interface GigabitEthernet 0/0/0
```
Device(config-if)# ip address 192.168.100.1 255.255.255.0
Device(config-if)# ip tcp adjust-mss 1452
Device(config-if)# ip nat inside
Device(config-if)# exit
Device(config)# interface ATM 0
Device(config-if)# no ip address
Device(config-if)# no atm ilmi-keepalive
Device(config-if)# pvc 8/35
Device(config-if)# pppoe client dial-pool-number 1
Device(config-if)# dsl equipment-type CPE
Device(config-if)# dsl operating-mode GSHDSL symmetric annex B
Device(config-if)# dsl linerate AUTO
Device(config-if)# exit
Device(config)# interface Dialer 1
Device(config-if)# ip address negotiated
Device(config-if)# ip mtu 1492
Device(config-if)# ip nat outside
Device(config-if)# encapsulation ppp
Device(config-if)# dialer pool 1
Device(config-if)# dialer-group 1
Device(config-if)# ppp authentication pap callin
Device(config-if)# ppp pap sent-username sohodyn password 141B1309000528
Device(config-if)# ip nat inside source list 101 Dialer1 overload
Device(config-if)# exit
Device(config)# ip route 0.0.0.0.0.0.0.0 Dialer1
Device(config)# access-list permit ip 192.168.100.0.0.0.0.255 any

The following example shows the configuration of interface adjustment value for IPv6 traffic:

Device> enable
Device# configure terminal
Device(config)# interface GigabitEthernet 0/0/0
Device(config)# ipv6 tcp adjust-mss 1452
Device(config)# end

Example: Configuring the TCP Application Flags Enhancement

The following output shows the flags (status and option) displayed using the show tcp command:

Device# show tcp
.
.
Status Flags: passive open, active open, retransmission timeout
  App closed
Option Flags: vrf id set
IP Precedence value: 6
.
.
SRTT: 273 ms, RTTO: 490 ms, RTV: 217 ms, KRTT: 0 ms
minRTT: 0 ms, maxRTT: 300 ms, ACK hold: 200 ms

Example: Displaying Addresses in IP Format

The following example shows the IP activity by using the numeric keyword to display the addresses in IP format:
Device# show tcp brief numeric

<table>
<thead>
<tr>
<th>TCB</th>
<th>Local Address</th>
<th>Foreign Address</th>
<th>(state)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6523A4FC</td>
<td>10.1.25.3.11000</td>
<td>10.1.25.3.23</td>
<td>ESTAB</td>
</tr>
<tr>
<td>65239A84</td>
<td>10.1.25.3.23</td>
<td>10.1.25.3.11000</td>
<td>ESTAB</td>
</tr>
<tr>
<td>653FCBBC</td>
<td><em>.</em></td>
<td><em>.</em></td>
<td>LISTEN</td>
</tr>
</tbody>
</table>

Additional References

Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Commands List, All Releases</td>
</tr>
<tr>
<td>IP Application Services commands</td>
<td>IP Application Services Command Reference</td>
</tr>
</tbody>
</table>

Standards and RFCs

<table>
<thead>
<tr>
<th>Standard/RFC</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFC 793</td>
<td>Transmission Control Protocol</td>
</tr>
<tr>
<td>RFC 1191</td>
<td>Path MTU discovery</td>
</tr>
<tr>
<td>RFC 1323</td>
<td>TCP Extensions for High Performance</td>
</tr>
<tr>
<td>RFC 2018</td>
<td>TCP Selective Acknowledgment Options</td>
</tr>
<tr>
<td>RFC 2581</td>
<td>TCP Congestion Control</td>
</tr>
<tr>
<td>RFC 3168</td>
<td>The Addition of Explicit Congestion Notification (ECN) to IP</td>
</tr>
<tr>
<td>RFC 3782</td>
<td>The NewReno Modification to TCP’s Fast Recovery Algorithm</td>
</tr>
<tr>
<td>RFC 4022</td>
<td>Management Information Base for the Transmission Control Protocol (TCP)</td>
</tr>
</tbody>
</table>

MIBs

<table>
<thead>
<tr>
<th>MIB</th>
<th>MIBs Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>CISCO-TCP-MIB</td>
<td>To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL:</td>
</tr>
<tr>
<td></td>
<td><a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
</tr>
</tbody>
</table>
Technical Assistance

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
</tr>
</tbody>
</table>

Feature Information for TCP

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

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

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP Application Flags Enhancement</td>
<td>12.2(31)SB2 12.4(2)T</td>
<td>The TCP Applications Flags Enhancement feature enables the user to display additional flags with reference to TCP applications. There are two types of flags: status and option. The status flags indicate the status of TCP connections such as retransmission timeouts, application closed, and synchronized (SYNC) handshakes for listening. The additional flags indicate the state of set options such as whether a VPN routing and forwarding instance (VRF) is set, whether a user is idle, and whether a keepalive timer is running. The following command was modified by this feature: <code>show tcp</code>.</td>
</tr>
</tbody>
</table>

Table 6: Feature Information for TCP
<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
</table>
| TCP Congestion Avoidance         | 12.3(7)T | The TCP Congestion Avoidance feature enables the monitoring of acknowledgment packets to the TCP sender when multiple packets are lost in a single window of data. Before this feature was introduced, the sender would exit Fast-Recovery mode, wait for three or more duplicate acknowledgment packets before retransmitting the next unacknowledged packet, or wait for the retransmission timer to start slowly. This delay could lead to performance issues. Implementation of RFC 2581 and RFC 3782 addresses the modifications to the Fast-Recovery algorithm that incorporates a response to partial acknowledgments received during Fast Recovery, improving performance in situations where multiple packets are lost in a single window of data. This feature is an enhancement to the existing Fast Recovery algorithm. No commands are used to enable or disable this feature. The output of the `debug ip tcp transactions` command monitors acknowledgment packets by displaying the following conditions:
  - TCP entering Fast Recovery mode.
  - Duplicate acknowledgments being received during Fast Recovery mode.
  - Partial acknowledgments being received.
  The following command was modified by this feature: `debug ip tcp transactions`. |
<p>| TCP Explicit Congestion Notification | 12.3(7)T | The TCP Explicit Congestion Notification (ECN) feature allows an intermediate router to notify end hosts of impending network congestion. It also provides enhanced support for TCP sessions associated with applications such as Telnet, web browsing, and transfer of audio and video data, that are sensitive to delay or packet loss. The benefit of this is the reduction of delay and packet loss in data transmissions. The following commands were introduced or modified by this feature: <code>debug ip tcp ecn</code>, <code>ip tcp ecn</code>, <code>show debugging</code>, <code>show tcp</code>. |
| TCP MIB for RFC4022 Support      | 12.2(33)X | The TCP MIB for RFC 4022 Support feature introduces support for RFC 4022, <em>Management Information Base for the Transmission Control Protocol (TCP)</em>. RFC 4022 is an incremental change of the TCP MIB to improve the manageability of TCP. There are no new or modified commands for this feature. |</p>
<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
</table>
| TCP MSS Adjust    | 12.2(4)T, 12.2(8)T, 12.2(18)ZU2, 12.2(28)SB, 12.2(33)SRA, 12.2(33)SXH, 15.0(1)S | The TCP MSS Adjust feature enables the configuration of the maximum segment size (MSS) for transient packets that traverse a device, specifically TCP segments in the SYN bit set. In 12.2(4)T, this feature was introduced. In 12.2(8)T, the command that was introduced by this feature was changed from `ip adjust-mss` to `ip tcp adjust-mss`.
In 12.2(28)SB and 12.2(33)SRA, this feature was enhanced to be configurable on subinterfaces.
The following command was introduced by this feature: `ip tcp adjust-mss`. |
| TCP Show Extension| 12.2(31)SB2, 12.4(2)T | The TCP Show Extension feature introduces the capability to display addresses in IP format instead of hostname format and to display the VRF table associated with the connection.
The following command was modified by this feature: `show tcp brief`. |
| TCP Window Scaling| 12.2(8)T, 12.2(31)SB2 | The TCP Window Scaling feature adds support for the Window Scaling option in RFC 1323. A larger window size is recommended to improve TCP performance in network paths with large bandwidth, long-delay characteristics that are called Long Fat Networks (LFNs). This TCP Window Scaling enhancement provides that support.
The following command was introduced or modified by this feature: `ip tcp window-size`. |
| TCP Keepalive Timer| 15.2(4)M               | The TCP Keepalive Timer feature introduces the capability to identify dead connections between multiple routing devices.
The following command was introduced or modified by this feature: `ip tcp keepalive`. |
Feature Information for TCP

Configuring TCP
Configuring WCCP

The Web Cache Communication Protocol (WCCP) is a Cisco-developed content-routing technology that intercepts IP packets and redirects those packets to a destination other than that specified in the IP packet. Typically the packets are redirected from their destination web server on the Internet to a content engine that is local to the client. In some WCCP deployment scenarios, redirection of traffic may also be required from the web server to the client. WCCP enables you to integrate content engines into your network infrastructure.

Cisco IOS Release 12.1 and later releases allow the use of either WCCP Version 1 (WCCPv1) or Version 2 (WCCPv2).

The tasks in this document assume that you have already configured content engines on your network. For specific information on hardware and network planning associated with Cisco Content Engines and WCCP, see the Cisco Content Engines documentation at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/webscale/content/index.htm

- Finding Feature Information, on page 85
- Prerequisites for WCCP, on page 86
- Restrictions for WCCP, on page 86
- Information About WCCP, on page 87
- How to Configure WCCP, on page 99
- Configuration Examples for WCCP, on page 109
- Additional References, on page 114
- Feature Information for WCCP, on page 116

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and 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 table.

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

- To use WCCP, IP must be configured on the interface connected to the Internet and another interface must be connected to the content engine.
- The interface connected to the content engine must be a Fast Ethernet or Gigabit Ethernet interface.

Restrictions for WCCP

General
The following limitations apply to Web Cache Communication Protocol Version 1 (WCCPv1) and WCCP Version 2 (WCCPv2):
- WCCP works only with IPv4 networks.
- WCCP bypasses Network Address Translation (NAT) when Cisco Express Forwarding is enabled.

WCCPv1
- WCCPv1 supports the redirection of HTTP (TCP port 80) traffic only.
- WCCPv1 does not allow multiple routers to be attached to a cluster of content engines.

WCCPv2
- WCCP works only with IPv4 networks.
- For routers servicing a multicast cluster, the Time To Live (TTL) value must be set at 15 or fewer.
- Service groups can comprise up to 32 content engines and 32 routers.
- All content engines in a cluster must be configured to communicate with all routers servicing the cluster.
- Multicast addresses must be from 224.0.0.0 to 239.255.255.255.

WCCP VRF Support
- In Cisco IOS Release 12.2(33)SRE, this feature is supported only on Cisco 7200 NPE-G2 and Cisco 7304-NPE-G100 routers.

WCCP Layer 2 Forwarding and Return
In a Cisco Wide Area Application Services (WAAS) and Cisco IOS XE firewall configuration, all packets processed by a Wide Area Application Engine (WAE) device must go over the Cisco IOS XE firewall in both directions to support the Web Cache Coordination Protocol (WCCP) generic routing encapsulation (GRE) redirect. This situation occurs when a Layer 2 redirect is not available. If a Layer 2 redirect is configured on the WAE, the system defaults to the GRE redirect to continue to function.
The client device and a WAE device or a cache engine cannot be connected to a Cisco device with the same interface and WCCP redirect configured on the interface.

The following two configurations are supported:

- For WCCP Layer 2 return, the client and WAE are connected to a Cisco device with same interface and WCCP output is configured on the interface.
- For WCCP Layer 2 return, the client and WAE are connected to a Cisco device with same physical interface but in different VLANs and sub-interfaces.

**Cisco 7600 Series Routers Access Control Lists**

When WCCP is using the mask assignment, any redirect list is merged with the mask information from the appliance and the resulting merged ACL is passed down to the Cisco 7600 series router hardware. Only Permit or Deny ACL entries from the redirect list in which the protocol is IP or exactly matches the service group protocol are merged with the mask information from the appliance.

The following restrictions apply to the redirect-list ACL:

- The ACL must be an IPv4 simple or extended ACL.
- Only individual source or destination port numbers may be specified; port ranges cannot be specified.
- The only valid matching criteria in addition to individual source or destination port numbers are dscp or tos.
- The use of fragments, time-range, or options keywords, or any TCP flags is not permitted.
- If the redirect ACL does not meet the restrictions shown, the system will log the following error message:

