QoS: NBAR Configuration Guide, Cisco IOS XE Release 3S

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

THE SPECIFICATIONS AND INFORMATION REGARDING THE PRODUCTS IN THIS MANUAL ARE SUBJECT TO CHANGE WITHOUT NOTICE. ALL STATEMENTS, INFORMATION, AND RECOMMENDATIONS IN THIS MANUAL ARE BELIEVED TO BE ACCURATE BUT ARE PRESENTED WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED. USERS MUST TAKE FULL RESPONSIBILITY FOR THEIR APPLICATION OF ANY PRODUCTS.

THE SOFTWARE LICENSE AND LIMITED WARRANTY FOR THE ACCOMPANYING PRODUCT ARE SET FORTH IN THE INFORMATION PACKET THAT SHIPPED WITH THE PRODUCT AND ARE INCORPORATED HEREIN BY THIS REFERENCE. IF YOU ARE UNABLE TO LOCATE THE SOFTWARE LICENSE OR LIMITED WARRANTY, CONTACT YOUR CISCO REPRESENTATIVE FOR A COPY.

The Cisco implementation of TCP header compression is an adaptation of a program developed by the University of California, Berkeley (UCB) as part of UCB's public domain version of the UNIX operating system. All rights reserved. Copyright © 1981, Regents of the University of California.

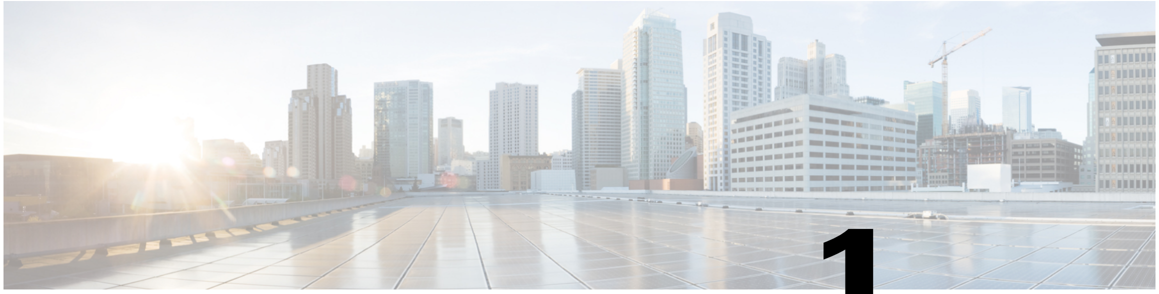
NOTWITHSTANDING ANY OTHER WARRANTY HEREIN, ALL DOCUMENT FILES AND SOFTWARE OF THESE SUPPLIERS ARE PROVIDED “AS IS" WITH ALL FAULTS. CISCO AND THE ABOVE-NAMED SUPPLIERS DISCLAIM ALL WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, THOSE OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT OR ARISING FROM A COURSE OF DEALING, USAGE, OR TRADE PRACTICE.

IN NO EVENT SHALL CISCO OR ITS SUPPLIERS BE LIABLE FOR ANY INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES, INCLUDING, WITHOUT LIMITATION, LOST PROFITS OR LOSS OR DAMAGE TO DATA ARISING OUT OF THE USE OR INABILITY TO USE THIS MANUAL, EVEN IF CISCO OR ITS SUPPLIERS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Any Internet Protocol (IP) addresses and phone numbers used in this document are not intended to be actual addresses and phone numbers. Any examples, command display output, network topology diagrams, and other figures included in the document are shown for illustrative purposes only. Any use of actual IP addresses or phone numbers in illustrative content is unintentional and coincidental.

Cisco and the Cisco logo are trademarks or registered trademarks of Cisco and/or its affiliates in the U.S. and other countries. To view a list of Cisco trademarks, go to this URL: http://www.cisco.com/go/trademarks. Third-party trademarks mentioned are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (1110R)

CONTENTS



CHAPTER 1

Auto Traffic Analysis and Protocol Generation

NBAR includes an **auto-learn** feature that analyzes generic and unknown network traffic to determine the most frequently used hosts and ports. Using this data, the **auto-custom** feature can automatically generate NBAR protocols provisionally to improve identification of traffic

Prerequisites for auto-custom

The auto-custom feature requires auto-learn to be active.

See NBAR2 auto-learn.

Limitations of auto-custom

Default

The auto-custom feature is disabled by default.

Environments Supported

- The auto-custom feature supports environments with:

  A single router with a single collector

  or

  A single router with no collector

- The feature does not support environments with multiple routers operating with a single collector.

Background: Auto Traffic Analysis Using NBAR2 Auto-learn

The NBAR2 **auto-learn** (see NBAR2 Auto-learn) and **auto-custom** features work together. NBAR2 Auto-learn analyzes traffic classified as generic HTTP/SSL or unknown. For generic HTTP/SSL traffic, it derives hostnames from packet header fields in the traffic and tracks the "top hosts" that occur in generic traffic. For unknown traffic, it identifies server-side ports and tracks the "top ports" and "top sockets" that occur in unknown traffic.

The results produced by **auto-learn** can be used by the **auto-custom** feature to automatically create custom NBAR protocols that improve classification of the traffic to improve application visibility for this difficult-to-classify traffic. For example, top hosts provide "candidate" hosts to use in creating custom protocols.

Auto Generation of Custom Protocols Using auto-custom

The **auto-custom** feature uses the results of **auto-learn** to improve NBAR classification of generic and unknown network traffic, automatically generating custom NBAR protocols.

Format for Reporting of Traffic Classified by Auto-generated NBAR Protocols

Auto-generated NBAR protocols report traffic according to hostname or port number:

- For **generic** traffic, protocols are generated for the most frequently occurring **hosts**, and are named according to the hostname. For traffic that contains only a host address and not a hostname, where possible, NBAR uses DNS lookup to provide the corresponding hostname.

  Examples: abcd.com, efgh.net

- For **unknown** traffic, protocols are generated for the most frequently occurring ports, and are named according to the **port number or socket** (server-side IP + port), and the traffic type: TCP or UDP.

  Examples for port: Port_80_TCP, Port_443_UDP

  Example for socket: 72.163.4.162:256_TCP

Auto-generation Is Based on Sampling of Traffic Flows

The **auto-learn** mechanism collects data about generic and unknown traffic by sampling traffic flows for analysis. Not every flow is analyzed. Using sampling rather than analyzing each flow is necessary due to the constraints of hardware resources. The availability of hardware resources for auto-learn analysis depends mostly on the network traffic volume that a device is handling.

For **generic** traffic, the sampling rate is dynamic, adjusting automatically according to system load. For **unknown** traffic, the default sampling rate is 128, meaning that the mechanism samples 1 flow for every 128 of unknown traffic. This value can be configured manually.