```
WCCP-3-BADACE: Service <service group>, invalid access-list entry (seq:<sequence>, reason:<reason>)
```

- WCCP continues to redirect packets, but the redirection is carried out in software until the access list is adjusted.

**Information About WCCP**

**WCCP Overview**

WCCP uses Cisco Content Engines (or other content engines running WCCP) to localize traffic patterns in the network, enabling content requests to be fulfilled locally. Traffic localization reduces transmission costs and download time.

WCCP enables routing platforms to transparently redirect content requests. With transparent redirection, users can fulfill content requests locally without configuring their browsers to use a web proxy. Instead, they can use the target URL to request content, and have their requests automatically redirected to a content engine. The word “transparent” in this case means that the end user does not know that a requested file (such as a web page) came from the content engine instead of from the originally specified server.

A content engine receiving a request attempts to service it from its own local cache. If the requested information is not present, the content engine issues its own request to the originally targeted server to get the required
information. A content engine retrieving the requested information forwards it to the requesting client and caches it to fulfill future requests, thus maximizing download performance and substantially reducing transmission costs.

WCCP enables a series of content engines, called a content engine cluster, to provide content to a router or multiple routers. Network administrators can easily scale their content engines to manage heavy traffic loads through these clustering capabilities. Cisco clustering technology enables each cluster member to work in parallel, resulting in linear scalability. Clustering content engines greatly improves the scalability, redundancy, and availability of your caching solution. You can cluster up to 32 content engines to scale to your desired capacity.

Layer 2 Forwarding Redirection and Return

WCCP uses either generic routing encapsulation (GRE) or Layer 2 (L2) to redirect or return IP traffic. When WCCP forwards traffic via GRE, the redirected packets are encapsulated within a GRE header. The packets also have a WCCP redirect header. When WCCP forwards traffic using L2, the original MAC header of the IP packet is overwritten and replaced with the MAC header for the WCCP client.

Using L2 as a forwarding method allows direct forwarding to the content engine without further lookup. Layer 2 redirection requires that the router and content engines are directly connected, that is, on the same IP subnet.

When WCCP returns traffic via GRE, the returned packets are encapsulated within a GRE header. The destination IP address is the address of the router and the source address is the address of the WCCP client. When WCCP returns traffic via L2, the original IP packet is returned without any added header information. The router to which the packet is returned will recognize the source of the packet and prevent redirection.

The WCCP redirection method does not have to match the return method.

L2 forwarding, return, or redirection are typically used for hardware-accelerated platforms. Depending on your release, L2 forwarding, return, and redirection can also be used for software-switching platforms.

For content engines running Application and Content Networking System (ACNS) software, use the `wccp custom-web-cache` command with the `l2-redirect` keyword to configure L2 redirection. For content engines running Cisco Wide Area Application Services (WAAS) software, use the `wccp tcp-promiscuous` command with the `l2-redirect` keyword to configure L2 redirection.

Before configuring a GRE tunnel, configure a loopback interface (that is not attached to a VRF) with an IP address so that the internally created tunnel interface is enabled for IPv4 forwarding by unnumbering itself to this dummy loopback interface. You do not need to configure a loopback interface if the system has at least one interface that is not attached to a VRF and that is configured with an IPv4 address.

For information about Cisco ACNS commands used to configure Cisco Content Engines, see the Cisco ACNS Software Command Reference.

For more information about WAAS commands used to configure Cisco Content Engines, see the Cisco Wide Area Application Services Command Reference.

WCCP Mask Assignment

The WCCP Mask Assignment feature enables mask assignment as the load-balancing method (instead of the default hash assignment method) for a WCCP service.
For content engines running Application and Content Networking System (ACNS) software, use the `wccp custom-web-cache` command with the `mask-assign` keyword to configure mask assignment. For content engines running Cisco Wide Area Application Services (WAAS) software, use the `wccp tcp-promiscuous` command with the `mask-assign` keyword to configure mask assignment.

For information about Cisco ACNS commands used to configure Cisco Content Engines, see the Cisco ACNS Software Command Reference.

For more information about WAAS commands used to configure Cisco Content Engines, see the Cisco Wide Area Application Services Command Reference.

### Hardware Acceleration

Cisco 7600 series routers provide WCCP Layer 2 Policy Feature Card (PFC) redirection hardware acceleration. Hardware acceleration allows Cisco Content Engines to perform a L2 MAC address rewrite redirection method when directly connected to a compatible router.

Redirecting processing is accelerated in the routing hardware, which is more efficient than L3 redirection with Generic Routing Encapsulation (GRE). L2 redirection takes place on the router, and is not visible to the Multilayer Switch Feature Card (MSFC). The WCCP L2 PFC redirection feature requires no configuration on the MSFC. The `show ip wccp {service-number | web-cache} detail` command displays which redirection method is in use for each content engine.

In order for the router to make complete use of hardware redirection, the content engine must be configured with L2 redirection and mask assignment.

Use the `ip wccp web-cache accelerated` command on hardware-based platforms to enforce the use of L2 redirection and mask assignment. Using this command configures the router to form a service group and redirect packets with an appliance only if the appliance is configured for L2 and mask assignment.

The following guidelines apply to WCCP Layer 2 PFC redirection:

- The WCCP Layer 2 PFC redirection feature sets the IP flow mask to full-flow mode.
- You can configure the Cisco Cache Engine software Release 2.2 or later releases to use the WCCP Layer 2 PFC redirection feature.
- L2 redirection takes place on the PFC and is not visible to the MSFC. The `show ip wccp {service-number | web-cache} detail` command on the MSFC displays statistics for only the first packet of an L2 redirected flow, which provides an indication of how many flows, rather than packets, are using L2 redirection. You can view information about L2 redirected flows by entering the `show platform flow ip` command. The PFC3 provides hardware acceleration for GRE. If you use WCCP Layer 3 redirection with GRE, there is hardware support for encapsulation, but the PFC3 does not provide hardware support for decapsulation of WCCP GRE traffic.

### WCCPv1 Configuration

With WCCPv1, only a single router services a cluster. In this scenario, this router is the device that performs all the IP packet redirection. The figure below illustrates the WCCPv1 configuration.
Content is not duplicated on the content engines. The benefit of using multiple content engines is that you can scale a caching solution by clustering multiple physical content engines to appear as one logical cache.

The following sequence of events details how WCCPv1 configuration works:

1. Each content engine is configured by the system administrator with the IP address of the control router. Up to 32 content engines can connect to a single control router.

2. The content engines send their IP addresses to the control router using WCCP, indicating their presence. Routers and content engines communicate to each other via a control channel; this channel is based on UDP port 2048.

3. This information is used by the control router to create a cluster view (a list of caches in the cluster). This view is sent to each content engine in the cluster, essentially making all the content engines aware of each other. A stable view is established after the membership of the cluster remains the same for a certain amount of time.

4. When a stable view has been established, one content engine is elected as the lead content engine. (The lead is defined as the content engine seen by all the content engines in the cluster with the lowest IP address). This lead content engine uses WCCP to indicate to the control router how IP packet redirection should be performed. Specifically, the lead content engine designates how redirected traffic should be distributed across the content engines in the cluster.

**WCCPv2 Configuration**

Multiple routers can use WCCPv2 to service a content engine cluster. In WCCPv1, only one router could redirect content requests to a cluster. The figure below illustrates a sample configuration using multiple routers.
The subset of content engines within a cluster and routers connected to the cluster that are running the same service is known as a service group. Available services include TCP and UDP redirection.

In WCCPv1, the content engines were configured with the address of the single router. WCCPv2 requires that each content engine be aware of all the routers in the service group. To specify the addresses of all the routers in a service group, you must choose one of the following methods:

- **Unicast**—A list of router addresses for each of the routers in the group is configured on each content engine. In this case the address of each router in the group must be explicitly specified for each content engine during configuration.

- **Multicast**—A single multicast address is configured on each content engine. In the multicast address method, the content engine sends a single-address notification that provides coverage for all routers in the service group. For example, a content engine could indicate that packets should be sent to a multicast address of 224.0.0.100, which would send a multicast packet to all routers in the service group configured for group listening using WCCP (see the `ip wccp group-listen` or the `ipv6 wccp group-listen` interface configuration command for details).

The multicast option is easier to configure because you need only specify a single address on each content engine. This option also allows you to add and remove routers from a service group dynamically, without needing to reconfigure the content engines with a different list of addresses each time.

The following sequence of events details how WCCPv2 configuration works:

1. Each content engine is configured with a list of routers.
2. Each content engine announces its presence and a list of all routers with which it has established communications. The routers reply with their view (list) of content engines in the group.
3. When the view is consistent across all content engines in the cluster, one content engine is designated as the lead and sets the policy that the routers need to deploy in redirecting packets.
WCCPv2 Support for Services Other Than HTTP

WCCPv2 allows redirection of traffic other than HTTP (TCP port 80 traffic), including a variety of UDP and TCP traffic. WCCPv2 supports the redirection of packets intended for other ports, including those used for proxy-web cache handling, File Transfer Protocol (FTP) caching, FTP proxy handling, web caching for ports other than 80, and Real Audio, video, and telephony applications.

To accommodate the various types of services available, WCCPv2 introduced the concept of multiple service groups. Service information is specified in the WCCP configuration commands using dynamic services identification numbers (such as 98) or a predefined service keyword (such as web-cache). This information is used to validate that service group members are all using or providing the same service.

The content engines in a service group specify traffic to be redirected by protocol (TCP or UDP) and up to eight source or destination ports. Each service group has a priority status assigned to it. The priority of a dynamic service is assigned by the content engine. The priority value is in the range of 0 to 255 where 0 is the lowest priority. The predefined web-cache service has an assigned priority of 240.

WCCPv2 Support for Multiple Routers

WCCPv2 allows multiple routers to be attached to a cluster of cache engines. The use of multiple routers in a service group allows for redundancy, interface aggregation, and distribution of the redirection load. WCCPv2 supports up to 32 routers per service group. Each service group is established and maintained independently.

WCCPv2 MD5 Security

WCCPv2 provides optional authentication that enables you to control which routers and content engines become part of the service group using passwords and the Hashed Message Authentication Code—Message Digest (HMAC MD5) standard. Shared-secret MD5 one-time authentication (set using the \texttt{ip wccp [password [0 | 7] password]} global configuration command) enables messages to be protected against interception, inspection, and replay.

WCCPv2 Web Cache Packet Return

If a content engine is unable to provide a requested object it has cached due to error or overload, the content engine will return the request to the router for onward transmission to the originally specified destination server. WCCPv2 provides a check on packets that determines which requests have been returned from the content engine unserviced. Using this information, the router can then forward the request to the originally targeted server (rather than attempting to resend the request to the content engine cluster). This process provides error handling transparency to clients.

Typical reasons why a content engine would reject packets and initiate the packet return feature include the following:

- Instances when the content engine is overloaded and has no room to service the packets
- Instances when the content engine is filtering for certain conditions that make caching packets counterproductive (for example, when IP authentication has been turned on)
WCCPv2 Load Distribution

WCCPv2 can be used to adjust the load being offered to individual content engines to provide an effective use of the available resources while helping to ensure high quality of service (QoS) to the clients. WCCPv2 allows the designated content engine to adjust the load on a particular content engine and balance the load across the content engines in a cluster. WCCPv2 uses three techniques to perform load distribution:

- **Hot spot handling**—Allows an individual hash bucket to be distributed across all the content engines. Prior to WCCPv2, information from one hash bucket could go to only one content engine.
- **Load balancing**—Allows the set of hash buckets assigned to a content engine to be adjusted so that the load can be shifted from an overwhelmed content engine to other members that have available capacity.
- **Load shedding**—Enables the router to selectively redirect the load to avoid exceeding the capacity of a content engine.

The use of these hashing parameters prevents one content engine from being overloaded and reduces the potential for bottlenecks.

WCCP VRF Support

The WCCP VRF Support feature enhances the WCCPv2 protocol by implementing support for virtual routing and forwarding (VRF).

The WCCP VRF Support feature allows service groups to be configured on a per-VRF basis in addition to those defined globally.

Along with the service identifier, the VRF of WCCP protocol packets arriving at the router is used to associate cache-engines with a configured service group.

The same VRF must have the interface on which redirection is applied, the interface which is connected to cache engine, and the interface on which the packet would have left if it had not been redirected.

WCCP VRF Tunnel Interfaces

In releases that support the WCCP VRF Support feature, the use of GRE redirection results in the creation of new tunnel interfaces. You can display these tunnel interfaces by entering the `show ip interface brief | include tunnel` command:

```
Device# show ip interface brief | include tunnel

Tunnel0    172.16.0.1    YES unset up
Tunnel1    172.16.0.1    YES unset up
Tunnel2    172.16.0.1    YES unset up
Tunnel3    172.16.0.1    YES unset up
Device#
```

The tunnel interfaces are automatically created in order to process outgoing GRE-encapsulated traffic for WCCP. The tunnel interfaces appear when a content engine connects and requests GRE redirection. The tunnel interfaces are not created directly by WCCP, but are created indirectly via a tunnel application programming interface (API). WCCP does not have direct knowledge of the tunnel interfaces, but can redirect packets to them, resulting in the appropriate encapsulation being applied to the packets. After the appropriate encapsulation is applied, the packet is then sent to the content engine.
The tunnel interfaces are not used to connect with incoming WCCP GRE return packets.

One tunnel is created for each service group that is using GRE redirection. One additional tunnel is created to provide an IP address that allows the other tunnel group interfaces to be unnumbered but still enabled for IPv4.

You can confirm the connection between the tunnels and WCCP by entering the `show tunnel groups wccp` command:

```
Device# show tunnel groups wccp
WCCP : service group 0 in "Default", ver v2, assignmnt: hash-table
    intf: Tunnel0, locally sourced
WCCP : service group 317 in "Default", ver v2, assignmnt: hash-table
    intf: Tunnel3, locally sourced
WCCP : service group 318 in "Default", ver v2, assignmnt: hash-table
    intf: Tunnel2, locally sourced
```

You can display additional information about each tunnel interface by entering the `show tunnel interface interface-number` command:

```
Device# show tunnel interface t0
Tunnel0
    Mode:multi-GRE/IP, Destination UNKNOWN, Source 10.1.1.80
    Application ID 2: WCCP : service group 0 in "Default", ver v2, assignmnt: hash-table
    Linestate - current up
    Internal linestate - current up, evaluated up

Device# show tunnel interface t1
Tunnel1
    Mode:multi-GRE/IP, Destination UNKNOWN, Source 172.16.0.1
    Application ID 2: unspecified
    Linestate - current up
    Internal linestate - current up, evaluated up

Device# show tunnel interface t2
Tunnel2
    Mode:multi-GRE/IP, Destination UNKNOWN, Source 10.1.1.80
    Application ID 2: WCCP : service group 318 in "Default", ver v2, assignmnt: hash-table
    Linestate - current up
    Internal linestate - current up, evaluated up

Device# show tunnel interface t3
Tunnel3
    Mode:multi-GRE/IP, Destination UNKNOWN, Source 10.1.1.80
    Application ID 2: WCCP : service group 317 in "Default", ver v2, assignmnt: hash-table
    Linestate - current up
    Internal linestate - current up, evaluated up
```

Note that the service group number shown in the examples is the internal tunnel representation of the WCCP service group number. Group 0 is the web-cache service. To determine the dynamic services, subtract 256 from the displayed service group number to convert to the WCCP service group number. For interfaces that are used for redirection, the source address shown is the WCCP router ID.
You can display information about the connected content engines and encapsulation, including software packet counters, by entering the `show adjacency [tunnel-interface] [encapsulation] [detail] [internal]` command:

```
Device# show adjacency t0
Protocol Interface Address
IP Tunnel0 10.1.1.82(3)
```

```
Device# show adjacency t0 encapsulation
Protocol Interface Address
Encap length 28
4500000000000000FF2F7D2B1E010150
1E0101520000883E00000000
Provider: TUNNEL
Protocol header count in macstring: 3
 HDR 0: ipv4
   dst: static, 10.1.1.82
   src: static, 10.1.1.80
   prot: static, 47
   ttl: static, 255
   df: static, cleared
   per packet fields: tos ident tl chksm
 HDR 1: gre
   prot: static, 0x883E
   per packet fields: none
 HDR 2: wccpv2
   dyn: static, cleared
   sgID: static, 0
   per packet fields: alt altB priB
```

```
Device# show adjacency t0 detail
Protocol Interface Address
IP Tunnel0 10.1.1.82(3)
connectionid 1
0 packets, 0 bytes
epoch 0
sourced in sev-epoch 1
Encap length 28
4500000000000000FF2F7D2B1E010150
1E0101520000883E00000000
Tun endpt
Next chain element:
IP adj out of Ethernet0/0, addr 10.1.1.82
```

```
Device# show adjacency t0 internal
Protocol Interface Address
IP Tunnel0 10.1.1.82(3)
connectionid 1
0 packets, 0 bytes
epoch 0
sourced in sev-epoch 1
Encap length 28
4500000000000000FF2F7D2B1E010150
1E0101520000883E00000000
Tun endpt
Next chain element:
IP adj out of Ethernet0/0, addr 10.1.1.82
parent oce 0x4BC76A8
frame originated locally (Null0)
L3 mtu 17856
```
WCCP Bypass Packets

WCCP intercepts IP packets and redirects those packets to a destination other than the destination that is specified in the IP header. Typically the packets are redirected from a web server on the Internet to a web cache that is local to the destination.

Occasionally a web cache cannot manage the redirected packets appropriately and returns the packets unchanged to the originating router. These packets are called bypass packets and are returned to the originating router using either Layer 2 forwarding without encapsulation (L2) or encapsulated in generic routing encapsulation (GRE). The router decapsulates and forwards the packets normally. The VRF associated with the ingress interface (or the global table if there is no VRF associated) is used to route the packet to the destination.

GRE is a tunneling protocol developed by Cisco that encapsulates packet types from a variety of protocols inside IP tunnels, creating a virtual point-to-point link over an IP network.

WCCP Closed Services and Open Services

In applications where packets are intercepted and redirected by a Cisco IOS router to external WCCP client devices, it may be necessary to block the packets for the application when a WCCP client device is not available. This blocking is achieved by configuring a WCCP closed service. When a WCCP service is configured as closed, the packets that fulfill the services, but do not have an active client device, are discarded.

By default, WCCP operates as an open service, wherein communication between clients and servers proceeds normally in the absence of an intermediary device.

The `ip wccp service-list` or the `ipv6 wccp service-list` command can be used for both closed-mode and open-mode services. Use the `service-list` keyword and `service-access-list` argument to register an application protocol type or port number. Use the `mode` keyword to select an open or closed service.

WCCP Outbound ACL Check

When WCCP is enabled for redirection on an ingress interface, the packets are redirected by WCCP and instead egress on an interface other than the destination that is specified in the IP header. The packets are still subject to ACLs configured on the ingress interface. However, redirection can cause the packets to bypass the ACL configured on the original egress interface. Packets that would have been dropped because of the ACL configured on the original egress interface can be sent out on the redirect egress interface, which poses a possible security problem. Enabling the WCCP Outbound ACL check feature ensures that redirected packets are subject to any ACL conditions configured on the original egress interface.
**WCCP Service Groups**

WCCP is a component of Cisco IOS software that redirects traffic with defined characteristics from its original destination to an alternative destination. The typical application of WCCP is to redirect traffic bound for a remote web server to a local web cache to improve response time and optimize network resource usage.

The nature of the selected traffic for redirection is defined by service groups (see figure below) specified on content engines and communicated to routers by using WCCP. The maximum number of service groups allowed across all VRFs is 256.

WCCPv2 supports up to 32 routers per service group. Each service group is established and maintained independently.

WCCPv2 uses service groups based on logical redirection services, deployed for intercepting and redirecting traffic. The standard service is web cache, which intercepts TCP port 80 (HTTP) traffic and redirects that traffic to the content engines. This service is referred to as a **well-known service**, because the characteristics of the web cache service are known by both the router and content engines. A description of a well-known service is not required beyond a service identification. To specify the standard web cache service, use the `ip wccp` or the `ipv6 wccp` command with the `web-cache` keyword.

---

**Note**

More than one service can run on a router at the same time, and routers and content engines can be part of multiple service groups at the same time.

---

**Figure 6: WCCP Service Groups**

The dynamic services are defined by the content engines; the content engine instructs the router which protocol or ports to intercept, and how to distribute the traffic. The router itself does not have information on the characteristics of the dynamic service group’s traffic, because this information is provided by the first content engine to join the group. In a dynamic service, up to eight ports can be specified within a single protocol.

Cisco Content Engines, for example, use dynamic service 99 to specify a reverse-proxy service. However, other content engine devices may use this service number for some other service.
WCCP—Check All Services

An interface may be configured with more than one WCCP service. When more than one WCCP service is configured on an interface, the precedence of a service depends on the relative priority of the service compared to the priority of the other configured services. Each WCCP service has a priority value as part of its definition. When an interface is configured with more than one WCCP service, the precedence of the packets is matched against service groups in priority order.

Note
The priority of a WCCP service group cannot be configured via Cisco IOS software.

With the `ip wccp check services all` or the `ipv6 wccp check services all` command, WCCP can be configured to check all configured services for a match and perform redirection for those services if appropriate. The caches to which packets are redirected can be controlled by a redirect ACL and by the service priority. The `ip wccp check services all` commands must be configured at global level to support multiple WCCP services.

If no WCCP services are configured with a redirect ACL, the services are considered in priority order until a service is found that matches the IP packet. If no services match the packet, the packet is not redirected. If a service matches the packet and the service has a redirect ACL configured, then the IP packet will be checked against the ACL. If the packet is rejected by the ACL, the packet will not be passed down to lower priority services unless the `ip wccp check services all` or the `ipv6 wccp check services all` command is configured. When the `ip wccp check services all` or the `ipv6 wccp check services all` command is configured, WCCP will continue to attempt to match the packet against any remaining lower priority services configured on the interface.

WCCP Interoperability with NAT

To redirect traffic using WCCP to a router running WAAS software that is also configured with NAT, enable the `ip nat inside` or the `ipv6 nat inside` command on the WAAS interface. If you are not able to configure the `ip nat inside` or the `ipv6 nat inside` command on the WAAS interface, disable Cisco Express Forwarding. You must also update the WCCP redirect ACL to include a private address to ensure that pretranslated traffic is redirected.

WCCP Troubleshooting Tips

CPU usage may be very high when WCCP is enabled. The WCCP counters enable a determination of the bypass traffic directly on the router and can indicate whether the cause is high CPU usage due to enablement of WCCP. In some situations, 10 percent bypass traffic may be normal; in other situations, 10 percent may be high. However, any figure above 25 percent should prompt a closer investigation of what is occurring in the web cache.

If the counters suggest that the level of bypass traffic is high, the next step is to examine the bypass counters in the content engine and determine why the content engine is choosing to bypass the traffic. You can log in to the content engine console and use the CLI to investigate further. The counters allow you to determine the percent of traffic being bypassed.

You can use the `clear ipv6 wccp-service-id` command to remove the IPv6 WCCP statistics (counts) maintained on the router for a particular service.

You can use the `clear wccp` command to remove all (IPv4 and IPv6) WCCP statistics (counts) maintained on the router for a particular service.
You can use the `show ipv6 wccp` command to display the IPv6 WCCP global statistics (counts).

You can use the `show wccp` command to display all (IPv4 and IPv6) WCCP global statistics (counts).

# How to Configure WCCP

The following configuration tasks assume that you have already installed and configured the content engines you want to include in your network. You must configure the content engines in the cluster before configuring WCCP functionality on your routers or switches. Refer to the Cisco Cache Engine User Guide for content engine configuration and setup tasks.

## Configuring WCCP

Perform this task to configure WCCP.

Until you configure a WCCP service using the `ip wccp {web-cache | service-number}` global configuration command, WCCP is disabled on the device. The first use of a form of the `ip wccp` command enables WCCP. By default WCCPv2 is used for services, but you can use WCCPv1 functionality instead. To change the running version of WCCP from Version 2 to Version 1, or to return to WCCPv2 after an initial change, use the `ip wccp version` command in global configuration mode.

If a function is not allowed in WCCPv1, an error prompt will be printed to the screen. For example, if WCCPv1 is running on the device and you try to configure a dynamic service, the following message will be displayed: “WCCP V1 only supports the web-cache service.” The `show ip wccp` EXEC command will display the WCCP protocol version number that is running on your device.

Use the `ip wccp web-cache password` command to set a password for a device and the content engines in a service group. MD5 password security requires that each device and content engine that wants to join a service group be configured with the service group password. The password must be up to eight characters in length. Each content engine or device in the service group will authenticate the security component in a received WCCP packet immediately after validating the WCCP message header. Packets failing authentication will be discarded.

## SUMMARY STEPS

1. enable
2. configure terminal
3. ip wccp version {1 | 2}
4. ip wccp {web-cache | service-number} [group-address multicast-address] [redirect-list access-list] [group-list access-list] [password password [0 | 7]]
5. interface type number
6. ip wccp {web-cache | service-number} redirect {in | out}
7. exit
8. interface type number
9. ip wccp redirect exclude in

## DETAILED STEPS

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal Example: Device# configure terminal</td>
<td>Enters global configuration mode.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> ip wccp version {1</td>
<td>2} Example: Device(config)# ip wccp version 2</td>
<td>Specifies which version of WCCP to configure on a device. • WCCPv2 is the default running version.</td>
</tr>
<tr>
<td><strong>Step 4</strong> ip wccp [web-cache</td>
<td>service-number] [group-address multicast-address] [redirect-list access-list] [group-list access-list] [password password [0</td>
<td>7]] Example: Device(config)# ip wccp web-cache password pwd</td>
</tr>
<tr>
<td><strong>Step 5</strong> interface type number Example: Device(config)# interface Gigabitethernet 0/0</td>
<td>Targets an interface number for which the web cache service will run, and enters interface configuration mode.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> ip wccp [web-cache</td>
<td>service-number] redirect {in</td>
<td>out} Example: Device(config-if)# ip wccp web-cache redirect in</td>
</tr>
<tr>
<td><strong>Step 7</strong> exit Example: Device(config-if)# exit</td>
<td>Exits interface configuration mode.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 8</strong> interface type number Example: Device(config)# interface GigabitEthernet 0/2/0</td>
<td>Targets an interface number on which to exclude traffic for redirection, and enters interface configuration mode.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 9</strong> ip wccp redirect exclude in Example: Device(config-if)# ip wccp redirect exclude in</td>
<td>(Optional) Excludes traffic on the specified interface from redirection.</td>
<td></td>
</tr>
</tbody>
</table>
Configuring Closed Services

Perform this task to specify the number of service groups for WCCP, to configure a service group as a closed or open service, and to optionally specify a check of all services.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. Enter one of the following commands:
   - `ip wccp [vrf vrf-name] service-number [service-list service-access-list mode {open | closed}]`
   - or
   - `ip wccp [vrf vrf-name] web-cache mode {open | closed}`
4. `ip wccp check services all`
5. `ip wccp [vrf vrf-name] {web-cache | service-number}`
6. `exit`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device&gt; enable</code></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td><code>configure terminal</code></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device# configure terminal</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
</tr>
<tr>
<td>Enter one of the following commands:</td>
<td>Configures a dynamic WCCP service as closed or open.</td>
</tr>
<tr>
<td>• `ip wccp [vrf vrf-name] service-number [service-list service-access-list mode {open</td>
<td>closed}]`</td>
</tr>
<tr>
<td>• or</td>
<td>Configures a web-cache service as closed or open.</td>
</tr>
<tr>
<td>• `ip wccp [vrf vrf-name] web-cache mode {open</td>
<td>closed}`</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device(config)# ip wccp 90 service-list 120 mode closed</code></td>
<td><strong>Note</strong> When configuring a dynamic WCCP service as a closed service, you must specify a service access list.</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td><code>Device(config)# ip wccp web-cache mode closed</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>(Optional) Enables a check of all WCCP services.</td>
</tr>
<tr>
<td><code>ip wccp check services all</code></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Device(config)# ip wccp check services all</td>
<td>Use this command to configure WCCP to check the other configured services for a match and perform redirection for those services if appropriate. The caches to which packets are redirected can be controlled by the redirect ACL and not just the service description.</td>
</tr>
</tbody>
</table>

**Note** The `ip wccp check services all` command is a global WCCP command that applies to all services and is not associated with a single service.

| Step 5 | ip wccp [vrf vrf-name] {web-cache | service-number} |
|--------|-----------------------------------------------------|
| **Example:** | Device(config)# ip wccp 201 |

<table>
<thead>
<tr>
<th>Step 6</th>
<th>exit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# exit</td>
</tr>
</tbody>
</table>

### Registering a Router to a Multicast Address

If you decide to use the multicast address option for your service group, you must configure the router to listen for the multicast broadcasts on an interface.

For network configurations where redirected traffic needs to traverse an intervening router, the router being traversed must be configured to perform IP multicast routing. You must configure the following two components to enable traversal over an intervening router:

- Enable IP multicast routing using the `ip multicast-routing` global configuration command.
- Enable the interfaces to which the cache engines will connect to receive multicast transmissions using the `ip wccp group-listen` interface configuration command.

### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `ip multicast-routing [vrf vrf-name] [distributed]`
4. `ip wccp [vrf vrf-name] {web-cache | service-number} group-address multicast-address`
5. `interface type number`
6. `ip pim {sparse-mode | sparse-dense-mode | dense-mode [proxy-register {list access-list | route-map map-name}]}`
7. `ip wccp [vrf vrf-name] {web-cache | service-number} group-listen`
### DETAILED STEPS

<table>
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<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td></td>
<td>Device&gt; enable</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 2</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
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<tbody>
<tr>
<td>Step 2</td>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device# configure terminal</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 3</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 3</td>
<td>ip multicast-routing [vrf vrf-name] [distributed]</td>
<td>Enables IP multicast routing.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config)# ip multicast-routing</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 4</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 4</td>
<td>ip wccp [vrf vrf-name] [web-cache</td>
<td>specifies the multicast address for the service group.</td>
</tr>
<tr>
<td></td>
<td>service-number]</td>
<td>group-address multicast-address</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config)# ip wccp 99 group-address 239.1.1.1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 5</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 5</td>
<td>interface type number</td>
<td>Enables the interfaces to which the content engines will connect to receive multicast transmissions for which the web cache service will run, and enters interface configuration mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config)# interface ethernet 0/0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 6</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 6</td>
<td>ip pim [sparse-mode</td>
<td>(Optional) Enables Protocol Independent Multicast (PIM) on an interface.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Note: To ensure correct operation of the ip wccp group-listen command on Cisco 7600 series routers, you must enter the ip pim command in addition to the ip wccp group-listen command.</td>
</tr>
<tr>
<td></td>
<td>sparse-dense-mode</td>
<td></td>
</tr>
<tr>
<td></td>
<td>dense-mode</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[proxy-register</td>
<td></td>
</tr>
<tr>
<td></td>
<td>list access-list</td>
<td></td>
</tr>
<tr>
<td></td>
<td>route-map map-name}</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# ip pim dense-mode</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 7</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 7</td>
<td>ip wccp [vrf vrf-name]</td>
<td>Configures an interface to enable or disable the reception of IP multicast packets for WCCP.</td>
</tr>
<tr>
<td></td>
<td>[web-cache</td>
<td>service-number]</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# ip wccp 99 group-listen</td>
<td></td>
</tr>
</tbody>
</table>

### Using Access Lists for a WCCP Service Group

Perform this task to configure the device to use an access list to determine which traffic should be directed to which content engines.
SUMMARY STEPS

1. enable
2. configure terminal
3. access-list access-list-number remark remark
4. access-list access-list-number permit {source [source-wildcard] | any} [log]
5. access-list access-list-number remark remark
6. access-list access-list-number deny {source [source-wildcard] | any} [log]
7. Repeat some combination of Steps 3 through 6 until you have specified the sources on which you want to base your access list.
8. ip wccp [vrf vrf-name] web-cache group-list access-list
9. ip wccp [vrf vrf-name] web-cache redirect-list access-list

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> access-list access-list-number remark remark</td>
<td>(Optional) Adds a user-friendly comment about an access list entry.</td>
</tr>
<tr>
<td>Example:</td>
<td>• A remark of up to 100 characters can precede or follow an access list entry.</td>
</tr>
<tr>
<td>Device(config)# access-list 1 remark Give access to user1</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> access-list access-list-number permit {source [source-wildcard]</td>
<td>any} [log]</td>
</tr>
<tr>
<td>Example:</td>
<td>• Every access list needs at least one permit statement; it does not need to be the first entry.</td>
</tr>
<tr>
<td>Device(config)# access-list 1 permit 172.16.5.22 0.0.0.0</td>
<td>• Standard IP access lists are numbered 1 to 99 or 1300 to 1999.</td>
</tr>
<tr>
<td></td>
<td>• If the source-wildcard is omitted, a wildcard mask of 0.0.0.0 is assumed, meaning match on all bits of the source address.</td>
</tr>
<tr>
<td></td>
<td>• Optionally use the keyword any as a substitute for the source source-wildcard to specify the source and source wildcard of 0.0.0.0 255.255.255.255.</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Step 5</strong> access-list access-list-number remark remark</td>
<td>• In this example, host 172.16.5.22 is allowed to pass the access list.</td>
</tr>
</tbody>
</table>

*Example:*

Device(config)# access-list 1 remark Give access to user1

(Optional) Adds a user-friendly comment about an access list entry.

• A remark of up to 100 characters can precede or follow an access list entry.

| Step 6 | access-list access-list-number deny {source [source-wildcard] | any} | [log] |
|--------|-------------------|---------|

*Example:*

Device(config)# access-list 1 deny 172.16.7.34 0.0.0.0

Denies the specified source based on a source address and wildcard mask.

• If the `source-wildcard` is omitted, a wildcard mask of 0.0.0.0 is assumed, meaning match on all bits of the source address.

• Optionally use the abbreviation any as a substitute for the `source-wildcard` to specify the source and source wildcard of 0.0.0.0 255.255.255.255.

• In this example, host 172.16.7.34 is denied passing the access list.

<table>
<thead>
<tr>
<th>Step 7</th>
<th>Repeat some combination of Steps 3 through 6 until you have specified the sources on which you want to base your access list.</th>
</tr>
</thead>
</table>

Remember that all sources not specifically permitted are denied by an implicit `deny` statement at the end of the access list.

<table>
<thead>
<tr>
<th>Step 8</th>
<th><code>ip wccp [vrf vrf-name] web-cache group-list access-list</code></th>
</tr>
</thead>
</table>

*Example:*

Device(config) ip wccp web-cache group-list 1

Indicates to the device from which IP addresses of content engines to accept packets.

<table>
<thead>
<tr>
<th>Step 9</th>
<th><code>ip wccp [vrf vrf-name] web-cache redirect-list access-list</code></th>
</tr>
</thead>
</table>

*Example:*

Device(config)# ip wccp web-cache redirect-list 1

(Optional) Disables caching for certain clients.

---

**Enabling the WCCP Outbound ACL Check**

**Note**

When all redirection is performed in the hardware, the mode of redirection will change when outbound ACL checking is enabled. The first packet is switched in software to allow the extra ACL check to be performed before a shortcut is installed.

**SUMMARY STEPS**

1. enable
2. configure terminal
3. ip wccp [vrf vrf-name] {web-cache | service-number} [group-address multicast-address] [redirect-list access-list] [group-list access-list] [password password]
4. ip wccp check acl outbound
5. exit

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>enable</td>
</tr>
<tr>
<td>Example:</td>
<td>Device&gt; enable</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>configure terminal</td>
</tr>
<tr>
<td>Example:</td>
<td>Device# configure terminal</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>ip wccp [vrf vrf-name] {web-cache</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# ip wccp web-cache</td>
</tr>
<tr>
<td></td>
<td>Note</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>ip wccp check acl outbound</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# ip wccp check acl outbound</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>exit</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# exit</td>
</tr>
</tbody>
</table>

Enabling WCCP Interoperability with NAT

SUMMARY STEPS

1. enable
2. configure terminal
3. interface type number
4. ip nat inside
5. ip wccp service-number redirect in
6. exit
7. `interface type number`
8. `ip nat outside`
9. `ip wccp service-number redirect in`
10. `exit`
11. `interface type number`
12. `ip nat inside`
13. `ip wccp redirect exclude in`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><code>enable</code></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><code>Example:</code></td>
<td></td>
</tr>
<tr>
<td><code>Router&gt; enable</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><code>configure terminal</code></td>
<td></td>
</tr>
<tr>
<td><code>Example:</code></td>
<td></td>
</tr>
<tr>
<td><code>Router# configure terminal</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Specifies an interface on which to enable NAT and enters interface configuration mode.</td>
</tr>
<tr>
<td><code>interface type number</code></td>
<td>• This is the LAN-facing interface.</td>
</tr>
<tr>
<td><code>Example:</code></td>
<td></td>
</tr>
<tr>
<td><code>Router(config)# interface ethernet 1</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>Designates that traffic originating from or destined for the interface is subject to NAT and indicates that the interface is connected to the inside network (the network subject to NAT translation).</td>
</tr>
<tr>
<td><code>ip nat inside</code></td>
<td></td>
</tr>
<tr>
<td><code>Example:</code></td>
<td></td>
</tr>
<tr>
<td><code>Router(config-if)# ip nat inside</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>Enables packet redirection on an inbound interface using WCCP.</td>
</tr>
<tr>
<td><code>ip wccp service-number redirect in</code></td>
<td></td>
</tr>
<tr>
<td><code>Example:</code></td>
<td></td>
</tr>
<tr>
<td><code>Router(config-if)# ip wccp 61 redirect in</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td>Exits interface configuration mode and returns to global configuration mode.</td>
</tr>
<tr>
<td><code>exit</code></td>
<td></td>
</tr>
<tr>
<td><code>Example:</code></td>
<td></td>
</tr>
<tr>
<td><code>Router(config-if)# exit</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td>Specifies an interface on which to enable NAT and enters interface configuration mode.</td>
</tr>
<tr>
<td><code>interface type number</code></td>
<td>• This is the WAN-facing interface.</td>
</tr>
<tr>
<td><code>Example:</code></td>
<td></td>
</tr>
<tr>
<td><code>Router(config)# interface ethernet 2</code></td>
<td></td>
</tr>
</tbody>
</table>
### Command or Action

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 8</td>
<td><code>ip nat outside</code></td>
<td>Designates that traffic originating from or destined for the interface is subject to NAT and indicates that the interface is connected to the outside network.</td>
</tr>
<tr>
<td>Example:</td>
<td><code>Router(config-if)# ip nat outside</code></td>
<td></td>
</tr>
<tr>
<td>Step 9</td>
<td><code>ip wccp service-number redirect in</code></td>
<td>Enables packet redirection on an inbound interface using WCCP.</td>
</tr>
<tr>
<td>Example:</td>
<td><code>Router(config-if)# ip wccp 62 redirect in</code></td>
<td></td>
</tr>
<tr>
<td>Step 10</td>
<td><code>exit</code></td>
<td>Exits interface configuration mode and returns to global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td><code>Router(config-if)# exit</code></td>
<td></td>
</tr>
<tr>
<td>Step 11</td>
<td><code>interface type number</code></td>
<td>Specifies an interface on which to enable NAT and enters interface configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td><code>Router(config)# interface ethernet 3</code></td>
<td></td>
</tr>
<tr>
<td>• This is the WAAS-facing interface.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 12</td>
<td><code>ip nat inside</code></td>
<td>Designates that traffic originating from or destined for the interface is subject to NAT and indicates that the interface is connected to the inside network (the network subject to NAT translation).</td>
</tr>
<tr>
<td>Example:</td>
<td><code>Router(config-if)# ip nat inside</code></td>
<td></td>
</tr>
<tr>
<td>Step 13</td>
<td><code>ip wccp redirect exclude in</code></td>
<td>Configures an interface to exclude packets received on an interface from being checked for redirection.</td>
</tr>
<tr>
<td>Example:</td>
<td><code>Router(config-if)# ip wccp redirect exclude in</code></td>
<td></td>
</tr>
</tbody>
</table>

### Verifying and Monitoring WCCP Configuration Settings

#### SUMMARY STEPS

1. `enable`
2. `show ip wccp [web-cache | service-number] [detail view]`
3. `show ip interface`
4. `more system:running-config`

#### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td><code>enable</code></td>
</tr>
<tr>
<td>Example:</td>
<td>- Enter your password if prompted.</td>
</tr>
</tbody>
</table>
### Command or Action

**Device> enable**

**Step 2**

**show ip wccp [web-cache [service-number] [detail view]]**

**Example:**

Device# show ip wccp 24 detail

<table>
<thead>
<tr>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displays global information related to WCCP, including the protocol version running, the number of content engines in the router service group, which content engine group is allowed to connect to the router, and which access list is being used.</td>
</tr>
<tr>
<td><strong>service-number</strong>—(Optional) Dynamic number of the web-cache service group being controlled by the content engine. The range is from 0 to 99. For web caches that use Cisco Content Engines, the reverse proxy service is indicated by a value of 99.</td>
</tr>
<tr>
<td><strong>web-cache</strong>—(Optional) statistics for the web-cache service.</td>
</tr>
<tr>
<td><strong>detail</strong>—(Optional) other members of a particular service group or web cache that have or have not been detected.</td>
</tr>
<tr>
<td><strong>view</strong>—(Optional) information about a router or all web caches.</td>
</tr>
</tbody>
</table>

**Step 3**

**show ip interface**

**Example:**

Device# show ip interface

<table>
<thead>
<tr>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displays status about whether any ip wccp redirection commands are configured on an interface; for example, “Web Cache Redirect is enabled / disabled.”</td>
</tr>
</tbody>
</table>

**Step 4**

**more system:running-config**

**Example:**

Device# more system:running-config

<table>
<thead>
<tr>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Optional) Displays contents of the running configuration file (equivalent to the show running-config command).</td>
</tr>
</tbody>
</table>

### Configuration Examples for WCCP

#### Example: Changing the Version of WCCP on a Router

The following example shows how to change the WCCP version from the default of WCCPv2 to WCCPv1, and enabling the web-cache service in WCCPv1:

Device# show ip wccp
% WCCP version 2 is not enabled
Device# configure terminal

Device(config)# ip wccp version 1
Example: Configuring a General WCCPv2 Session

Device(config)# configure terminal
Device(config)# ip wccp web-cache
Device(config)# ip wccp source-interface GigabitEthernet 0/1/0
Device(config)# ip wccp check services all
Device(config)# interface GigabitEthernet 0/1/0
Device(config-if)# ip wccp web-cache redirect in
Device(config-if)# exit
Device(config)# interface GigabitEthernet 0/2/0
Device(config-if)# ip wccp redirect exclude in
Device(config-if)# exit

Example: Setting a Password for a Router and Content Engines

Router(config)# ip wccp web-cache password password

Example: Configuring a Web Cache Service

Device(config)# configure terminal
Device(config)# ip wccp web-cache
Device(config)# interface GigabitEthernet 0/1/0
Device(config-if)# ip wccp web-cache redirect in
Device(config-if)# exit
Device(config)# copy running-config startup-config

The following example shows how to configure a session in which redirection of HTTP traffic arriving on Gigabit Ethernet interface 0/1/0 is enabled:

Device(config)# configure terminal
Device(config)# interface GigabitEthernet 0/1/0
Device(config-if)# ip wccp web-cache redirect in
Device(config-if)# exit
Device(config)# show ip interface GigabitEthernet 0/1/0
WCCP Redirect inbound is enabled
WCCP Redirect exclude is disabled

Example: Running a Reverse Proxy Service

The following example assumes that you are configuring a service group using Cisco cache engines, which use dynamic service 99 to run a reverse proxy service:

Router# configure terminal
Router(config)# ip wccp 99
Router(config)# interface gigabitethernet 0/1/0
Router(config-if)# ip wccp 99 redirect out

Example: Registering a Router to a Multicast Address

Device# configure terminal
Device(config)# ip wccp web-cache group-address 224.1.1.100
Device(config)# interface gigabitethernet 0/1/0
Device(config-if)# ip wccp web-cache group-listen

The following example shows a router configured to run a reverse proxy service, using the multicast address of 224.1.1.1. Redirection applies to packets outgoing via Gigabit Ethernet interface 0/1/0:

Device# configure terminal
Device(config)# ip wccp 99 group-address 224.1.1.1
Device(config)# interface gigabitethernet 0/1/0
Device(config-if)# ip wccp 99 redirect out

Example: Using Access Lists

To achieve better security, you can use a standard access list to notify the device which IP addresses are valid addresses for a content engine attempting to register with the current device. The following example shows a standard access list configuration session where the access list number is 10 for some sample hosts:

Device(config)# access-list 10 permit host 10.1.1.1
Device(config)# access-list 10 permit host 10.1.1.2
Device(config)# access-list 10 permit host 10.1.1.3
Device(config)# ip wccp web-cache group-list 10

To disable caching for certain clients, servers, or client/server pairs, you can use WCCP access lists. The following example shows that any requests coming from 10.1.1.1 to 10.3.1.1 will bypass the cache, and that all other requests will be serviced normally:

Device(config)# ip wccp web-cache redirect-list 120
Device(config)# access-list 120 deny tcp host 10.1.1.1 any
Device(config)# access-list 120 deny tcp any host 10.3.1.1
Device(config)# access-list 120 permit ip any any
The following example configures a device to redirect web-related packets received via Gigabit Ethernet interface 0/1/0, destined to any host except 209.165.200.224:

Device(config)# access-list 100 deny ip any host 209.165.200.224
Device(config)# access-list 100 permit ip any any
Device(config)# interface gigabitethernet 0/1/0
Device(config-if)# ip wccp web-cache redirect-list 100

Example: WCCP Outbound ACL Check Configuration

The following configuration example shows that the access list prevents traffic from network 10.0.0.0 leaving Gigabit Ethernet interface 0/1/0. Because the outbound ACL check is enabled, WCCP does not redirect that traffic. WCCP checks packets against the ACL before they are redirected.

Device(config)# ip wccp web-cache
Device(config)# ip wccp check acl outbound
Device(config)# interface gigabitethernet 0/1/0
Device(config-if)# ip access-group 10 out
Device(config-if)# exit
Device(config)# ip wccp web-cache redirect-list redirect-out
Device(config)# access-list 10 deny 10.0.0.0 0.255.255.255
Device(config)# access-list 10 permit any

If the outbound ACL check is disabled, the HTTP packets from network 10.0.0.0 would be redirected to a web cache. Users with that network address could retrieve web pages even though the network administrator wanted to prevent it.

Example: Verifying WCCP Settings

The following example shows how to verify your configuration changes by using the more system:running-config command in privileged EXEC mode. The following example shows that both the web cache service and dynamic service 99 are enabled on the device:

Device# more system:running-config

Building configuration...
Current configuration:
!
version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
service udp-small-servers
service tcp-small-servers
!
hostname router4
!
enable secret 5 $1$nSVy$flalijfVQXVFw.KuCzNThl
enable password password1
!
ip subnet-zero
ip wccp web-cache
ip wccp 99
ip domain-name cisco.com
ip name-server 10.1.1.1
ip name-server 10.1.1.2
The following example shows how to display global statistics related to WCCP:

```
Device# show ip wccp web-cache detail

WCCP Client information:
WCCP Client ID: 10.1.1.2
Protocol Version: 2.0
State: Usable
Redirection: L2
Packet Return: L2
Packets Redirected: 0
Connect Time: 00:20:34
Assignment: MASK
Mask  SrcAddr  DstAddr  SrcPort  DstPort
```

The following example shows how to display global statistics related to WCCP:
Example: Enabling WCCP Interoperability with NAT

Router(config)# interface ethernet1 ! This is the LAN-facing interface
Router(config-if)# ip nat inside
Router(config-if)# ip wccp 61 redirect in
Router(config-if)# exit
Router(config)# interface ethernet2 ! This is the WAN-facing interface
Router(config-if)# ip nat outside
Router(config-if)# ip wccp 62 redirect in
Router(config-if)# exit
Router(config)# interface ethernet3 ! This is the WAAS-facing interface
Router(config-if)# ip nat inside
Router(config-if)# ip wccp redirect exclude in

Additional References

Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
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</thead>
<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Commands List, All Releases</td>
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<td>Cisco ACNS software configuration information</td>
<td>• Cisco ACNS Software Caching Configuration Guide, Release 4.2</td>
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<td>• Cisco ACNS Software listing page on Cisco.com</td>
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<tr>
<td>IP access list overview, configuration tasks, and commands</td>
<td>Cisco IOS Security Command Reference</td>
</tr>
<tr>
<td>IP addressing and services commands and configuration tasks</td>
<td>• Cisco IOS IP Addressing Services Configuration Guide</td>
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<td>• Cisco IOS IP Addressing Services Command Reference</td>
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### MIBs

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<td>No new or modified MIBs are supported, and support for existing MIBs has not been modified.</td>
<td>To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
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### RFCs

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### Technical Assistance

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<th>Description</th>
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<td>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.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
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## Feature Information for WCCP

### Table 7: Feature Information for WCCP

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<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>WCCP Bypass Counters</td>
<td>Cisco IOS XE Release 2.2</td>
<td>The WCCP Bypass Counters feature allows you to display a count of packets that have been bypassed by a web cache and returned to the originating router to be forwarded normally. The <code>show ip wccp</code> command was modified by this feature.</td>
</tr>
<tr>
<td>WCCP: Check Services All</td>
<td>Cisco IOS XE Release 3.1S</td>
<td>The WCCP: Check Services All feature enables you to configure WCCP to search all service groups and redirect ACLs in priority order for a match. The following command was modified by this feature: <code>ip wccp check services all</code></td>
</tr>
<tr>
<td>WCCP Closed Services</td>
<td>Cisco IOS XE Release 3.1S</td>
<td>The WCCP Closed Services feature permits WCCP services to be configured so that WCCP always intercepts traffic for such services but, if no WCCP client (such as a content engine) has registered to receive this traffic, packets are discarded. This behavior supports Application-Oriented Network Services (AONS) applications, which require traffic to be transparently intercepted using WCCP but do not want the packets to be forwarded to their destination if the WCCP client is unavailable to perform its processing. (This is contrary to the traditional use of WCCP to assist caches where the absence of a cache does not change the behavior as observed by the user.) The following command was modified by this feature: <code>ip wccp</code></td>
</tr>
<tr>
<td>WCCP—Configurable Router ID</td>
<td>Cisco IOS XE Release 3.1S</td>
<td>The WCCP—Configurable Router ID feature permits the router ID which WCCP uses to be configurable, rather than relying on the router’s selection mechanism. The following command was modified by this feature: <code>ip wccp source-interface</code></td>
</tr>
<tr>
<td>WCCP Egress Redirection Support</td>
<td>Cisco IOS XE Release 3.1S</td>
<td>The WCCP Egress Redirection Support feature enables WCCP based redirection applied to the outbound traffic on the outbound interface. The following command was modified by this feature: <code>ip wccp redirect</code></td>
</tr>
<tr>
<td>WCCP Exclude Interface</td>
<td>Cisco IOS XE Release 3.1S</td>
<td>The WCCP Exclude Interface feature enables you to configure an interface to exclude packets received on an interface from being checked for redirection by configuring. The following command was introduced by this feature: <code>ip wccp redirect exclude</code></td>
</tr>
<tr>
<td>Feature Name</td>
<td>Releases</td>
<td>Feature Information</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>---------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>WCCP Fast Timers</td>
<td>Cisco IOS XE Release 3.1S</td>
<td>The WCCP Fast Timers feature enables WCCP to establish redirection more quickly when a WCCP client is added to a service group or when a WCCP client fails. The following command was modified by this feature: <code>show ip wccp</code>.</td>
</tr>
<tr>
<td>WCCP Group List</td>
<td>Cisco IOS XE Release 3.1S</td>
<td>The WCCP Group List feature enables you to configure the IP addresses of cache engines from which a router accepts packets. Configuring a group list is used to validate the protocol packets received from the cache engine. Packets matching the address in a configured group-list are processed, others are discarded. The following command was modified by this feature: <code>ip wccp</code>.</td>
</tr>
<tr>
<td>WCCP—Group Listen and Multicast Service Support</td>
<td>Cisco IOS XE Release 3.1S</td>
<td>The WCCP—Group Listen and Multicast Service Support feature adds the ability to configure a multicast address per service group for sending and receiving protocol messages. In the multicast address method, the cache engine sends a single-address notification that provides coverage for all routers in the service group. The following command was modified by this feature: <code>ip wccp group-listen</code>.</td>
</tr>
<tr>
<td>WCCP Increased Services</td>
<td>Cisco IOS XE Release 3.1S</td>
<td>The WCCP Increased Services feature increases the number of services supported by WCCP to a maximum of 256 across all VRFs. The following commands were modified by this feature: <code>ip wccp</code>, <code>ip wccp check services all</code>, <code>ip wccp outbound-acl-check</code>, <code>show ip wccp</code>.</td>
</tr>
<tr>
<td>WCCP Layer 2 Redirection/Forwarding</td>
<td>Cisco IOS XE Release 2.2</td>
<td>The WCCP Layer 2 Redirection/Forwarding feature allows directly connected Cisco content engines to use Layer 2 redirection, which is more efficient than Layer 3 redirection via GRE encapsulation. You can configure a directly connected Cache Engine to negotiate use of the WCCP Layer 2 Redirection/Forwarding feature. The WCCP Layer 2 Redirection/Forwarding feature requires no configuration on the router or switch. There are no new or modified commands associated with this feature.</td>
</tr>
<tr>
<td>WCCP L2 Return</td>
<td>Cisco IOS XE Release 2.2</td>
<td>The WCCP L2 Return feature allows content engines to return packets to WCCP routers directly connected at Layer 2 by swapping the source and destination MAC addresses rather than tunneling packets back to the router inside a Layer 3 GRE tunnel. There are no new or modified commands associated with this feature.</td>
</tr>
<tr>
<td>Feature Name</td>
<td>Releases</td>
<td>Feature Information</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>WCCP Mask Assignment</td>
<td>Cisco IOS XE Release 2.2</td>
<td>The WCCP Mask Assignment feature introduces support for ACNS/WAAS devices using mask assignment as a cache engine assignment method. There are no new or modified commands associated with this feature.</td>
</tr>
<tr>
<td>WCCP Outbound ACL Check</td>
<td>Cisco IOS XE Release 3.1S</td>
<td>The WCCP Outbound ACL Check feature enables you to ensure that traffic redirected by WCCP at an input interface is subjected to the outbound ACL checks that may be configured on the output interface prior to redirection. This feature is supported by Web Cache Communication Protocol (WCCP) Version 1 and Version 2. The following commands were introduced or modified by this feature: <code>ip wccp, ip wccp check acl outbound</code>.</td>
</tr>
<tr>
<td>WCCP Redirection on Inbound Interfaces</td>
<td>Cisco IOS XE Release 2.2, Cisco IOS XE Release 3.0S</td>
<td>The WCCP Redirection on Inbound Interfaces feature enables interfaces to be configured for input redirection for a particular WCCP service. When this feature is enabled on an interface, all packets arriving at that interface are compared against the specified WCCP service. If the packets match, they will be redirected. The following commands were introduced or modified by this feature: <code>ip wccp redirect-list</code>.</td>
</tr>
</tbody>
</table>
| WCCP Version 2               | Cisco IOS XE Release 2.2        | The WCCP Version 2 feature provides several enhancements and features to the WCCP protocol, including:  
  - The ability of multiple routers to service a content engine cluster.  
  - Redirection of traffic other than HTTP (TCP port 80 traffic), including a variety of UDP and TCP traffic.  
  - Optional authentication that enables you to control which routers and content engines become part of the service group using passwords and the HMAC MD5 standard.  
  - A check on packets that determines which requests have been returned from the content engine unserviced.  
  - Load adjustments for individual content engines to provide an effective use of the available resources while helping to ensure high quality of service (QoS) to the clients.  
  The following commands were introduced or modified by this feature: `clear ip wccp, ip wccp, ip wccp group-listen, ip wccp redirect, ip wccp redirect exclude in, ip wccp version, show ip wccp`. |
The WCCP VRF Support feature provides enhancements to the existing WCCPv2 protocol which support VRF awareness.

In Cisco IOS Release 12.2(33)SRE, this feature is supported only on Cisco 7200 NPE-G2 and Cisco 7304-NPE-G100 routers.

The following commands were introduced or modified by this feature: `clear ip wccp, debug ip wccp, ip wccp, ip wccp group-listen, ip wccp redirect, show ip wccp`.

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>WCCP VRF Support</td>
<td>Cisco IOS XE</td>
<td>The WCCP VRF Support feature provides enhancements to the existing WCCPv2 protocol which support VRF awareness. In Cisco IOS Release 12.2(33)SRE, this feature is supported only on Cisco 7200 NPE-G2 and Cisco 7304-NPE-G100 routers. The following commands were introduced or modified by this feature: <code>clear ip wccp, debug ip wccp, ip wccp, ip wccp group-listen, ip wccp redirect, show ip wccp</code>.</td>
</tr>
<tr>
<td></td>
<td>Release 3.1S</td>
<td></td>
</tr>
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</table>
WCCP—Configurable Router ID

The WCCP—Configurable Router ID feature enables the configuration of a Web Cache Communication Protocol (WCCP) source interface. The IP address of this configured source interface is then used as the preferred WCCP router ID and WCCP GRE source address. When a WCCP router ID is manually configured, router IDs are no longer automatically generated when the current router ID is no longer valid and the router ID does not change when another IP address is added to the system.

- Finding Feature Information, on page 121
- Restrictions for WCCP—Configurable Router ID, on page 121
- Information About WCCP—Configurable Router ID, on page 122
- How to Configure WCCP—Configurable Router ID, on page 122
- Configuration Examples for WCCP—Configurable Router ID, on page 123
- Additional References for WCCP—Configurable Router ID, on page 123
- Feature Information for WCCP—Configurable Router ID, on page 124

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and 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 table.

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

Restrictions for WCCP—Configurable Router ID

The following restriction apply to this feature:

- Do not configure the Web Cache Control Protocol (WCCP) router ID as the tunnel source, if multipoint generic routing encapsulation (GRE) tunnels are configured on a router, because this configuration may cause the traffic over this tunnel to fail.
Information About WCCP—Configurable Router ID

WCCP—Configurable Router ID Overview

WCCP uses a router ID in its control messages that a WCCP client can use to uniquely identify a particular WCCP server. The router ID is an IP address and is used as the source address of any WCCP-generated Generic Routing Encapsulation (GRE) frames. Prior to the WCCP—Configurable Router ID feature, WCCP selected a router ID using an automatic mechanism; the highest reachable IP address on the system (or the highest loopback IP address, if there is one) was used as the WCCP router ID. The highest IP address on the system is not always the best choice as the router ID or as the source address of GRE frames. A change in addressing information on the system may cause the WCCP router ID to change unexpectedly. During this changeover period, WCCP clients briefly advertise the existence of two routers (the old router ID and the new router ID) and GRE frames are sourced from a different address.

The WCCP—Configurable Router ID feature enables you to define a WCCP source interface from which the router ID will be obtained. The IP address of this configured source interface is then used as the preferred WCCP router ID and WCCP GRE source address. When a WCCP router ID is manually configured, the router ID does not change when another IP address is added to the system. The router ID changes only when a new router ID is manually configured using the `ip wccp source-interface` or the `ipv6 wccp source-interface` command, or when the address on the manually configured interface is no longer valid.

How to Configure WCCP—Configurable Router ID

Configuring a Preferred WCCP Router ID

SUMMARY STEPS

1. enable
2. configure terminal
3. ip wccp [vrf vrf-name] source-interface source-interface
4. exit

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
</tbody>
</table>
### Purpose

**Command or Action**

<table>
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<tr>
<th>Command or Action</th>
<th>Purpose</th>
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</thead>
<tbody>
<tr>
<td>ip wccp [vrf vrf-name] source-interface source-interface</td>
<td>Configures a preferred WCCP router ID.</td>
</tr>
</tbody>
</table>

**Example:**

Device(config)# ip wccp source-interface GigabitEthernet 0/0/0

---

**Step 4**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>exit</td>
<td>Exits global configuration mode and returns to privileged EXEC mode.</td>
</tr>
</tbody>
</table>

**Example:**

Device(config)# exit

---

### Configuration Examples for WCCP—Configurable Router ID

#### Example: Configuring a Preferred WCCP Router ID

The following example displays the configuration for a preferred WCCP router ID:

```
! Configure a preferred WCCP router ID
ip wccp source-interface GigabitEthernet 0/0/0
```

---

### Additional References for WCCP—Configurable Router ID

#### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
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<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Commands List, All Releases</td>
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<tr>
<td>WCCP commands</td>
<td>Cisco IOS IP Application Services Command Reference</td>
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<td>Currently assigned IP multicast addresses</td>
<td>Internet Multicast Addresses <a href="http://www.iana.org/assignments/multicast-addresses">http://www.iana.org/assignments/multicast-addresses</a></td>
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<td>Configuration fundamentals configuration tasks</td>
<td>Cisco IOS Configuration Fundamentals Configuration Guide</td>
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<td>Configuration fundamentals commands</td>
<td>Cisco IOS Configuration Fundamentals Command Reference</td>
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<tr>
<td>Cisco IOS bridging and IBM networking configuration tasks</td>
<td>Cisco IOS Bridging and IBM Networking Configuration Guide</td>
</tr>
<tr>
<td>Cisco IOS bridging and IBM networking commands</td>
<td>Cisco IOS Bridging and IBM Networking Command Reference</td>
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</table>
### Feature Information for WCCP—Configurable Router ID

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

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

<table>
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<tr>
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<tr>
<td>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.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
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### Related Topic

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<tr>
<td>Cisco IOS IP multicast configuration tasks</td>
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<tr>
<td>Cisco IOS IP Multicast Command Reference</td>
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<td>Cisco IOS IP Multicast Configuration Guide</td>
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<td>Cisco IOS IP Multicast Command Reference</td>
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### New Topic

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<td>802.1D MAC Bridges</td>
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<td>IEEE Spanning-Tree Bridging</td>
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### MIBs Link

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<td>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.</td>
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</table>

<table>
<thead>
<tr>
<th>Link</th>
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</table>
WCCPv2—IPv6 Support

This feature introduces support for Web Cache Communication Protocol version 2 (WCCPv2) in an IPv6 environment.

WCCP is a Cisco-developed content-routing technology that intercepts IP packets and redirects those packets to a destination other than that specified in the IP packet. Typically the packets are redirected from their destination web server on the Internet to a content engine that is local to the client. In some WCCP deployment scenarios, redirection of traffic may also be required from the web server to the client. WCCP enables you to integrate content engines into your network infrastructure.

Multiple routers can use WCCPv2 to service a content engine cluster. In WCCPv1, only one router can redirect content requests to a cluster.

- Finding Feature Information, on page 125
- Prerequisites for WCCPv2—IPv6 Support, on page 125
- Restrictions for WCCPv2—IPv6 Support, on page 126
- Information About WCCPv2—IPv6 Support, on page 126
- How to Configure WCCPv2—IPv6 Support, on page 136
- Configuration Examples for WCCPv2—IPv6 Support, on page 145
- Additional References, on page 150
- Feature Information for WCCPv2—IPv6 Support, on page 151

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and 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 table.

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

Prerequisites for WCCPv2—IPv6 Support

- IPv6 must be configured on the interface used for redirection and on the interface facing the content engine.
The interface connected to the content engine must be a Fast Ethernet or Gigabit Ethernet interface.

Restrictions for WCCPv2—IPv6 Support

WCCPv2

- For routers servicing a multicast cluster, the Time To Live (TTL) value must be set at 15 or lower.
- Service groups can comprise up to 32 content engines and 32 routers.
- All content engines in a cluster must be configured to communicate with all routers servicing the cluster.
- Multicast addresses must be in the range from 224.0.0.0 to 239.255.255.255.

Layer 2 Forwarding and Return

- Layer 2 redirection requires that content engines be directly connected to an interface on each WCCP router. Unless multicast IP addresses are used, WCCP configuration of the content engine must reference the directly connected interface IP address of the WCCP router and not a loopback IP address or any other IP address configured on the WCCP router.

Information About WCCPv2—IPv6 Support

WCCP Overview

WCCP uses Cisco Content Engines (or other content engines running WCCP) to localize traffic patterns in the network, enabling content requests to be fulfilled locally. Traffic localization reduces transmission costs and download time.

WCCP enables routing platforms to transparently redirect content requests. With transparent redirection, users can fulfill content requests locally without configuring their browsers to use a web proxy. Instead, they can use the target URL to request content, and have their requests automatically redirected to a content engine. The word "transparent" in this case means that the end user does not know that a requested file (such as a web page) came from the content engine instead of from the originally specified server.

A content engine receiving a request attempts to service it from its own local cache. If the requested information is not present, the content engine issues its own request to the originally targeted server to get the required information. A content engine retrieving the requested information forwards it to the requesting client and caches it to fulfill future requests, thus maximizing download performance and substantially reducing transmission costs.

WCCP enables a series of content engines, called a content engine cluster, to provide content to a router or multiple routers. Network administrators can easily scale their content engines to manage heavy traffic loads through these clustering capabilities. Cisco clustering technology enables each cluster member to work in parallel, resulting in linear scalability. Clustering content engines greatly improves the scalability, redundancy, and availability of your caching solution. You can cluster up to 32 content engines to scale to your desired capacity.
Layer 2 Forwarding Redirection and Return

WCCP uses either generic routing encapsulation (GRE) or Layer 2 (L2) to redirect or return IP traffic. When WCCP forwards traffic via GRE, the redirected packets are encapsulated within a GRE header. The packets also have a WCCP redirect header. When WCCP forwards traffic using L2, the original MAC header of the IP packet is overwritten and replaced with the MAC header for the WCCP client.

Using L2 as a forwarding method allows direct forwarding to the content engine without further lookup. Layer 2 redirection requires that the router and content engines are directly connected, that is, on the same IP subnetwork.

When WCCP returns traffic via GRE, the returned packets are encapsulated within a GRE header. The destination IP address is the address of the router and the source address is the address of the WCCP client. When WCCP returns traffic via L2, the original IP packet is returned without any added header information. The router to which the packet is returned will recognize the source of the packet and prevent redirection.

The WCCP redirection method does not have to match the return method.

L2 forwarding, return, or redirection are typically used for hardware-accelerated platforms. Depending on your release, L2 forwarding, return, and redirection can also be used for software-switching platforms.

For content engines running Application and Content Networking System (ACNS) software, use the `wccp custom-web-cache` command with the `l2-redirect` keyword to configure L2 redirection. For content engines running Cisco Wide Area Application Services (WAAS) software, use the `wccp tcp-promiscuous` command with the `l2-redirect` keyword to configure L2 redirection.

---

**Note**

Before configuring a GRE tunnel, configure a loopback interface (that is not attached to a VRF) with an IP address so that the internally created tunnel interface is enabled for IPv4 forwarding by unnumbering itself to this dummy loopback interface. You do not need to configure a loopback interface if the system has at least one interface that is not attached to a VRF and that is configured with an IPv4 address.

For information about Cisco ACNS commands used to configure Cisco Content Engines, see the Cisco ACNS Software Command Reference.

For more information about WAAS commands used to configure Cisco Content Engines, see the Cisco Wide Area Application Services Command Reference.

---

WCCP Mask Assignment

The WCCP Mask Assignment feature enables mask assignment as the load-balancing method (instead of the default hash assignment method) for a WCCP service.

For content engines running Application and Content Networking System (ACNS) software, use the `wccp custom-web-cache` command with the `mask-assign` keyword to configure mask assignment. For content engines running Cisco Wide Area Application Services (WAAS) software, use the `wccp tcp-promiscuous` command with the `mask-assign` keyword to configure mask assignment.

For information about Cisco ACNS commands used to configure Cisco Content Engines, see the Cisco ACNS Software Command Reference.

For more information about WAAS commands used to configure Cisco Content Engines, see the Cisco Wide Area Application Services Command Reference.
**WCCP Hash Assignment**

The Cisco ASR 1000 Series Aggregation Services Routers support hash assignment for IPv6 load balance across different content engines, but does not support mask assignment. However, it supports both hash assignment and mask assignment for IPv4.

For content engines running the Cisco Application and Content Networking System (ACNS) software, use the `wccp custom-web-cache` command with the `hash-assign` keyword to configure hash assignment. For content engines running Cisco Wide Area Application Services (WAAS) software, use the `wccp tcp-promiscuous` command with the `hash-assign` keyword to configure hash assignment.

For information about Cisco ACNS commands used to configure Cisco Content Engines, see the Cisco ACNS Software Command Reference.

For more information about WAAS commands used to configure Cisco Content Engines, see the Cisco Wide Area Application Services Command Reference.

**WCCPv2 Configuration**

Multiple routers can use WCCPv2 to service a content engine cluster. In WCCPv1, only one router could redirect content requests to a cluster. The figure below illustrates a sample configuration using multiple routers.

*Figure 7: Cisco Content Engine Network Configuration Using WCCPv2*

The subset of content engines within a cluster and routers connected to the cluster that are running the same service is known as a service group. Available services include TCP and UDP redirection.

In WCCPv1, the content engines were configured with the address of the single router. WCCPv2 requires that each content engine be aware of all the routers in the service group. To specify the addresses of all the routers in a service group, you must choose one of the following methods:
• Unicast—A list of router addresses for each of the routers in the group is configured on each content engine. In this case the address of each router in the group must be explicitly specified for each content engine during configuration.

• Multicast—A single multicast address is configured on each content engine. In the multicast address method, the content engine sends a single-address notification that provides coverage for all routers in the service group. For example, a content engine could indicate that packets should be sent to a multicast address of 224.0.0.100, which would send a multicast packet to all routers in the service group configured for group listening using WCCP (see the `ip wccp group-listen` or the `ipv6 wccp group-listen` interface configuration command for details).

The multicast option is easier to configure because you need only specify a single address on each content engine. This option also allows you to add and remove routers from a service group dynamically, without needing to reconfigure the content engines with a different list of addresses each time.

The following sequence of events details how WCCPv2 configuration works:

1. Each content engine is configured with a list of routers.
2. Each content engine announces its presence and a list of all routers with which it has established communications. The routers reply with their view (list) of content engines in the group.
3. When the view is consistent across all content engines in the cluster, one content engine is designated as the lead and sets the policy that the routers need to deploy in redirecting packets.

**WCCPv2 Support for Services Other Than HTTP**

WCCPv2 allows redirection of traffic other than HTTP (TCP port 80 traffic), including a variety of UDP and TCP traffic. WCCPv2 supports the redirection of packets intended for other ports, including those used for proxy-web cache handling, File Transfer Protocol (FTP) caching, FTP proxy handling, web caching for ports other than 80, and Real Audio, video, and telephony applications.

To accommodate the various types of services available, WCCPv2 introduced the concept of multiple service groups. Service information is specified in the WCCP configuration commands using dynamic services identification numbers (such as 98) or a predefined service keyword (such as `web-cache`). This information is used to validate that service group members are all using or providing the same service.

The content engines in a service group specify traffic to be redirected by protocol (TCP or UDP) and up to eight source or destination ports. Each service group has a priority status assigned to it. The priority value is in the range of 0 to 255 where 0 is the lowest priority. The predefined `web-cache` service has an assigned priority of 240.

**WCCPv2 Support for Multiple Routers**

WCCPv2 allows multiple routers to be attached to a cluster of cache engines. The use of multiple routers in a service group allows for redundancy, interface aggregation, and distribution of the redirection load. WCCPv2 supports up to 32 routers per service group. Each service group is established and maintained independently.

**WCCPv2 MD5 Security**

WCCPv2 provides optional authentication that enables you to control which routers and content engines become part of the service group using passwords and the Hashed Message Authentication Code—Message...
Digest (HMAC MD5) standard. Shared-secret MD5 one-time authentication (set using the `ip wccp [password [0 | 7] password]` global configuration command) enables messages to be protected against interception, inspection, and replay.

**WCCPv2 Web Cache Packet Return**

If a content engine is unable to provide a requested object it has cached due to error or overload, the content engine will return the request to the router for onward transmission to the originally specified destination server. WCCPv2 provides a check on packets that determines which requests have been returned from the content engine unserviced. Using this information, the router can then forward the request to the originally targeted server (rather than attempting to resend the request to the content engine cluster). This process provides error handling transparency to clients.

Typical reasons why a content engine would reject packets and initiate the packet return feature include the following:

- Instances when the content engine is overloaded and has no room to service the packets
- Instances when the content engine is filtering for certain conditions that make caching packets counterproductive (for example, when IP authentication has been turned on)

**WCCPv2 Load Distribution**

WCCPv2 can be used to adjust the load being offered to individual content engines to provide an effective use of the available resources while helping to ensure high quality of service (QoS) to the clients. WCCPv2 allows the designated content engine to adjust the load on a particular content engine and balance the load across the content engines in a cluster. WCCPv2 uses three techniques to perform load distribution:

- **Hot spot handling**—Allows an individual hash bucket to be distributed across all the content engines. Prior to WCCPv2, information from one hash bucket could go to only one content engine.
- **Load balancing**—Allows the set of hash buckets assigned to a content engine to be adjusted so that the load can be shifted from an overwhelmed content engine to other members that have available capacity.
- **Load shedding**—Enables the router to selectively redirect the load to avoid exceeding the capacity of a content engine.

The use of these hashing parameters prevents one content engine from being overloaded and reduces the potential for bottlenealing.

**WCCP VRF Support**

The WCCP VRF Support feature enhances the WCCPv2 protocol by implementing support for virtual routing and forwarding (VRF).

The WCCP VRF Support feature allows service groups to be configured on a per-VRF basis in addition to those defined globally.

Along with the service identifier, the VRF of WCCP protocol packets arriving at the router is used to associate cache-engines with a configured service group.

The same VRF must have the interface on which redirection is applied, the interface which is connected to cache engine, and the interface on which the packet would have left if it had not been redirected.
IPv6 WCCP Tunnel Interface

The use of GRE redirection results in the creation of new tunnel interfaces. You can display these tunnel interfaces by entering the `show ipv6 interface brief | include tunnel` command:

```
Device# show ipv6 interface brief | include tunnel

Tunnel0 2001::DB8:1::1 YES unset up up
Tunnel1 2001::DB8:1::1 YES unset up up
Tunnel2 2001::DB8:1::1 YES unset up up
Tunnel3 2001::DB8:1::1 YES unset up up
Device#
```

The tunnel interfaces are automatically created in order to process outgoing GRE-encapsulated traffic for WCCP. The tunnel interfaces appear when a content engine connects and requests GRE redirection. The tunnel interfaces are not created directly by WCCP, but are created indirectly via a tunnel application programming interface (API). WCCP does not have direct knowledge of the tunnel interfaces, but can redirect packets to them, resulting in the appropriate encapsulation being applied to the packets. After the appropriate encapsulation is applied, the packet is then sent to the content engine.

---

**Note**

The tunnel interfaces are not used to connect with incoming WCCP GRE return packets.

---

One tunnel is created for each service group that is using GRE redirection. One additional tunnel is created to provide an IP address that allows the other tunnel group interfaces to be unnumbered but still enabled for IPv6.

You can confirm the connection between the tunnels and WCCP by entering the `show tunnel groups wccp` command:

```
Device# show tunnel groups wccp

WCCP : service group 0 in "Default", ver v2, assignmnt: hash-table
    intf: Tunnel0, locally sourced
WCCP : service group 317 in "Default", ver v2, assignmnt: hash-table
    intf: Tunnel3, locally sourced
WCCP : service group 318 in "Default", ver v2, assignmnt: hash-table
    intf: Tunnel2, locally sourced

Device#
```

You can display additional information about each tunnel interface by entering the `show tunnel interface interface-number` command:

```
Device# show tunnel interface t0

Tunnel0
    Mode: multi-GRE/IP, Destination UNKNOWN, Source 2001::DB8:1::2
    Application ID 2: WCCP : service group 0 in "Default", ver v2, assignmnt: hash-table
    Linestate - current up
    Internal linestate - current up, evaluated up

Device# show tunnel interface t1

Tunnel1
    Mode: multi-GRE/IP, Destination UNKNOWN, Source 2001::DB8:1::1
    Application ID 2: unspecified
    Linestate - current up
    Internal linestate - current up, evaluated up
```
Device# show tunnel interface t2

Tunnel2
  Mode:multi-GRE/IP, Destination UNKNOWN, Source 2001::DB8:1::1
  Application ID 2: WCCP : service group 318 in "Default", ver v2, assignmnt: hash-table
  Linestate - current up
  Internal linestate - current up, evaluated up

Device# show tunnel interface t3

Tunnel3
  Mode:multi-GRE/IP, Destination UNKNOWN, Source 2001::DB8:1::1
  Application ID 2: WCCP : service group 317 in "Default", ver v2, assignmnt: hash-table
  Linestate - current up
  Internal linestate - current up, evaluated up

Device#

Note that the service group number shown in the examples is the internal tunnel representation of the WCCP service group number. Group 0 is the web-cache service. To determine the dynamic services, subtract 256 from the displayed service group number to convert to the WCCP service group number. For interfaces that are used for redirection, the source address shown is the WCCP router ID.

You can display information about the connected content engines and encapsulation, including software packet counters, by entering the show adjacency [tunnel-interface] [encapsulation] [detail] [internal] command:

Device# show adjacency t0

Protocol Interface Address
IP  Tunnel0 2001::DB8:1::1(3)

Device# show adjacency t0 encapsulation

Protocol Interface Address
IPV6 Tunnel1 2001::DB8:1::11(2)
  Encap length 48
  6000000000002FFF20010DB801000000
  0000000000000120010DB800010000
  0000000000000010000883E00000000
  Provider: TUNNEL

IPV6 Tunnel1 2001::DB8:1::12(2)
  Encap length 48
  6000000000002FFF20010DB801000000
  0000000000000120010DB800010000
  00000000000000120000883E00000000
  Provider: TUNNEL

Device# show adjacency t0 detail

Protocol Interface Address
IPV6 Tunnel1 2001::DB8:1::11(2)
  0 packets, 0 bytes
  epoch 0
  sourced in sev-epoch 22
  Encap length 48
  6000000000002FFF20010DB801000000
  0000000000000120010DB800010000
  00000000000000110000883E00000000
  Tun endpt
  Next chain element: punt

Device# show adjacency t0 internal
<table>
<thead>
<tr>
<th>Protocol Interface</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPV6 Tunnell</td>
<td>2001:DB8:1::11(2)</td>
</tr>
</tbody>
</table>

0 packets, 0 bytes
epoch 0
sourced in sev-epoch 22
Encap length 48
600000000000002FFF20010DB801000000
00000000000000120010DB800010000
00000000000000110000883E00000000

Tun endpt
Next chain element:
punt
parent oce 0x68C55B00
frame originated locally (Null0)
L3 mtu 0
Flags (0x2808C6)
Fixup disabled
HWIDB/IDB pointers 0x200900DC/0x20090D98
IP redirect disabled
Switching vector: IPv6 midchain adjacency oce
Next-hop cannot be inferred
IP Tunnel stack to 2001:DB8:1::11 in Default (0x0)

Device#

**WCCP Bypass Packets**

WCCP intercepts IP packets and redirects those packets to a destination other than the destination that is specified in the IP header. Typically the packets are redirected from a web server on the Internet to a web cache that is local to the destination.

Occasionally a web cache cannot manage the redirected packets appropriately and returns the packets unchanged to the originating router. These packets are called bypass packets and are returned to the originating router using either Layer 2 forwarding without encapsulation (L2) or encapsulated in generic routing encapsulation (GRE). The router decapsulates and forwards the packets normally. The VRF associated with the ingress interface (or the global table if there is no VRF associated) is used to route the packet to the destination.

GRE is a tunneling protocol developed by Cisco that encapsulates packet types from a variety of protocols inside IP tunnels, creating a virtual point-to-point link over an IP network.

**WCCP Closed Services and Open Services**

In applications where packets are intercepted and redirected by a Cisco IOS router to external WCCP client devices, it may be necessary to block the packets for the application when a WCCP client device is not available. This blocking is achieved by configuring a WCCP closed service. When a WCCP service is configured as closed, the packets that fulfill the services, but do not have an active client device, are discarded.

By default, WCCP operates as an open service, wherein communication between clients and servers proceeds normally in the absence of an intermediary device.

The `ip wccp service-list` or the `ipv6 wccp service-list` command can be used for both closed-mode and open-mode services. Use the `service-list` keyword and `service-access-list` argument to register an application protocol type or port number. Use the `mode` keyword to select an open or closed service.
WCCP Outbound ACL Check

When WCCP is enabled for redirection on an ingress interface, the packets are redirected by WCCP and instead egress on an interface other than the destination that is specified in the IP header. The packets are still subject to ACLs configured on the ingress interface. However, redirection can cause the packets to bypass the ACL configured on the original egress interface. Packets that would have been dropped because of the ACL configured on the original egress interface can be sent out on the redirect egress interface, which poses a possible security problem. Enabling the WCCP Outbound ACL check feature ensures that redirected packets are subject to any ACL conditions configured on the original egress interface.

WCCP Service Groups

WCCP is a component of Cisco IOS software that redirects traffic with defined characteristics from its original destination to an alternative destination. The typical application of WCCP is to redirect traffic bound for a remote web server to a local web cache to improve response time and optimize network resource usage.

The nature of the selected traffic for redirection is defined by service groups (see figure below) specified on content engines and communicated to routers by using WCCP. The maximum number of service groups allowed across all VRFs is 256.

WCCPv2 supports up to 32 routers per service group. Each service group is established and maintained independently.

WCCPv2 uses service groups based on logical redirection services, deployed for intercepting and redirecting traffic. The standard service is web cache, which intercepts TCP port 80 (HTTP) traffic and redirects that traffic to the content engines. This service is referred to as a well-known service, because the characteristics of the web cache service are known by both the router and content engines. A description of a well-known service is not required beyond a service identification. To specify the standard web cache service, use the `ip wccp` or the `ipv6 wccp` command with the `web-cache` keyword.

More than one service can run on a router at the same time, and routers and content engines can be part of multiple service groups at the same time.
The dynamic services are defined by the content engines; the content engine instructs the router which protocol or ports to intercept, and how to distribute the traffic. The router itself does not have information on the characteristics of the dynamic service group’s traffic, because this information is provided by the first content engine to join the group. In a dynamic service, up to eight ports can be specified within a single protocol.

Cisco Content Engines, for example, use dynamic service 99 to specify a reverse-proxy service. However, other content engine devices may use this service number for some other service.

**WCCP—Check All Services**

An interface may be configured with more than one WCCP service. When more than one WCCP service is configured on an interface, the precedence of a service depends on the relative priority of the service compared to the priority of the other configured services. Each WCCP service has a priority value as part of its definition. When an interface is configured with more than one WCCP service, the precedence of the packets is matched against service groups in priority order.

The priority of a WCCP service group cannot be configured via Cisco IOS software.

With the `ip wccp check services all` or the `ipv6 wccp check services all` command, WCCP can be configured to check all configured services for a match and perform redirection for those services if appropriate. The caches to which packets are redirected can be controlled by a redirect ACL and by the service priority. The `ip wccp check services all` commands must be configured at global level to support multiple WCCP services.

If no WCCP services are configured with a redirect ACL, the services are considered in priority order until a service is found that matches the IP packet. If no services match the packet, the packet is not redirected. If a service matches the packet and the service has a redirect ACL configured, then the IP packet will be checked against the ACL. If the packet is rejected by the ACL, the packet will not be passed down to lower priority services unless the `ip wccp check services all` or the `ipv6 wccp check services all` command is configured. When the `ip wccp check services all` or the `ipv6 wccp check services all` command is configured, WCCP
WCCP—Configurable Router ID Overview

WCCP uses a router ID in its control messages that a WCCP client can use to uniquely identify a particular WCCP server. The router ID is an IP address and is used as the source address of any WCCP-generated Generic Routing Encapsulation (GRE) frames. Prior to the WCCP—Configurable Router ID feature, WCCP selected a router ID using an automatic mechanism; the highest reachable IP address on the system (or the highest loopback IP address, if there is one) was used as the WCCP router ID. The highest IP address on the system is not always the best choice as the router ID or as the source address of GRE frames. A change in addressing information on the system may cause the WCCP router ID to change unexpectedly. During this changeover period, WCCP clients briefly advertise the existence of two routers (the old router ID and the new router ID) and GRE frames are sourced from a different address.

The WCCP—Configurable Router ID feature enables you to define a WCCP source interface from which the router ID will be obtained. The IP address of this configured source interface is then used as the preferred WCCP router ID and WCCP GRE source address. When a WCCP router ID is manually configured, the router ID does not change when another IP address is added to the system. The router ID changes only when a new router ID is manually configured using the `ip wccp source-interface` or the `ipv6 wccp source-interface` command, or when the address on the manually configured interface is no longer valid.

WCCP Troubleshooting Tips

CPU usage may be very high when WCCP is enabled. The WCCP counters enable a determination of the bypass traffic directly on the router and can indicate whether the cause is high CPU usage due to enablement of WCCP. In some situations, 10 percent bypass traffic may be normal; in other situations, 10 percent may be high. However, any figure above 25 percent should prompt a closer investigation of what is occurring in the web cache.

If the counters suggest that the level of bypass traffic is high, the next step is to examine the bypass counters in the content engine and determine why the content engine is choosing to bypass the traffic. You can log in to the content engine console and use the CLI to investigate further. The counters allow you to determine the percent of traffic being bypassed.

You can use the `clear ipv6 wccp service-id` command to remove the IPv6 WCCP statistics (counts) maintained on the router for a particular service.

You can use the `clear wccp` command to remove all (IPv4 and IPv6) WCCP statistics (counts) maintained on the router for a particular service.

You can use the `show ipv6 wccp` command to display the IPv6 WCCP global statistics (counts).

You can use the `show wccp` command to display all (IPv4 and IPv6) WCCP global statistics (counts).

How to Configure WCCPv2—IPv6 Support

Configuring a General WCCPv2—IPv6 Session

Perform this task to configure a general IPv6 WCCPv2 session.
Until you configure a WCCP service using the \texttt{ipv6 wccp [web-cache | service-number]} global configuration command, WCCP is disabled on the router. The first use of a form of the \texttt{ipv6 wccp} command enables WCCP. By default WCCPv2 is used for services.

Using the \texttt{ipv6 wccp web-cache password} command, you can set a password for a router and the content engines in a service group. MD5 password security requires that each router and content engine that wants to join a service group be configured with the service group password. The password can be up to eight characters in length. Each content engine or router in the service group will authenticate the security component in a received WCCP packet immediately after validating the WCCP message header. Packets failing authentication will be discarded.

### SUMMARY STEPS

1. enable
2. configure terminal
3. ipv6 wccp [vrf vrf-name] source-interface source-interface
4. ipv6 wccp [vrf vrf-name] { web-cache | service-number} [group-address group-address] [redirect-list access-list] [group-list access-list] [password password [0 | 7]]
5. interface type number
6. ipv6 wccp [vrf vrf-name] {web-cache | service-number} redirect {out | in}
7. exit
8. interface type number
9. ipv6 wccp redirect exclude in

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> ipv6 wccp [vrf vrf-name] source-interface source-interface</td>
<td>Configures a preferred WCCP router ID.</td>
</tr>
<tr>
<td>Example: Device(config)# ipv6 wccp source-interface GigabitEthernet 0/0/0</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> ipv6 wccp [vrf vrf-name] { web-cache</td>
<td>service-number} [group-address group-address] [redirect-list access-list] [group-list access-list] [password password [0</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
</tbody>
</table>
### Command or Action

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Device(config)# ipv6 wccp web-cache password password1</code></td>
<td>Targets an interfacenumber for which the web cache service will run, and enters interface configuration mode.</td>
</tr>
<tr>
<td><strong>Step 5</strong> interface <em>type number</em></td>
<td>Enables packet redirection on an outbound or inbound interface using WCCP.</td>
</tr>
<tr>
<td><strong>Example:</strong> <code>Device(config)# interface GigabitEthernet 0/0/0</code></td>
<td><strong>Example:</strong> <code>Device(config-if)# ipv6 wccp web-cache redirect in</code></td>
</tr>
<tr>
<td><strong>Step 7</strong> <code>exit</code></td>
<td>Targets an interface number on which to exclude traffic for redirection, and enters interface configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> <code>Device(config-if)# ipv6 wccp redirect exclude in</code></td>
<td>Exits interface configuration mode.</td>
</tr>
<tr>
<td><strong>Step 8</strong> interface <em>type number</em></td>
<td>(Optional) Excludes traffic on the specified interface from redirection.</td>
</tr>
<tr>
<td><strong>Example:</strong> <code>Device(config)# interface GigabitEthernet 0/2/0</code></td>
<td><code>Device(config-if)# exit</code></td>
</tr>
</tbody>
</table>

### Configuring Services for WCCPv2—IPv6

Perform this task to specify the number of service groups for WCCP, to configure a service group as a closed or open service, and to optionally specify a check of all services.

### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. Enter one of the following commands:
   - `ipv6 wccp [vrf vrf-name] service-number [service-list service-access-list mode {open | closed}]`
   - `ipv6 wccp [vrf vrf-name] web-cache mode {open | closed}`
4. `ipv6 wccp check services all`
5. `ipv6 wccp [vrf vrf-name] {web-cache | service-number}`
6. exit

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
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</tr>
</thead>
</table>
| Step 1 | enable | Enables privileged EXEC mode.  
Example:  
Device> enable |  |
| Step 2 | configure terminal | Enters global configuration mode.  
Example:  
Device# configure terminal |  |
| Step 3 | Enter one of the following commands:  
- `ipv6 wccp [vrf vrf-name] service-number [service-list service-access-list mode {open | closed}]`  
- `ipv6 wccp [vrf vrf-name] web-cache mode {open | closed}` | Configures a dynamic WCCP service as closed or open.  
Note: When configuring the web-cache service as a closed service, you cannot specify a service access list.  
| Example:  
Device(config)# ipv6 wccp 90 service-list 120 mode closed |  |
|  | or  
Device(config)# ipv6 wccp web-cache mode closed | Configures a web-cache service as closed or open.  
Note: When configuring a dynamic WCCP service as a closed service, you must specify a service access list. |
| Step 4 | `ipv6 wccp check services all` | (Optional) Enables a check of all WCCP services.  
Example:  
Device(config)# ipv6 wccp check services all |  |
| Step 5 | `ipv6 wccp [vrf vrf-name] {web-cache | service-number}` | Specifies the WCCP service identifier.  
Example:  
Device(config)# ipv6 wccp 201 |  
- You can specify the standard web-cache service or a dynamic service number from 0 to 255.  
- The maximum number of services that can be specified is 256.  
|  | |  |
Registering a Router to a Multicast Address for WCCPv2—IPv6

If you decide to use the multicast address option for your service group, you must configure the router to listen for the multicast broadcasts on an interface.

For network configurations where redirected traffic needs to traverse an intervening router, the router being traversed must be configured to perform IP multicast routing. You must configure the following two components to enable traversal over an intervening router:

- Enable IP multicast routing using the `ipv6 multicast-routing` global configuration command.
- Enable the interfaces to which the cache engines will connect to receive multicast transmissions using the `ipv6 wccp group-listen` interface configuration command.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `ipv6 multicast-routing [vrf vrf-name] [distributed]`
4. `ipv6 wccp [vrf vrf-name] {web-cache | service-number} group-address multicast-address`
5. `interface type number`
6. `ip pim {sparse-mode | sparse-dense-mode | dense-mode [proxy-register {list access-list | route-map map-name}]}`
7. `ipv6 wccp [vrf vrf-name] {web-cache | service-number} group-listen`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: <code>Device&gt; enable</code></td>
<td>Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><code>configure terminal</code></td>
<td></td>
</tr>
<tr>
<td>Example: <code>Device# configure terminal</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Enables IP multicast routing.</td>
</tr>
<tr>
<td><code>ipv6 multicast-routing [vrf vrf-name] [distributed]</code></td>
<td></td>
</tr>
<tr>
<td>Example: <code>Device(config)# ipv6 multicast-routing</code></td>
<td></td>
</tr>
</tbody>
</table>
### Purpose

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 4</strong></td>
<td>ipv6 wccp [vrf vrf-name] {web-cache</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# ipv6 wccp 99 group-address FF15::8000:1</td>
</tr>
<tr>
<td></td>
<td>Specifies the multicast address for the service group.</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>interface type number</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# interface ethernet 0/0</td>
</tr>
<tr>
<td></td>
<td>Enables the interfaces to which the content engines will connect to receive multicast transmissions for which the web cache service will run, and enters interface configuration mode.</td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td>ip pim {sparse-mode</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config-if)# ip pim dense-mode</td>
</tr>
<tr>
<td></td>
<td>(Optional) Enables Protocol Independent Multicast (PIM) on an interface.</td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>To ensure correct operation of the ipv6 wccp group-listen command, you must enter the ip pim command in addition to the ipv6 wccp group-listen command.</td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td>ipv6 wccp [vrf vrf-name] {web-cache</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config-if)# ipv6 wccp 99 group-listen</td>
</tr>
<tr>
<td></td>
<td>Configures an interface to enable or disable the reception of IP multicast packets for WCCP.</td>
</tr>
</tbody>
</table>

### Using Access Lists for WCCPv2—IPv6 Service Group

Perform this task to configure the router to use an access list to determine which traffic should be directed to which content engines.

#### SUMMARY STEPS

1. enable
2. configure terminal
3. access-list access-list-number remark remark
4. access-list access-list-number permit {source [source-wildcard] | any} [log]
5. access-list access-list-number remark remark
6. access-list access-list-number deny {source [source-wildcard] | any} [log]
7. Repeat some combination of Steps 3 through 6 until you have specified the sources on which you want to base your access list.
8. ipv6 wccp [vrf vrf-name] web-cache group-list access-list
9. ipv6 wccp [vrf vrf-name] web-cache redirect-list access-list
## DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| Step 1 | **enable** | Enables privileged EXEC mode.  
Example:  
Device> enable  
• Enter your password if prompted. |
| Step 2 | **configure terminal** | Enters global configuration mode.  
Example:  
Device# configure terminal |
| Step 3 | **access-list** **access-list-number** **remark** **remark**  
**Example:**  
Device(config)# access-list 1 remark Give access to user1 | (Optional) Adds a user-friendly comment about an access list entry.  
• A remark of up to 100 characters in length can precede or follow an access list entry. |
| Step 4 | **access-list** **access-list-number** **permit** {**source**  
[source-wildcard] | **any** | [**log**]  
**Example:**  
Device(config)# access-list 1 permit 172.16.5.22 0.0.0.0 | Creates an access list that enables or disables traffic redirection to the cache engine and permits the specified source based on a source address and wildcard mask.  
• Every access list needs at least one permit statement; it does not need to be the first entry.  
• Standard IP access lists are numbered 1 to 99 or 1300 to 1999.  
• If the source-wildcard string is omitted, a wildcard mask of 0.0.0.0 is assumed, meaning match on all bits of the source address.  
• Optionally use the keyword any as a substitute for the source source-wildcard to specify the source and source wildcard of 0.0.0.0 255.255.255.255.  
• In this example, host 172.16.5.22 is allowed to pass the access list. |
| Step 5 | **access-list** **access-list-number** **remark** **remark**  
**Example:**  
Device(config)# access-list 1 remark Give access to user1 | (Optional) Adds a user-friendly comment about an access list entry.  
• A remark of up to 100 characters can precede or follow an access list entry. |
| Step 6 | **access-list** **access-list-number** **deny** {**source**  
[source-wildcard] | **any** | [**log**]  
**Example:**  
Device(config)# access-list 1 deny 172.16.7.34 0.0.0.0 | Denies the specified source based on a source address and wildcard mask.  
• If the source-wildcard string is omitted, a wildcard mask of 0.0.0.0 is assumed, meaning match on all bits of the source address. |
<table>
<thead>
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<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Optionally use the abbreviation any as a substitute for the source source-wildcard to specify the source and source wildcard of 0.0.0.0 255.255.255.255.</td>
<td></td>
</tr>
<tr>
<td>• In this example, host 172.16.7.34 is denied passing the access list.</td>
<td></td>
</tr>
</tbody>
</table>

**Step 7**
Repeat some combination of Steps 3 through 6 until you have specified the sources on which you want to base your access list.

Remember that all sources not specifically permitted are denied by an implicit **deny** statement at the end of the access list.

**Step 8**
**ipv6 wccp [vrf vrf-name] web-cache group-list access-list**

**Example:**
```
Device(config) ipv6 wccp web-cache group-list 1
```

Indicates to the router from which IP addresses of content engines to accept packets.

**Step 9**
**ipv6 wccp [vrf vrf-name] web-cache redirect-list access-list**

**Example:**
```
Router(config)# ipv6 wccp web-cache redirect-list 1
```

(Optional) Disables caching for certain clients.

---

**Enabling the WCCP—IPv6 Outbound ACL Check**

**Note**
When all redirection is performed in the hardware, the mode of redirection will change when outbound ACL checking is enabled. The first packet is switched in software to allow the extra ACL check to be performed before a shortcut is installed.

**SUMMARY STEPS**

1. enable
2. configure terminal
3. ipv6 wccp [vrf vrf-name] [web-cache | service-number] [group-address | multicast-address] [redirect-list access-list] [group-list | access-list] [password | password]
4. ipv6 wccp check acl outbound
5. exit

**DETAILED STEPS**

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<td>Example:</td>
<td>• Enter your password if prompted.</td>
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</table>
Verifying and Monitoring WCCPv2—IPv6 Configuration Settings

SUMMARY STEPS

1. enable
2. show ipv6 wccp [vrf vrf-name] [service-number | web-cache] [detail | view]
3. show ipv6 interface
4. more system:running-config

DETAILED STEPS

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td>Step 2 show ipv6 wccp [vrf vrf-name] [service-number</td>
<td>(Optional) Displays global information related to WCCP, including the protocol version currently running, the number of content engines in the router service group, which content engine group is allowed to connect to the router, and which</td>
</tr>
<tr>
<td>web-cache] [detail</td>
<td>view]</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
</tbody>
</table>

Verifying and Monitoring WCCPv2—IPv6 Configuration Settings

SUMMARY STEPS

1. enable
2. show ipv6 wccp [vrf vrf-name] [service-number | web-cache] [detail | view]
3. show ipv6 interface
4. more system:running-config

DETAILED STEPS

<table>
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<tr>
<th>Command or Action</th>
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<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td>Step 2 show ipv6 wccp [vrf vrf-name] [service-number</td>
<td>(Optional) Displays global information related to WCCP, including the protocol version currently running, the number of content engines in the router service group, which content engine group is allowed to connect to the router, and which</td>
</tr>
<tr>
<td>web-cache] [detail</td>
<td>view]</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
</tbody>
</table>
PurposeCommand or Action

Device# show ipv6 wccp 24 detail

access list is being used. The argument and keywords are as follows:

- **service-number**—(Optional) Dynamic number of the web-cache service group being controlled by the content engine. The range is from 0 to 99. For web caches that use Cisco Content Engines, the reverse proxy service is indicated by a value of 99.
- **web-cache**—(Optional) Statistics for the web-cache service.
- **detail**—(Optional) Other members of a particular service group or web cache that have or have not been detected.
- **view**—(Optional) Information about a router or all web caches.

**Step 3**

**show ipv6 interface**

Example:

Device# show ipv6 interface

(Optional) Displays status about whether any ip wccp redirection commands are configured on an interface; for example, “Web Cache Redirect is enabled / disabled.”

**Step 4**

**more system:running-config**

Example:

Device# more system:running-config

(Optional) Displays contents of the currently running configuration file (equivalent to the show running-config command).

---

**Configuration Examples for WCCPv2—IPv6 Support**

**Example: Configuring a General WCCPv2—IPv6 Session**