Because the **auto-custom** feature relies on data collected by **auto-learn**, the flow sampling performed by auto-learn can influence the automatic generation of protocols by auto-custom. In most use cases, however, sampling accurately reflects the makeup of network traffic.

Use of Auto-generated NBAR Protocols By Other Features

The NBAR application protocols auto-generated by auto-custom improve network traffic reporting, improving application visibility. However, the auto-generated protocols present at any given time are determined by the makeup of recent network traffic, making them inherently dynamic and impermanent.

Because of this dynamic nature, auto-custom protocols are applicable to some features, but not to others. In general, auto-custom protocols improve application **visibility**, but do not affect **security** (firewall) or **QoS** policies.

Features affected by auto-custom protocols:

- NBAR protocol discovery
- Application visibility (FNF, performance-monitor, ezPM, MACE, ...)

Features not affected by auto-custom protocols:

- MQC/QoS
- WAAS
- Performance Routing (PfR)
- NAT

Enabling and Disabling auto-custom

Enables or disables one or both of the auto-custom modes:

- top-hosts
- top-ports

SUMMARY STEPS

1. **configure terminal**
2. [**no**] **ip nbar auto-custom** {**top-ports** | **top-hosts**}
3. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

Step 2	[**no**] **ip nbar auto-custom** {**top-ports** | **top-hosts**}
	Example:
	`Device(config)# ip nbar auto-custom top-hosts`
		Enables or disables auto-custom. The **top-ports** and **top-hosts** options apply the command to those respective modes of auto-custom.

Step 3	**exit** **Example:** `Device(config)# exit`	Exits global configuration mode.

Configuring the Maximum Number of Auto-generated NBAR Protocols to Create

Configures the maximum number of protocols automatically generated by **auto-custom**. The auto-generated protocols present at any given time are determined by the makeup of recent network traffic, making them inherently dynamic and impermanent.

SUMMARY STEPS

1. **configure terminal**
2. **ip nbar auto-custom** {**top-hosts** | **top-ports**} **max-protocols** *number*
3. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**ip nbar auto-custom** {**top-hosts** | **top-ports**} **max-protocols** *number* **Example:** `ip nbar auto-custom top-hosts max-protocols 30`	Configures the maximum number of auto-custom protocols to generate from the lists of top-hosts or top-ports collected by the auto-learn mechanism. **top-hosts** default: 10 **top-ports** default: 10

	Command or Action	Purpose
Step 3	**exit** **Example:** `Device(config)# exit`	Exits global configuration mode.

Configuring the Time Interval for Re-generating the auto-custom Protocols

Configures the time interval at which auto-custom reloads the lists of "top-hosts" for generic traffic and "top-ports" for unknown data. The lists are provided by the **auto-learn** mechanism. After reloading the lists, the **auto-custom** mechanism generates a new set of custom protocols based on the data, which reflects the most recent network traffic. Because of this mechanism, the list of auto-custom protocols is dynamic, changing with the makeup of generic and unknown network traffic.

SUMMARY STEPS

1. **configure terminal**
2. **ip nbar auto-custom** {**top-hosts** | **top-ports**} **time-interval** *minutes*
3. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**ip nbar auto-custom** {**top-hosts** | **top-ports**} **time-interval** *minutes* **Example:** `ip nbar auto-custom top-hosts time-interval 10`	Configures the time interval at which auto-custom reloads the lists of "top-hosts" for generic traffic and "top-ports" for unknown data. Default: 30 minutes
Step 3	**exit** **Example:** `Device(config)# exit`	Exits global configuration mode.

Clearing auto-custom Data

SUMMARY STEPS

1. **configure terminal**
2. **clear ip nbar auto-custom** {**top-hosts** | **top-ports**} {**stats** | **restart**}
3. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**clear ip nbar auto-custom** {**top-hosts** | **top-ports**} {**stats** | **restart**} **Example:** `clear ip nbar auto-custom top-ports restart`	Clears auto-custom data. The **top-ports** and **top-hosts** options apply the command to those respective modes of auto-custom. **stats**: Clears only counters **restart**: Clears counters and removes all current auto-custom protocols.
Step 3	**exit** **Example:** `Device(config)# exit`	Exits global configuration mode.

Disabling DNS-based auto-learn

The NBAR auto-learn feature uses numerous mechanisms to analyze network traffic. One method is DNS-based learning. NBAR learns the network addresses of applications by analyzing DNS query/response traffic. The DNS-based learning mechanism enables NBAR to classify application traffic from the first packet of a flow.

You can enable or disable the DNS-based auto-learn mechanism for application protocols provided in the NBAR Protocol Pack. Disabling the mechanism may be useful if DNS-based learning causes mis-classification of traffic.

SUMMARY STEPS

1. **configure terminal**
2. [**no**] **ip nbar classification dns learning**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	[**no**] **ip nbar classification dns learning** **Example:** `Device(config)#no ip nbar classification dns learning`	Enables or disables DNS-based auto-learn mechanism for protocols in the Cisco NBAR Protocol Pack. Default: enabled

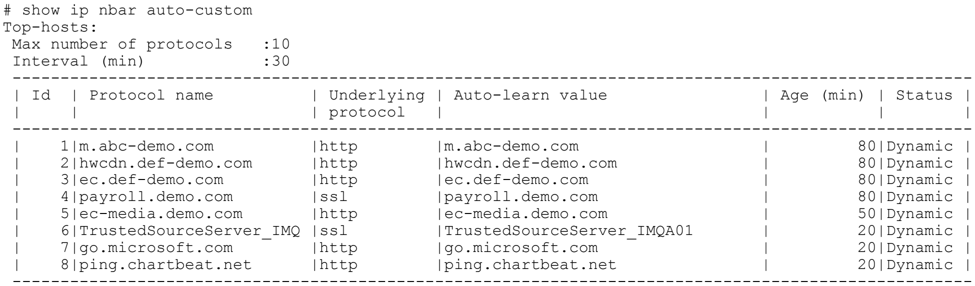
Displaying Auto-generated NBAR Protocols Created by auto-custom

SUMMARY STEPS

1. **show ip nbar auto-custom** [**top-hosts** | **top-ports**]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show ip nbar auto-custom** [**top-hosts** | **top-ports**] **Example:** `show ip nbar auto-custom`	Displays the auto-generated NBAR protocols created by the auto-custom mechanism. Optionally, can specify only protocols for **top-hosts** or **top-ports**. • The first part of the output shows the protocols based on hostnames, from **generic** traffic. • The second part of the output shows the protocols based on port numbers + traffic type (TCP or UDP), from **unknown** traffic.



```
# show ip nbar auto-custom
Top-hosts:
 Max number of protocols   :10
 Interval (min)            :30
 ----------------------------------------------------------------------------------------------------
 | Id  | Protocol name          | Underlying | Auto-learn value                 | Age (min) | Status |
 |     |                        | protocol   |                                  |           |        |
 ----------------------------------------------------------------------------------------------------
 |    1|m.abc-demo.com          |http        |m.abc-demo.com                    |         80|Dynamic |
 |    2|hwcdn.def-demo.com      |http        |hwcdn.def-demo.com                |         80|Dynamic |
 |    3|ec.def-demo.com         |http        |ec.def-demo.com                   |         80|Dynamic |
 |    4|payroll.demo.com        |ssl         |payroll.demo.com                  |         80|Dynamic |
 |    5|ec-media.demo.com       |http        |ec-media.demo.com                 |         50|Dynamic |
 |    6|TrustedSourceServer_IMQ |ssl         |TrustedSourceServer_IMQA01        |         20|Dynamic |
 |    7|go.microsoft.com        |http        |go.microsoft.com                  |         20|Dynamic |
 |    8|ping.chartbeat.net      |http        |ping.chartbeat.net                |         20|Dynamic |
 ----------------------------------------------------------------------------------------------------
```

```
Top-ports:
 Max number of protocols   :40
 Interval (min)            :1
 --------------------------------------------------------------------------------------------------------
 | Id  | Protocol name          |              Auto-learn value                    | Age (min) | Status |
 --------------------------------------------------------------------------------------------------------
 |    1|Port_256_TCP            |Port_256_TCP                                      |          0|Dynamic |
 |    2|72.163.4.162:256_TCP    |72.163.4.162:256_TCP                              |          0|Dynamic |
 --------------------------------------------------------------------------------------------------------
```

Displaying NBAR Protocol Discovery Information for auto-custom Protocols

SUMMARY STEPS

1. **show ip nbar protocol-discovery stat auto-custom**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show ip nbar protocol-discovery stat auto-custom** **Example:** `show ip nbar protocol-discovery stats auto-custom`	Displays the auto-custom protocol discovery statistics.

```
# show ip nbar protocol-discovery stats auto-custom

 Ethernet0/0

 Last clearing of "show ip nbar protocol-discovery" counters 1d05h


                            Input                    Output
                            -----                    ------
   ------------------------ ------------------------ ------------------------
www.abcdef-demo.com          152        0
Total                        152                      0
```

CHAPTER 2

Classifying Network Traffic Using NBAR

Network-Based Application Recognition (NBAR) is a classification engine that recognizes and classifies a wide variety of protocols and applications. When NBAR recognizes and classifies a protocol or an application, you can configure the network to apply the appropriate quality of service (QoS) for that application or traffic with the classified protocol.

This module contains an overview of classifying network traffic using NBAR.

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 Classifying Network Traffic Using NBAR

NBAR does not support the following applications:

- Non-IP traffic.
- Multiprotocol Label Switching (MPLS)-labeled packets. NBAR classifies only IP packets. You can, however, use NBAR to classify IP traffic before the traffic is handed over to MPLS. Use the modular QoS CLI (MQC) to set the IP differentiated services code point (DSCP) field on NBAR-classified packets and make MPLS map the DSCP setting to the MPLS experimental (EXP) setting inside the MPLS header.
- NBAR processing. By design, NBAR processing is temporarily disabled during the In-Service Software Upgrade (ISSU). The following syslog message indicates the restart of the NBAR classification once ISSU is complete: “%NBAR_HA-5-NBAR_INFO: NBAR sync DONE!.”
- Multicast packet classification.
- Asymmetric flows with stateful protocols.
- Packets that originate from or destined to a device running NBAR.

Note In the NBAR context, asymmetric flows are flows in which different packets go through different devices, for reasons such as load balancing implementation or asymmetric routing, where packets flow through different routes in different directions.

NBAR is not supported on the following logical interfaces:

- Dialer interfaces
- Dynamic tunnels such as Dynamic Virtual Tunnel Interface (DVTI)
- Fast Etherchannels
- IPv6 tunnels that terminate on the device
- MPLS
- Overlay Transport Virtualization (OTV) overlay interfaces

Note In cases where encapsulation is not supported by NBAR on some links, you can apply NBAR on other interfaces of the device to perform input classification. For example, you can configure NBAR on LAN interfaces to classify output traffic on the WAN link.

The following virtual interfaces are supported depending on the image of your Cisco IOS:

- Generic routing encapsulation (GRE)
- IPsec IPv4 tunnel (including tunneled IPv6) in protocol discovery mode and MQC mode
- IPsec IPv6 tunnel in protocol discovery mode but not in MQC mode
- Multipoint GRE/Dynamic Multipoint VPN (DMVPN) in protocol discovery mode

Note NBAR requires more CPU power when NBAR is enabled on tunneled interfaces.

If protocol discovery is enabled on both the tunnel interface and the physical interface on which the tunnel interface is configured, the packets that are designated to the tunnel interface are counted on both interfaces. On the physical interface, the packets are classified and are counted based on the encapsulation. On the tunnel interface, packets are classified and are counted based on the Layer 7 protocol.

For all protocols, only 20 combinations of subclassification per protocol can be configured. You can define a combination for subclassification using the **match protocol** *protocol-name variable-field-name value* command.

Information About Classifying Network Traffic Using NBAR

NBAR Functionality

NBAR is a classification engine that recognizes and classifies a wide variety of protocols and applications, including web-based and other difficult-to-classify applications and protocols that use dynamic TCP/UDP port assignments.

When NBAR recognizes and classifies a protocol or an application, the network can be configured to apply the appropriate QoS for that application or traffic with that protocol. The QoS is applied using the MQC.

Note For more information about the MQC, see the “Applying QoS Features Using the MQC” module.

NBAR introduces several classification features that identify applications and protocols from Layer 4 through Layer 7. These classification features are as follows:

- Statically assigned TCP and UDP port numbers.
- Non-TCP and non-UDP IP protocols.
- Dynamically assigned TCP and UDP port numbers. This kind of classification requires stateful inspection, that is, the ability to inspect a protocol across multiple packets during packet classification.
- Subport classification or classification based on deep packet inspection, that is, classification for inspecting packets.

Note Access Control Lists (ACLs) can also be used for classifying static port protocols. However, NBAR is easier to configure and can provide classification statistics that are not available when ACLs are used.

NBAR includes a Protocol Discovery feature that provides an easy way to discover application protocols that are operating on an interface. For more information about Protocol Discovery, see the “Enabling Protocol Discovery” module.

Note NBAR classifies network traffic by application or protocol. Network traffic can be classified without using NBAR. For information about classifying network traffic without using NBAR, see the "Classifying Network Traffic" module.

NBAR includes the Protocol Pack feature that provides an easy way to load protocols and helps NBAR recognize additional protocols for network traffic classification. A protocol pack is set a of protocols developed and packed together. A new protocol pack can be loaded on the device to replace the default IOS protocol pack that is already present in the device.