```
Device# configure terminal
Device(config)# ipv6 wccp web-cache password password1
Device(config)# ipv6 wccp source-interface GigabitEthernet 0/1/0
Device(config)# ipv6 wccp check services all
  Configures a check of all WCCP services.
Device(config)# interface GigabitEthernet 0/1/0
Device(config-if)# ipv6 wccp web-cache redirect in
Device(config-if)# exit
Device(config)# interface GigabitEthernet 0/2/0
Device(config-if)# ipv6 wccp redirect exclude in
Device(config-if)# exit
```
Example: WCCPv2—IPv6—Setting a Password for a Router and Content Engines

Device# configure terminal
Device(config)# ipv6 wccp web-cache password password1

Example: WCCPv2—IPv6—Configuring a Web Cache Service

Device# configure terminal
Device(config)# ipv6 wccp web-cache
Device(config)# interface GigabitEthernet 0/1/0
Device(config-if)# ipv6 wccp web-cache redirect in
Device(config-if)# exit
Device# copy running-config startup-config

The following example shows how to configure a session in which redirection of HTTP traffic arriving on Gigabit Ethernet interface 0/1/0 is enabled:

Device# configure terminal
Device(config)# interface GigabitEthernet 0/1/0
Device(config-if)# ipv6 wccp web-cache redirect in
Device(config-if)# exit
Device# show ip interface GigabitEthernet 0/1/0

WCCP Redirect inbound is enabled
WCCP Redirect exclude is disabled

Example: WCCPv2—IPv6—Running a Reverse Proxy Service

The following example assumes that you are configuring a service group using Cisco cache engines, which use dynamic service 99 to run a reverse proxy service:

Device# configure terminal
Device(config)# ipv6 wccp 99
Device(config)# interface GigabitEthernet 0/1/0
Device(config-if)# ipv6 wccp 99 redirect out

Example: WCCPv2—IPv6—Registering a Router to a Multicast Address

Device# configure terminal
Device(config)# ipv6 wccp web-cache group-address 224.1.1.100
Device(config)# interface gigabitethernet 0/1/0
Device(config-if)# ipv6 wccp web cache group-listen

The following example shows a device configured to run a reverse proxy service, using the multicast address of 224.1.1.1. Redirection applies to packets outgoing via Gigabit Ethernet interface 0/1/0:
Example: WCCPv2—IPv6—Using Access Lists for a WCCPv2 IPv6 Service Group

To achieve better security, you can use a standard access list to notify the device which IP addresses are valid addresses for a content engine attempting to register with the current device. The following example shows a standard access list configuration session where the access list number is 10 for some sample hosts:

Device(config)# access-list 10 permit host 10.1.1.1
Device(config)# access-list 10 permit host 10.1.1.2
Device(config)# access-list 10 permit host 10.1.1.3
Device(config)# ipv6 wccp web-cache group-list 10

To disable caching for certain clients, servers, or client/server pairs, you can use WCCP access lists. The following example shows that any requests coming from 10.1.1.1 to 10.3.1.1 will bypass the cache, and that all other requests will be serviced normally:

Device(config)# ipv6 wccp web-cache redirect-list 120
Device(config)# access-list 120 deny tcp host 10.1.1.1 any
Device(config)# access-list 120 deny tcp any host 10.3.1.1
Device(config)# access-list 120 permit ip any any

The following example configures a device to redirect web-related packets received via Gigabit Ethernet interface 0/1/0, destined to any host except 209.165.200.224:

Device(config)# access-list 100 deny ip any host 209.165.200.224
Device(config)# access-list 100 permit ip any any
Device(config)# ipv6 wccp web-cache redirect-list 100
Device(config)# interface gigabitethernet 0/1/0
Device(config-if)# ipv6 wccp web-cache redirect in

Example: WCCPv2—IPv6—Configuring Outbound ACL Check

The following configuration example shows that the access list prevents traffic from network 10.0.0.0 leaving Gigabit Ethernet interface 0/1/0. Because the outbound ACL check is enabled, WCCP does not redirect that traffic. WCCP checks packets against the ACL before they are redirected.

Device(config)# ipv6 wccp web-cache
Device(config)# ipv6 wccp check acl outbound
Device(config)# interface gigabitethernet 0/1/0
Device(config-if)# ip access-group 10 out
Device(config-if)# exit
Device(config)# ipv6 wccp web-cache redirect-list redirect-out
Device(config)# access-list 10 deny 10.0.0.0 0.255.255.255
Device(config)# access-list 10 permit any

If the outbound ACL check is disabled, the HTTP packets from network 10.0.0.0 would be redirected to a web cache. Users with that network address could retrieve web pages even though the network administrator wanted to prevent it.
Example: WCCPv2—IPv6—Verifying WCCP Settings

The following example shows how to verify your configuration changes by using the `more system:running-config` command in privileged EXEC mode. The following example shows that both the web cache service and dynamic service 99 are enabled on the device:

```
Device# more system:running-config

Building configuration...
Current configuration:
!
version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
service udp-small-servers
service tcp-small-servers
!
hostname router4
!
enable secret 5 $1$nSVy$faliJsVQXVFW.KuCxZNTh1
enable password password1
!
ip subnet-zero
ipv6 wccp web-cache
ipv6 wccp 99
ip domain-name cisco.com
ip name-server 10.1.1.1
ip name-server 10.1.1.2
ip name-server 10.1.1.3
!
!
interface GigabitEthernet0/1/1
ip address 10.3.1.2 255.255.255.0
no ip directed-broadcast
ipv6 wccp web-cache redirect in
ipv6 wccp 99 redirect in
no ip route-cache
no ip mroute-cache
!
interface GigabitEthernet0/1/0
ip address 10.4.1.1 255.255.255.0
no ip directed-broadcast
ipv6 wccp 99 redirect in
no ip route-cache
no ip mroute-cache
!
interface Serial0
no ip address
no ip directed-broadcast
no ip route-cache
no ip mroute-cache
shutdown
!
interface Serial1
no ip address
no ip directed-broadcast
no ip route-cache
no ip mroute-cache
shutdown
!
```

ip default-gateway 10.3.1.1
ip classless
ip route 0.0.0.0 0.0.0.0 10.3.1.1
no ip http server
!
!
line con 0
transport input none
line aux 0
transport input all
line vty 0 4
password password1
login
!
end

The following example shows how to display global statistics related to WCCP:

Device# show ipv6 wccp web-cache detail

WCCP Client information:
WCCP Client ID: 10.1.1.2
Protocol Version: 2.0
State: Usable
Redirection: L2
Packet Return: L2
Packets Redirected: 0
Connect Time: 00:20:34
Assignment: MASK

<table>
<thead>
<tr>
<th>Mask</th>
<th>SrcAddr</th>
<th>DstAddr</th>
<th>SrcPort</th>
<th>DstPort</th>
<th>CE-IP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>0x00000000 0x00001741 0x0000 0x0000</td>
<td>(10.1.1.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>0x00000000 0x00000000 0x0000 0x0000</td>
<td>(10.1.1.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0002</td>
<td>0x00000000 0x00000000 0x0000 0x0000</td>
<td>(10.1.1.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0003</td>
<td>0x00000000 0x00000000 0x0000 0x0000</td>
<td>(10.1.1.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0004</td>
<td>0x00000000 0x00000000 0x0000 0x0000</td>
<td>(10.1.1.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0005</td>
<td>0x00000000 0x00000000 0x0000 0x0000</td>
<td>(10.1.1.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0006</td>
<td>0x00000000 0x00000000 0x0000 0x0000</td>
<td>(10.1.1.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For more information about the show ip wccp web-cache command, see the Cisco IOS IP Application Services Command Reference document.

Example: WCCPv2—IPv6—Cisco ASR 1000 Platform Specific Configuration

The following example shows how to display platform-specific configuration and IPv6 counters information related to WCCP on a Cisco ASR 1000 Series Aggregation Services Router:

Device# show platform software wccp service-number ipv6 counters
Service Group (1, 61, 0) counters
  Unassigned count = 0
  Dropped due to closed service count = 0
  Bypass count = 0
  Bypass failed count = 0
  Denied count = 0
  Redirect count = 4
  CE = 2001:1:100::105, obj_id = 213, Redirect Packets = 4
The following example shows how to display platform-specific configuration and route processor slot information related to WCCP on a Cisco ASR 1000 Series Aggregation Services Router:

```
Device# show platform software wccp rp active service-number ipv6
IPV6 Dynamic service 61
Priority: 34, Number of clients: 1
Assign Method: Hash, Fwd Method: GRE, Ret Method: GRE
L4 proto: 6, Use Source Port: No
Is closed: No
```

The following example shows how to display platform-specific configuration and embedded service processor slot information related to WCCP on a Cisco ASR 1000 Series Aggregation Services Router:

```
Device# show platform software wccp fp active service-number ipv6
IPV6 Dynamic service 61
Priority: 34, Number of clients: 1
Assign Method: Hash, Fwd Method: GRE, Ret Method: GRE
Is closed: No
Current ACE: 0, Pending ACE: 0
New ACE: 0, New ACE completed: No
ACL id: 0
AOM id: 0x18a, status: created
```

The following example shows how to display the WCCP service group information in the active Cisco Quantum Flow Processor (QFP) on a Cisco ASR 1000 Series Aggregation Services Router:

```
Device# show platform hardware qfp active feature wccp service id service-id ipv6
Service ID: 61
Service Type: 1
Service Priority: 34
Assign Method: 1
Hash key: 0x51
Hash buckets ppe address: 0x8bceb600
Mode: Open
State: Active
Number of Caches in this service: 1
  ce index: 0
  cache_id : 11
  Cache ip addr : 0x20010001
  Cache cfg ppe addr : 0x8bceb200
  Cache oce ppe addr : 0x891a7670
  Cache state ppe addr : 0x8bcfd288
Number of interfaces using this service: 1
  Interface: GigabitEthernet0/0/0.1
cpp-if-h: 12
Dir: 0
pal-if-h: 15
uidb sb ppe addr: 0x8bd308e0
```

### Additional References

#### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS commands</td>
<td><a href="#">Cisco IOS Master Commands List, All Releases</a></td>
</tr>
</tbody>
</table>
Feature Information for WCCPv2—IPv6 Support

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.
Table 8: Feature Information for WCCPv2 — IPv6 Support

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>WCCPv2—IPv6 Support</td>
<td>15.1(1)SY1</td>
<td>This feature introduces support for Web Cache Communication Protocol version 2 (WCCPv2) in an IPv6 environment.</td>
</tr>
<tr>
<td></td>
<td>15.2(3)T</td>
<td>WCCP is a Cisco-developed content-routing technology that intercepts IP packets and redirects those packets to a destination other than that specified in the IP packet.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Multiple routers can use WCCPv2 to service a content engine cluster. In WCCPv1, only one router could redirect content requests to a cluster.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The following commands were added: clear ipv6 wccp, clear wccp, debug ipv6 wccp, debug wccp, ipv6 wccp, ipv6 wccp check acl outbound, ipv6 wccp check services all, ipv6 wccp group-listen, ipv6 wccp redirect, ipv6 wccp redirect exclude in ipv6 wccp source-interface, show ipv6 wccp, show ipv6 wccp global counters, show wccp, show wccp global counters, show platform software wccp service-number ipv6 counters, show platform software wccp rp active service-number ipv6 , show platform software wccp fp active service-number ipv6 , show platform hardware qfp active feature wccp service-id service-number ipv6</td>
</tr>
</tbody>
</table>

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CHAPTER 9

WCCP with Generic GRE Support

Extended Web Cache Communication Protocol (WCCP) supports multipoint generic routing encapsulation (mGRE) return method on Cisco IOS devices. GRE-negotiated return is not supported on the Cisco Wide Area Application Services (WAAS) AppNav I/O module (IOM), customers need to use generic GRE tunnels (multipoint GRE) on the devices.

• Finding Feature Information, on page 153
• Restrictions for WCCP with Generic GRE Support, on page 153
• Information About WCCP with Generic GRE Support, on page 154
• How to Configure WCCP with Generic GRE Support, on page 154
• Configuration Examples for WCCP with Generic GRE Support, on page 160
• Additional References for WCCP with Generic GRE Support, on page 161
• Feature Information for WCCP with Generic GRE Support, on page 162

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and 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 table.

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Restrictions for WCCP with Generic GRE Support

• Generic GRE tunnel does not work with a loopback source address. Because the highest numbered loopback is reserved for WCCP, customers need to use the second highest loopback address.

• WCCP traffic redirection does not work when a zone-based policy firewall is configured on a Cisco Aggregation Services Router that is configured with Cisco AppNav I/O modules. Cisco AppNav is a wide-area networking optimization solution. For WCCP traffic redirection to work, remove the zone-based policy firewall configuration from interfaces. If you are using a WAVE device, WCCP traffic redirection works correctly.

• Static and dynamic NAT with generic GRE and dynamic NAT with Layer 2 do not work when used with hardware-based Cisco AppNav appliances (for example, Wide Area Application Services [WAAS]).
Information About WCCP with Generic GRE Support

WCCP with Generic GRE Support

The generic routing encapsulation (GRE) negotiated return is not supported on AppNav I/O Module (IOM), the customers need to use Generic GRE tunnels (multipoint GRE [mGRE]) on devices. That is, a mGRE tunnel needs to be configured manually on the router if the AppNav is configured with Generic GRE return method.

Note

If two multipoint generic routing encapsulation (mGRE) tunnels are configured (one programmatically generated and the other manually created) on a device, and have the same key or exist in the same VRF, do one of the following:

• Configure both tunnels with different loopback addresses.
• Configure a physical interface on manually created tunnel, and configure a loopback address on the programmatically generated tunnel.

This feature focuses on the interactions between AppNav IOM and the router. The Cisco Wide Area Application Services (WAAS) AppNav must be configured as a device mode application-accelerator and interception method WCCP.

Cisco WAAS AppNav Solution

Cisco Wide Area Application Services (WAAS) AppNav is a hardware and software solution that simplifies network integration of WAN optimization. It also overcomes the challenges related to provisioning, visibility, scalability, asymmetry, and high availability. Only a Wide Area Virtualization Engine (WAVE) appliance that contains a Cisco AppNav Controller (ANC) Interface Module can operate as an ANC. AppNav is configured as Web Cache Communication Protocol (WCCP) client of the router.

For more information on Cisco WAAS AppNav and how to configure Cisco WAAS AppNav, see "Configuring AppNav" chapter in Cisco Wide Area Application Services Configuration Guide.

How to Configure WCCP with Generic GRE Support

Configure WCCP Redirection with Generic GRE Configured on the Device Using a Loopback Interface

SUMMARY STEPS

1. enable
2. configure terminal
3. interface loopback  loopback-interface-number
### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> interface loopback loopback-interface-number</td>
<td>Enters interface configuration for the device.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config)# interface loopback 100</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> ip address ip-address subnet-mask</td>
<td>Sets a primary IP address for the loopback interface.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config-if)# ip address 10.10.10.1 255.255.255.255</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> no shutdown</td>
<td>Restarts the loopback interface if the interface is down.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config-if)# no shutdown</td>
<td></td>
</tr>
<tr>
<td>Step</td>
<td>Command or Action</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>6</td>
<td>exit</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# exit</td>
</tr>
<tr>
<td>7</td>
<td>interface loopback  <code>loopback-interface-number</code></td>
</tr>
<tr>
<td></td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td>Device(config)# interface loopback 1000</td>
</tr>
<tr>
<td>8</td>
<td>ip address  <code>ip-address  subnet-mask</code></td>
</tr>
<tr>
<td></td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# ip address 10.11.10.1 255.255.255.255</td>
</tr>
<tr>
<td>9</td>
<td>no shutdown</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# no shutdown</td>
</tr>
<tr>
<td>10</td>
<td>exit</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# exit</td>
</tr>
<tr>
<td>11</td>
<td>ip wccp source-interface loopback  <code>loopback-interface-number</code></td>
</tr>
<tr>
<td></td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td>Device(config)# ip wccp source-interface loopback 1000</td>
</tr>
<tr>
<td>12</td>
<td>interface Tunnel  <code>tunnel-interface-number</code></td>
</tr>
<tr>
<td></td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td>Device(config)# interface Tunnel 10</td>
</tr>
<tr>
<td>13</td>
<td>ip address  <code>ip-address  subnet-mask</code></td>
</tr>
<tr>
<td></td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# ip address 10.10.20.1 255.255.255.0</td>
</tr>
<tr>
<td>14</td>
<td>no shutdown</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# no shutdown</td>
</tr>
</tbody>
</table>
WCCP with Generic GRE Support

Configure WCCP Redirection with Generic GRE Configured on a Device Using a Physical Interface

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 15</td>
<td>no ip redirects</td>
<td>Disables the sending of ICMP redirect messages to learn routes. This command is enabled by default.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-if)# no ip redirects</td>
<td></td>
</tr>
<tr>
<td>Step 16</td>
<td>ip wccp redirect exclude in</td>
<td>Specifies that packets received on this interface be excluded from any egress redirection.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-if)# ip wccp redirect exclude in</td>
<td></td>
</tr>
<tr>
<td>Step 17</td>
<td>tunnel source loopback loopback-interface-number</td>
<td>Configures the loopback interface as the tunnel source.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-if)# tunnel source loopback 100</td>
<td></td>
</tr>
<tr>
<td>Step 18</td>
<td>tunnel mode gre multipoint</td>
<td>Sets the global encapsulation mode on all interfaces of a device to generic routing encapsulation (GRE).</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-if)# tunnel mode gre multipoint</td>
<td></td>
</tr>
<tr>
<td>Step 19</td>
<td>end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-if)# end</td>
<td></td>
</tr>
<tr>
<td>Step 20</td>
<td>show ip wccp summary</td>
<td>Displays a summary of WCCP services.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device# show ip wccp summary</td>
<td></td>
</tr>
</tbody>
</table>

Configure WCCP Redirection with Generic GRE Configured on a Device Using a Physical Interface

SUMMARY STEPS

1. enable
2. configure terminal
3. interface GigabitEthernet interface-id
4. ip address ip-address subnet-mask
5. no shutdown
6. exit
7. interface Tunnel tunnel-interface-number
8. ip address ip-address subnet-mask
9. no shutdown
10. no ip redirects
11. ip wccp redirect exclude in
12. tunnel source GigabitEthernet interface-id
13. tunnel mode gre multipoint
14. end
15. show ip wccp summary

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> interface GigabitEthernet</td>
<td>Enters interface configuration for the device.</td>
</tr>
<tr>
<td><em>interface-id</em></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config)# interface GigabitEthernet0/0/1</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> ip address <em>ip-address</em></td>
<td>Sets a primary IP address for the loopback interface.</td>
</tr>
<tr>
<td><em>subnet-mask</em></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config-if)# ip address 10.10.1</td>
<td></td>
</tr>
<tr>
<td>255.255.255.0</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> no shutdown</td>
<td>Restarts the loopback interface if the interface is down.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config-if)# no shutdown</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> exit</td>
<td>Returns to global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config-if)# exit</td>
<td></td>
</tr>
<tr>
<td><strong>Step 7</strong> interface Tunnel</td>
<td>Enters tunnel interface configuration mode.</td>
</tr>
<tr>
<td><em>tunnel-interface-number</em></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config)# interface Tunnel 10</td>
<td></td>
</tr>
<tr>
<td><strong>Step 8</strong> ip address <em>ip-address</em></td>
<td>Sets a primary IP address for the tunnel interface.</td>
</tr>
<tr>
<td><em>subnet-mask</em></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
</tbody>
</table>
### Command or Action

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device(config-if)# ip address 10.10.20.1 255.255.255.0</td>
<td></td>
</tr>
</tbody>
</table>

### Step 9
**no shutdown**

*Example:*

Device(config-if)# no shutdown

Restarts the tunnel interface if the interface is down.

### Step 10
**no ip redirects**

*Example:*

Device(config-if)# no ip redirects

Disables the sending of ICMP redirect messages to learn routes. This command is enabled by default.

### Step 11
**ip wccp redirect exclude in**

*Example:*

Device(config-if)# ip wccp redirect exclude in

Specifies that packets received on this interface be excluded from any egress redirection.

### Step 12
**tunnel source GigabitEthernet interface-id**

*Example:*

Device(config-if)# tunnel source GigabitEthernet0/0/1

Configures the loopback interface as the tunnel source.

### Step 13
**tunnel mode gre multipoint**

*Example:*

Device(config-if)# tunnel mode gre multipoint

Sets the global encapsulation mode on all interfaces of a device to generic routing encapsulation (GRE).

### Step 14
**end**

*Example:*

Device(config-if)# end

Returns to privileged EXEC mode.

### Step 15
**show ip wccp summary**

*Example:*

Device# show ip wccp summary

Displays a summary of WCCP services.
Configuration Examples for WCCP with Generic GRE Support

Example: Configure WCCP Redirection with Generic GRE Configured on Device Using a Loopback Interface

The following example shows how to configure Web Cache Communication Protocol (WCCP) redirection on the device using loopback interface when generic routing encapsulation (GRE) is enabled on the Cisco Wide Area Application Services (WAAS) AppNav:

```
Device> enable
Device# configure terminal
Device(config)# interface loopback 100
Device(config-if)# ip address 10.10.10.1 255.255.255.255
Device(config-if)# no shutdown
Device(config-if)# exit
Device(config)# interface loopback 1000
Device(config-if)# ip address 10.11.10.1 255.255.255.255
Device(config-if)# no shutdown
Device(config-if)# exit
Device(config)# ip wccp source-interface loopback 1000
Device(config)# interface Tunnel 10
Device(config-if)# ip address 10.12.10.1 255.255.255.0
Device(config-if)# no shutdown
Device(config-if)# no ip redirects
Device(config-if)# ip wccp redirect exclude in
Device(config-if)# tunnel source loopback 100
Device(config-if)# tunnel mode gre multipoint
Device(config-if)# end
Device# show ip wccp summary
```

WCCP version 2 enabled, 2 services

<table>
<thead>
<tr>
<th>Service</th>
<th>Clients</th>
<th>Routers</th>
<th>Assign</th>
<th>Redirect</th>
<th>Bypass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>routing table (Router Id: 10.10.10.1):</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>1</td>
<td>1</td>
<td>MASK</td>
<td>GRE</td>
<td>GRE</td>
</tr>
<tr>
<td>62</td>
<td>1</td>
<td>1</td>
<td>MASK</td>
<td>GRE</td>
<td>GRE</td>
</tr>
</tbody>
</table>

Example: Configure WCCP Redirection with Generic GRE Configured on a Device Using a Physical Interface

The following example shows how to configure Web Cache Communication Protocol (WCCP) redirection on the device using a physical interface when generic routing encapsulation (GRE) is enabled on the Cisco Wide Area Application Services (WAAS) AppNav:

```
Device> enable
Device# configure terminal
Device(config)# interface GigabitEthernet0/0/1
Device(config-if)# ip address 10.12.10.1 255.255.255.0
Device(config-if)# no shutdown
Device(config-if)# exit
```
Device(config)# interface Tunnel 10
Device(config-if)# ip address 10.13.10.1 255.255.255.0
Device(config-if)# no ip redirects
Device(config-if)# ip wccp redirect exclude in
Device(config-if)# tunnel source GigabitEthernet0/0/1
tunnel mode gre multipoint
Device(config-if)#
Device(config)# show ip wccp summary

WCCP version 2 enabled, 2 services

<table>
<thead>
<tr>
<th>Service</th>
<th>Clients</th>
<th>Routers</th>
<th>Assign</th>
<th>Redirect</th>
<th>Bypass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>routing table (Router Id: 10.10.10.1):</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>1</td>
<td>1</td>
<td>MASK</td>
<td>GRE</td>
<td>GRE</td>
</tr>
<tr>
<td>62</td>
<td>1</td>
<td>1</td>
<td>MASK</td>
<td>GRE</td>
<td>GRE</td>
</tr>
</tbody>
</table>

Additional References for WCCP with Generic GRE Support

Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Commands List, All Releases</td>
</tr>
</tbody>
</table>
| IP addressing and services commands and configuration tasks | • IP Addressing: IPv4 Addressing Configuration Guide  
• Cisco IOS IP Addressing Services Command Reference |
| WCCP commands: complete command syntax, command mode, command history, defaults, usage guidelines, and examples | Cisco IOS IP Application Services Command Reference |

Technical Assistance

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
</tr>
</tbody>
</table>
Feature Information for WCCP with Generic GRE Support

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

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Table 9: Feature Information for WCCP with Generic GRE Support

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>WCCP with Generic GRE Support</td>
<td>Cisco IOS XE Release 3.10.2</td>
<td>This feature provides extended WCCP support to use Generic GRE tunnels (multipoint GRE) on the devices when generic routing encapsulation (GRE) negotiated return is not supported on AppNav I/O Module (IOM).</td>
</tr>
</tbody>
</table>

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