NBAR Benefits

Identifying and classifying network traffic is an important first step in implementing QoS. A network administrator can more effectively implement QoS in a networking environment after identifying the number and types of applications and protocols that are running on a network.

NBAR gives network administrators the ability to see the different types of protocols and the amount of traffic generated by each protocol. After NBAR gathers this information, users can organize traffic into classes. These classes can then be used to provide different levels of service for network traffic, thereby allowing better network management by providing the appropriate level of network resources for the network traffic.

NBAR is also used in Cisco Application Visibility and Control (AVC). With AVC, NBAR provides better application performance through better QoS and policing, and provides finer visibility about the network that is being used.

With AVC license, the following NBAR features are supported:

- Classification inside transient IPv6 tunnels
- Custom protocols
- Customization of protocol attributes
- Field extraction
- Protocol pack updates

NBAR and Classification of HTTP Traffic

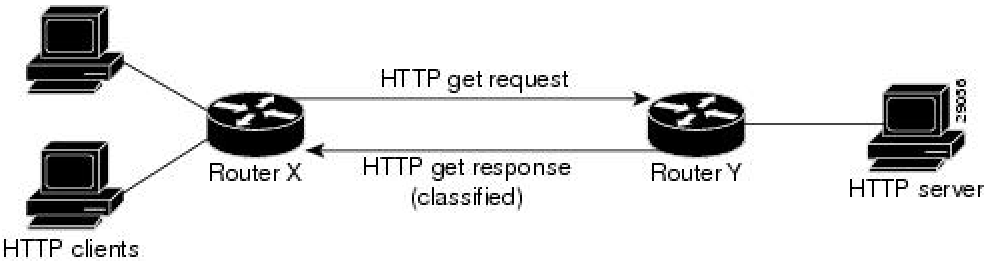
Classification of HTTP Traffic by a URL Host or MIME

NBAR can classify application traffic by looking beyond the TCP/UDP port numbers of a packet. This is called subport classification. NBAR looks into the TCP/UDP payload itself and classifies packets based on content, such as the transaction identifier, message type, or other similar data, within the payload.

Classification of HTTP traffic by a URL, a host, or a Multipurpose Internet Mail Extension (MIME) type is an example of subport classification. NBAR classifies HTTP traffic by the text within the URL or host fields of a request by using regular expression matching. HTTP client request matching in NBAR supports most HTTP request methods such as GET, PUT, HEAD, POST, DELETE, OPTIONS, CONNECT, and TRACE. The NBAR engine then converts the specified match string into a regular expression.

The figure below illustrates a network topology with NBAR in which Device Y is the NBAR-enabled device.

Figure 1: Network Topology with an NBAR-enabled Device



When specifying a URL for classification, include only the portion of the URL that follows the www.*hostname.domain* in the **match** statement. For example, for the URL www.cisco.com/latest/whatsnew.html, include only /latest/whatsnew.html with the **match** statement (for instance, **match protocol http url /latest/whatsnew.html**).

Host specifications are identical to URL specifications. NBAR performs a regular expression match on the host field contents inside an HTTP packet and classifies all packets from that host. For example, for the URL www.cisco.com/latest/whatsnew.html, include only www.cisco.com.

For MIME type matching, the MIME type can contain any user-specified text string. A list of the Internet Assigned Numbers Authority (IANA) supported MIME types can be found at the following URL:

http://www.iana.org/assignments/media-types/

When matching by MIME type, NBAR matches a packet containing the MIME type and all subsequent packets until the next HTTP transaction.

NBAR supports URL and host classification in the presence of persistent HTTP. NBAR does not classify packets that are part of a pipelined request. With pipelined requests, multiple requests are pipelined to the server before previous requests are serviced. Pipelined requests are not supported with subclassification and tunneled protocols that use HTTP as the transport protocol.

The NBAR Extended Inspection for HTTP Traffic feature allows NBAR to scan TCP ports that are not well known and to identify HTTP traffic that traverses these ports. HTTP traffic classification is no longer limited to the well-known and defined TCP ports.

Depending on your release, the Enable NBAR URI Extraction for HTTP Transactions for Persistent Connections feature supports extraction and export of the URL field per transaction, and not only the URL of the first transaction as supported in earlier releases. To enable multi-transaction, a protocol pack with 'Enhanced Web Classification' has to be installed. When an Enhanced Web Classification protocol pack is installed, the **match connection transaction-id** command configuration in flexible netflow tracks multiple HTTP transactions. For more information on tracking HTTP transactions, refer to *Cisco IOS Flexible NetFlow Configuration Guide*.

Note NBAR performs significant additional tasks for classification and export per transaction. These tasks impact performance and may cause increased export rate.

Classification of HTTP Traffic by Using HTTP Header Fields

NBAR introduces expanded ability for users to classify HTTP traffic by using information in the HTTP header fields.

HTTP works using a client/server model. HTTP clients open connections by sending a request message to an HTTP server. The HTTP server then returns a response message to the HTTP client (this response message is typically the resource requested in the request message from the HTTP client). After delivering the response, the HTTP server closes the connection and the transaction is complete.

HTTP header fields are used to provide information about HTTP request and response messages. HTTP has numerous header fields. For additional information on HTTP headers, see section 14 of RFC 2616: *Hypertext Transfer Protocol—HTTP/1.1*. This RFC can be found at the following URL:

http://www.w3.org/Protocols/rfc2616/rfc2616-sec14.html

NBAR is able to classify the following HTTP header fields:

- For request messages (client-to-server), the following HTTP header fields can be identified using NBAR:
  - User-Agent
  - Referrer
  - From
- For response messages (server to client), the following HTTP header fields can be identified using NBAR:
  - Server
  - Location
  - Content-Base
  - Content-Encoding

Within NBAR, the **match protocol http c-header-field** command is used to specify that NBAR identify request messages (the "c" in the **c-header-field** portion of the command is for client). The **match protocol http s-header-field** command is used to specify response messages (the "s" in the **s-header-field** portion of the command is for server).

Note The **c-header-field** and **s-header-field** keywords and associated arguments in the **match protocol http** command are no longer available. The same functionality is achieved by using the individual keywords and arguments. For more information, see the syntax of the **match protocol http** command in the *Quality of Service Solutions Command Reference*.

Note The c-header-field performs subclassifications based on a single value in the user-agent, the referrer, or from-header field values. The s-header-field performs subclassifications based on a single value in the server, location, content-encoding, or content-base header field values. These header field values are not related to each other. Hence, the c-header and s-header fields are replaced by the user-agent, referrer, from, server, content-base, content-encoding, and location parameters as per the intent and need of HTTP subclassification.

Combinations of Classification of HTTP Headers and URL Host or MIME Type to Identify HTTP Traffic

Note that combinations of URL, Host, MIME type, and HTTP headers can be used during NBAR configuration. These combinations provide customers with more flexibility to classify specific HTTP traffic based on their network requirements.

NBAR and Classification of Citrix ICA Traffic

NBAR can classify Citrix Independent Computing Architecture (ICA) traffic and perform subport classification of Citrix traffic based on the published application name or ICA tag number.

Classification of Citrix ICA Traffic by Published Application Name

NBAR can monitor Citrix ICA client requests for a published application that is destined to a Citrix ICA Master browser. After the client requests the published application, the Citrix ICA master browser directs the client to the server with the most available memory. The Citrix ICA client then connects to this Citrix ICA server for the application.

Note For Citrix to monitor and classify traffic by the published application name, use Server Browser Mode on the master browser.

In server browser mode, NBAR statefully tracks and monitors traffic and performs a regular expression search on the packet contents for the published application name specified by the **match protocol citrix** command. The published application name is specified by using the **app** keyword and the *application-name-string* argument of the **match protocol citrix** command. For more information about the **match protocol citrix** command, see the Quality of Service Solutions Command Reference.

The Citrix ICA session triggered to carry the specified application is cached, and traffic is classified appropriately for the published application name.

Citrix ICA Client Modes

Citrix ICA clients can be configured in various modes. NBAR cannot distinguish among Citrix applications in all modes of operation. Therefore, network administrators might need to collaborate with Citrix administrators to ensure that NBAR properly classifies Citrix traffic.

A Citrix administrator can configure Citrix to publish Citrix applications individually or in Published Desktop Mode. In the Published Desktop Mode of operation, all applications within the published desktop of a client use the same TCP session. Therefore, differentiation among applications is impossible, and NBAR can be used to classify Citrix applications only as aggregates (by looking at port 1494).

The Published Application Mode for Citrix ICA clients is recommended when you use NBAR. In Published Application Mode, a Citrix administrator can configure a Citrix client in either Seamless or Nonseamless (windows) modes of operation. In Nonseamless Mode, each Citrix application uses a separate TCP connection, and NBAR can be used to provide interapplication differentiation based on the name of the published application.

Seamless Mode clients can operate in one of two submodes: session sharing or nonsession sharing. In seamless session sharing mode, all clients share the same TCP connection, and NBAR is not able to differentiate among applications. Seamless sharing mode is enabled by default in some software releases. In seamless nonsession sharing mode, each application for each client uses a separate TCP connection. NBAR can provide interapplication differentiation in seamless nonsession sharing mode.

Note NBAR operates properly in Citrix ICA secure mode. Pipelined Citrix ICA client requests are not supported.

Classification of Citrix ICA Traffic by ICA Tag Number

Citrix uses a TCP session each time an application is opened. In the TCP session, a variety of Citrix traffic may be intermingled in the same session. For example, print traffic may be intermingled with interactive traffic, causing interruption and delay for a particular application.

Most users would prefer printing to be handled as a background process that does not interfere with the processing of higher-priority traffic. To accommodate this printing preference, the Citrix ICA protocol includes the ability to identify Citrix ICA traffic based on the ICA tag number of the packet. The ability to identify, tag, and prioritize Citrix ICA traffic is referred to as ICA Priority Packet Tagging. With ICA Priority Packet Tagging, Citrix ICA traffic is categorized as high, medium, low, and background, depending on the ICA tag of the packet.

When ICA traffic priority tag numbers are used, and the priority of the traffic is determined, QoS features can be implemented to determine how the traffic will be handled. For example, QoS traffic policing can be configured to transmit or drop packets with a specific priority.

Citrix ICA Packet Tagging

The Citrix ICA tag is included in the first two bytes of the Citrix ICA packet, after the initial negotiations are completed between the Citrix client and server.

The first two bytes of the packet (byte 1 and byte 2) contain the byte count and the ICA priority tag number. Byte 1 contains the low-order byte count, and the first two bits of byte 2 contain the priority tags. The other six bits contain the high-order byte count.

The ICA priority tag value can be a number from 0 to 3. The number indicates the packet priority, with 0 being the highest priority and 3 being the lowest priority.

To prioritize Citrix traffic by the ICA tag number of the packet, you must specify the tag number using the **ica-tag** keyword and the *ica-tag-value* argument of the **match protocol citrix** command. For more information about the **match protocol citrix** command, see the Quality of Service Solutions Command Reference.

The table below contains information about different Citrix traffic and the respective priority tags.

Table 1: Citrix ICA Packet Tagging

Priority	ICA Bits (decimal)	Sample Virtual Channels
High	0	Video, mouse, and keyboard screen updates
Medium	1	Program neighborhood, clipboard, audio mapping, and license management
Low	2	Client common equipment (COM) port mapping and client drive mapping
Background	3	Auto client update, client printer mapping, and original equipment manufacturers (OEM) channels

NBAR and RTP Payload Type Classification

Real-time Transport Protocol (RTP) is a packet format for multimedia data streams. It can be used for media-on-demand and for interactive services such as Internet telephony. RTP consists of a data part and a control part. The control part is called Real-Time Transport Control Protocol (RTCP). RTCP is a separate protocol that is supported by NBAR. It is important to note that the NBAR RTP Payload Type Classification feature does not identify RTCP packets and that RTCP packets run on odd-numbered ports and RTP packets run on even-numbered ports.

The data part of RTP is a thin protocol that provides support for applications with real-time properties such as continuous media (audio and video), which includes timing reconstruction, loss detection, and security and content identification. RTP is discussed in RFC 1889 (*A Transport Protocol for Real-Time Applications*) and RFC 1890 (*RTP Profile for Audio and Video Conferences with Minimal Control*).

The RTP payload type is the data transported by RTP in a packet, for example, audio samples or compressed video data.

The NBAR RTP Payload Type Classification feature not only allows real-time audio and video traffic to be statefully identified, but can also differentiate on the basis of audio and video codecs to provide more granular QoS. The RTP Payload Type Classification feature, therefore, does a deep-packet inspection into the RTP header to classify RTP packets.

For more information on the classification of RTP with NBAR, see NBAR RTP Payload Classification.

NBAR and Classification of Custom Protocols and Applications

NBAR supports the use of custom protocols to identify custom applications. Custom protocols support static port-based protocols and applications that NBAR does not currently support. You can add to the set of protocols and application types that NBAR recognizes by creating custom protocols.

Custom protocols extend the capability of NBAR Protocol Discovery to classify and monitor additional static port applications and allow NBAR to classify nonsupported static port traffic.

Once the custom protocols are defined, you can then use them with the help of NBAR Protocol Discovery and the MQC to classify the traffic.

With NBAR supporting the use of custom protocols, NBAR can map static TCP and UDP port numbers to the custom protocols.

There are two types of custom protocols:

- Predefined custom protocols
- User-defined custom protocols

NBAR includes the following characteristics related to predefined custom protocols and applications:

- Custom protocols have to be named custom-xx, with xx being a number.
- Ten custom applications can be assigned using NBAR, and each custom application can have up to 16 TCP and 16 UDP ports each mapped to the individual custom protocol. The real-time statistics of each custom protocol can be monitored using Protocol Discovery.
- After creating a variable when creating a custom protocol, you can use the **match protocol** commandto classify traffic on the basis of a specific value in the custom protocol.

NBAR includes the following characteristics related to user-defined custom protocols and applications:

- The ability to inspect the payload for certain matching string patterns at a specific offset.
- The ability to allow users to define the names of their custom protocol applications. The user-named protocol can then be used by Protocol Discovery, the Protocol Discovery MIB, the **match protocol**command, and the **ip nbar port-map** command as an NBAR-supported protocol.
- The ability of NBAR to inspect custom protocols specified by traffic direction (that is, traffic heading toward a source or destination rather than traffic in both directions), if desired by the user.
- CLI support that allows a user configuring a custom application to specify a range of ports rather than to specify each port individually.
- The **variable**keyword, the *field-name*argument,and the *field-length* argument were added to the **ip nbar custom**command.
- The **http** keyword group that lets you add custom host and URL signatures.

This additional keyword and two additional arguments allow for creation of more than one custom protocol based on the same port numbers.

Note Defining a user-defined custom protocol restarts the NBAR feature, whereas defining predefined custom protocol does not restart the NBAR feature.

NBAR DNS-based Classification

NBAR can improve traffic classification by using DNS transaction information exchanged when a user initiates a connection with an application server. This method offers the significant advantage of classifying flows from the first packet in the flow.

To illustrate, when a web-based application is opened in a browser, the browser first communicates with a DNS server to request the IP address of the relevant server for the application. The DNS transaction consists of a request and response; the response contains the IP address of the server for the web-based application.

Using information from this transaction, NBAR can correctly associate the web-based application with the relevant server IP address. NBAR can then identify future traffic involving that IP address from the first packet of the flow.

Supported Platforms

This feature is supported on platforms operating Cisco IOS XE, beginning with Cisco IOS XE release 3.17S.

Activation

The feature is activated at all times.

Advantages

NBAR applies multiple methods to classifying traffic, including in some cases, classifying traffic from the first packet, such as by socket-cache. The DNS-based classification feature operates with other NBAR methods to improve traffic classification. It is especially helpful for certain specific types of traffic that would not otherwise be classified, including asymmetric server-to-client flows, as well as some types of encrypted traffic.

Complementarity with Other NBAR Classification Methods

In general, the NBAR engine uses numerous strategies together to provide the most granular possible classification of traffic. First-packet classification may occur by multiple methods, including DNS-based classification and socket-cache. Additional classification methods may then add greater granularity to the classification.

Limitations

- Identification by DNS transaction information is insufficient in some situations. In these cases, NBAR relies on other methods to classify the traffic, where possible. For example, this method does not function well with generic hosts or service aggregation. (In the case of generic hosts or service aggregation, numerous services are hosted through a single server IP address, either using the same host name or different host names.)
- In some cases, NBAR may not be have access to the DNS transaction data for some traffic. For example, a network topology might include a local DNS server accessed through a connection not monitored by NBAR. DNS-based classification is not possible in these cases.

Related Functionality

In addition to the DNS-based classification feature, NBAR has other methods that can, in some cases, provide first packet classification of traffic.

Customized server specification. This feature operates on all platforms that support NBAR, including those that do not support the DNS-based classification method. This feature is more limited than the DNS transaction method in its functionality. Customized server specification requires user configuration of the specific domains to identify using the DNS transaction information.

Use of customized server specification overrides other NBAR classification methods for the specified domain, and should only be used when specifically required. For information about this feature, including configuration commands, see: NBAR Custom Applications Based on DNS Name.

NBAR and Classification with Dynamic PDLMs

Dynamic Packet Description Language Modules (PDLMs) allow new protocol support or enhance existing protocol support for NBAR without the requirement of a specific Cisco release upgrade and device reload. If the support is for enhancing protocols for NBAR, the module version of the PDLMs should be greater than the existing version of the PDLMs. Subsequent Cisco releases incorporate support for these new protocols.

Note PDLMs must be loaded on both Route Processors (RPs) when using the ASR 1006 redundant hardware setup.

Dynamic PDLMs are platform-specific and have a Software Family Identifier (SFI) embedded in them. Dynamic PDLMs of other platforms cannot be loaded on Cisco ASR 1000 Series Aggregation Services Routers.

NBAR-Supported Protocols

The **match protocol**(NBAR) command is used to classify traffic on the basis of protocols supported by NBAR. NBAR is can classify the following types of protocols:

- Non-UDP and non-TCP IP protocols
- TCP and UDP protocols that use statically assigned port numbers
- TCP and UDP protocols that use statically assigned port numbers but still require stateful inspection
- TCP and UDP protocols that dynamically assign port numbers and therefore require stateful inspection

To view the list of protocols supported in a protocol pack, see NBAR Protocol Library.

NBAR Protocol Pack

The NBAR protocol pack provides an easy way to update protocols supported by NBAR without replacing the base IOS image that is already present in the device. A protocol pack is a set of protocols developed and packed together. For more information about loading an NBAR Protocol Pack, see *QoS: NBAR Configuration Guide*. To view the list of protocols supported in a protocol pack, see NBAR Protocol Library.

NBAR and Classification of Peer-to-Peer File-Sharing Applications

The following applications are the most common peer-to-peer file-sharing applications supported by NBAR:

- BitTorrent
- DirectConnect
- eDonkey
- eMule
- FastTrack

- KazaA (and KazaA Lite and KazaA Lite Resurrection)
- Win MX
- POCO

DirectConnect and eDonkey P2P protocols support the following subclassifications depending on your release:

- eDonkey supports the following subclassification options:
  - file-transfer
  - search-file-name
  - text-chat
- KazaA, FastTrack, and Gnuetella support the file-transfer subclassification.

The Gnutella file sharing became classifiable using NBAR in Cisco IOS XE Release 2.5.

Applications that use the Gnutella protocol are Bearshare, Gnewtellium, Gnucleus, Gtk-Gnutella, Limewire, Mutella, Phex, Qtella, Swapper, and Xolo. The traffic from the applications that use the Gnutella protocol will be classified as Gnutella and not as the respective application.

NBAR Multi stage Classification

NBAR supports a wide range of stateful network protocols such as HTTP classification by URL, Host and MIME type, FTP, TFTP, and so on. NBAR classifies static-port protocols such as those classifiable with access control lists (ACLs).

Multi stage classification reports the underlying protocol as a temporary classification instead of an unknown classification. For example, in earlier releases, to support cases like Video-over-HTTP, where the signature is found on the HTTP response packet, recursive classification over HTTP was allowed causing the first packet of HTTP flows to be reported as unknown, which in turn impacted the following:

- Protocol discovery—reduced classification.
- Packet-based flexible NetFlow (FNF)—reduced classification.
- QoS—delayed classification.
- Performance—because more packets were being processed.
- Aging short flows that are in the middle of a classification process stops without any classification results, although they were partially classified.

Prior to NBAR multi stage classification, NBAR reported an unknown classification result until a final classification decision was reached. NBAR multi stage classification returns the most up-to-date classification decision. It modifies the data path to expose the underlying protocols from media partitioning (MP) recursive classification path—instead of returning “unknown” until a final classification is available, it returns the current (temporary) classification decision.

NBAR multi stage classification has the following characteristics:

Backward incompatibility

If a system has a policy that matches a protocol like SOCKet Secure (SOCKS), which is an underlying protocol for AOL Instant Messenger (AIM) and Bittorrent, when all other protocols have failed (when other protocols are also enabled, either through protocol discovery or through FNF or explicitly through modular QoS CLI [MQC]), this policy would match the first packets of AIM or Bittorrent flows as SOCKS. Blocking the underlying protocol while allowing non underlying protocols is not possible with multi stage classification.

Traffic Reordering

When a user configures different priorities for each classification on the traffic flow, the flow might be directed to different output queues. With multi stage classification more than one classification decision for a single traffic flow may occur. When the traffic is based on prioritized classification, we recommend that the underlying protocols get a higher priority (for example, HTTP get a higher priority than Video-over-HTTP).

Performance Routing (PfR)

When PfR checks the classification from NBAR to make a routing decision, it takes into account if this is a final classification or not. If it is not the final classification, no routing decision is made as it may split the traffic flow to many paths resulting in an “unknown” classification.

NBAR clients let the users know if the classification is temporary or not.

NBAR Scalability

Interface Scalability

Depending on your release there is no limit to the number of interfaces on which protocol discovery can be enabled.

The following table provides details of the protocol discovery supported interface and the release number.

Table 2: Release and Protocol Discovery Interface Support

Release	Number of Interfaces Supported with Protocol Discovery
Cisco IOS XE Release 2.5	128
Cisco IOS XE Release 2.6	256
Cisco IOS XE Release 2.7	32
Cisco IOS XE Release 3.2S and later releases	32

Flow Scalability

The number of bidirectional flows and the platforms supported are same for all releases. A method to reduce the number of active flows based on quick aging is available.

Quick aging occurs under the following conditions:

- TCP flows that do not reach the established state.
- UDP flows with fewer than five packets that are not classified within the specified quick aging timeout.
- Flows that are not classified within the specified quick aging timeout.

The quick aging method reduces the number of flows required for NBAR operation up to three times or more depending on the network behavior.

The Cisco Cloud Services Router 1000V Series devices exhibit the same behavior as that of ESP5 with respect to flow scalability.

Flow Table Sizing

The **ip nbar resources flow max-sessions** command provides the option to override the default maximum flow sessions that are allowed in a flow table. The performance of the device with the NBAR feature depends on the memory size and the number of flows configured for the flow table. The flexibility to change the number of flows helps in increasing the performance of the system depending on the capacity of the device. To verify the NBAR flow statistics, use the **show ip nbar resources flow** command.

The following table provides the details of the platform and the flow size limits:

Table 3: Platform and Flow Size Details

Platform	Maximum Number of Flows	Default Number of Flows	Memory Upper Limit (70% of Platform Memory)
ESP5/ASR1001/CSR	750,000	500,000	179 MB
ESP10	1,650,000	1,000,000	358 MB
ESP20/ESP40/ASR1002-X	3,500,000	1,000,000	716 MB
ESP100	10,000,000	3,000,000	2.1 GB

To reduce the memory impact, the recommended number of flows is 50,000, where such a configuration is sufficient.

Note The total number of flow entries does not increase when the overall system memory usage is at or above 90%.

NBAR Protocol Discovery

NBAR includes a feature called Protocol Discovery. Protocol discovery provides an easy way to discover protocol packets passing through an interface. For more information about Protocol Discovery, see the “Enabling Protocol Discovery” module.

NBAR Protocol Discovery MIB

The NBAR Protocol Discovery MIB expands the capabilities of NBAR Protocol Discovery by providing the following new functionalities through the Simple Network Management Protocol (SNMP):

- Enable or disable Protocol Discovery per interface.

- Display Protocol Discovery statistics.
- Configure and display multiple top-n tables that list protocols by bandwidth usage.
- Configure thresholds based on the traffic of particular NBAR-supported protocols or applications that report breaches and send notifications when these thresholds are exceeded.

For more information about the NBAR Protocol Discovery MIB, see the “Network-Based Application Recognition Protocol Discovery Management Information Base” module.

NBAR and Multipacket Classification

Depending on your release, NBAR provides the ability to simultaneously search large number of multipacket signatures. This new technique is supported for many of the new protocols. This technique also provides improved performance and accuracy for other protocols. Along with the support for new signatures, the multipacket classification capabilities change NBAR behavior in the following ways:

1. NBAR classification requires anywhere between 1 and 15 payload packets in a flow depending on the protocol. Retransmitted packets are not counted in this calculation.
2. NBAR will neither classify flows without any payload packets nor classify any TCP payload packet with a wrong sequence number even if there are 15 payload packets for classification.
3. TCP retransmitted packets are not counted as valid packets for classification in the Multipacket Engine module. These type of packets can delay the classification until a sufficient number of valid payload packets are accumulated.
4. Payload packets with only static signatures in NBAR are classified after the single-packet and multipacket protocols are processed and failed. Therefore, a maximum of 15 payload packets can be classified as unknown until the final (static) classification decision is taken.
5. Due to the above-mentioned restrictions, custom protocols can be used to force the classification of the first packet, ignoring the existence of payload or correct sequence numbers in the port-based classification.

NBAR on VRF Interfaces

Depending on your release, the NBAR IPv4 and IPv6 classification on VRF interfaces is supported.

Note Classification for Citrix protocol with “app” subclassification is not guaranteed on VRF interfaces when NBAR is enabled on VRF interfaces.

NBAR and IPv6

Depending on your release, the following types of classification are supported:

- NBAR provides static port-based classification and IP protocol-based classification for IPv6 packets.
- NBAR supports IPv6 classification in protocol discovery mode, but not in MQC mode.

- NBAR always reads the next header field in the fixed IPv6 header to determine the transport layer protocol used by the packet's payload for IPv6 packets. If an IPv6 packet contains one or more extension headers, NBAR will not skip to the last IPv6 extension header to read the actual protocol type; instead, NBAR classifies the packet as an IPv6 extension header packet.

NBAR Support for IPv6

Depending on your release, NBAR supports the following types of classification:

- Native IPv6 classification.
- Classification of IPv6 traffic flows inside tunneled IPv6 over IPv4 and teredo.
- IPv6 classification in protocol discovery mode and in MQC mode.
- Static and stateful classification.
- Flexible NetFlow with NBAR based fields on IPv6.

NBAR supports IPv6 in IPv4 (6-to-4, 6rd, and ISATAP), and teredo tunneled classification. The **ip nbar classification tunneled-traffic** command is used to enable the tunneled traffic classification. When the tunneled traffic classification is enabled, NBAR performs an application classification of IPv6 packets that are carried inside the IPv4 traffic. If the **ip nbar classification tunneled-traffic** command is disabled, the tunneled IPv6 packets are handled as IPv4 packets.

NBAR supports the capture of IPv6 fields and allows the creation of IPv6 traffic-based flow monitors. When you enable the **ipv6 flow monitor** command, the monitor is bound to the interface, NBAR classification is applied to the IPv6 traffic type, and Flexible NetFlow captures the application IDs in the IPv6 traffic flow.

NBAR Support for GETVPN

NBAR supports Group Encrypted Transport VPN (GETVPN). When ingress QoS is in crypto-map mode, the ingress QoS will work on encrypted traffic.

You can go back to backward compatible mode by using the **ip nbar disable classification encrypted-app** command in global configuration mode.

Note GETVPN is currently not supported by AVC and FNF.

NBAR Support for CAPWAP

CAPWAP (Control And Provisioning of Wireless Access Points) is a protocol is used in wireless traffic, providing point-to-point encapsulation (tunnel) for application traffic. There are two types of CAPWAP traffic: data and control.

NBAR provides a CAPWAP recognition mode that enables NBAR classification of the application traffic within a CAPWAP tunnel.

Classification Behavior: CAPWAP Recognition Disabled/Enabled

By default, CAPWAP recognition mode is not enabled. All CAPWAP traffic is reported as "capwap-data" or "capwap-control" without details about the application traffic within the tunnel.

When CAPWAP recognition is enabled:

- CAPWAP control traffic: NBAR reports as "capwap-control."
- CAPWAP data traffic: NBAR reports on the specific application traffic within the tunnel.

CAPWAP Traffic Type	NBAR CAPWAP Recognition Enabled	NBAR CAPWAP Recognition Disabled
Control traffic	NBAR reports traffic as "capwap-control"	NBAR reports traffic as "capwap-control"
Data traffic	NBAR reports application traffic within the CAPWAP tunnel	NBAR reports traffic as "capwap-data"

Requirements

The following are required for the NBAR recognition of application traffic within a CAPWAP tunnel:

- Cisco IOS XE platform
- Cisco IOS XE 3.17 or later
- NBAR enabled on the platform

Usage

The CAPWAP feature is disabled by default. Use the **ip nbar classification tunneled-traffic capwap** CLI to enable the feature. To disable, use **no ip nbar classification tunneled-traffic capwap**.

```
device# config terminal
device(config)# ip nbar classification tunneled-traffic capwap
```

NBAR Configuration Processes

You can configure NBAR in the following two ways:

- Configuring NBAR using MQC
- Enabling Protocol Discovery

For more information about the NBAR configuration, see the QoS: NBAR Configuration Guide.

Restarting NBAR

NBAR is restarted under the following circumstances.

- Custom protocol addition via CLI

- PDLM load
- RP switchover
- FP switchover
- Protocol pack installation
- Link-age change

Restart involves deactivating and reactivating NBAR. During this time, all packets are classified as 'Unknown' by NBAR. Once NBAR is reactivated, classification is activated.

Note Protocol Discovery statistics will be lost with RP Switchover.

How to Classify Network Traffic Using NBAR

NBAR provides two approaches to configuring attribute-based protocol matching:

- Grouping traffic into **categories and sub-categories** (see Configuring Attribute-based Protocol Match Using Categories and Sub-categories, on page 29)

  Useful for policy implementations that do not use SRND. A disadvantage of this method is that it can be difficult to keep track of the mapping between traffic and the categories and sub-categories defined within the policy.

- Using the Solution Reference Network Designs (**SRND**) model (see Configuring Attribute-based Protocol Match Using SRND, on page 31)

  Simplifies the configuration of SRND-based policies. Although the category/sub-category model can support SRND implementations, it is simpler and more efficient to use this model.

About Configuring Attribute-based Protocol Matching Using Categories

Useful for policy implementations that do not use SRND. A disadvantage of this method is that it can be difficult to keep track of the mapping between traffic and the categories and sub-categories defined within the policy. For information about the procedure, see Configuring Attribute-based Protocol Match Using Categories and Sub-categories, on page 29.

About Configuring Attribute-based Protocol Matching Using SRND

The NBAR category/sub-category model can support SRND implementations. However, beginning with the release of IOS 15.5(3)T and IOS XE 3.16S, for SRND policy implementations it is more efficient and recommended to use the SRND-specific model instead.

The SRND-specific model provides two attributes (**traffic-class** and **business-relevance**) to configure protocol matching for SRND-based policies. The attributes provided for operation with SRND-based policies are applicable only within the context of SRND implementations.

Background: SRND Policy Model

The Solution Reference Network Designs (SRND) policy model simplifies prioritization of traffic for QoS. It provides 12 classes that define traffic according to application. Each class of traffic can be directed to a specific QoS queue. Of these classes:

- 10 classes apply to business-relevant applications operating in 10 different recognized technologies, such as VoIP, video, conferencing, and so on.
- 1 class applies to business-relevant applications of unknown technology.
- 1 class applies to business-irrelevant applications.

Flexibility to Reclassify Applications

The 12 classes that NBAR provides for operating with the SRND model include default values appropriate for most enterprises. However, NBAR makes it easy to reclassify specific applications as business-relevant or business-irrelevant, as necessary. (See example of reclassifying the Skype VoIP application: Example: SRND Configuration - Reclassifying an Application as Business-relevant, on page 38)

Attribute: traffic-class

The **traffic-class** attribute specifies the general category of the traffic, such as VoIP, video, conferencing, and so on. The The following table describes the 10 values for **traffic-class**.

Table 4: Values for traffic-class

Value	Description
voip-telephony	VoIP telephony (bearer-only) traffic
broadcast-video	Broadcast TV, live events, video surveillance
real-time-interactive	High-definition interactive video applications
multimedia-conferencing	Desktop software multimedia collaboration applications
multimedia-streaming	Video-on-Demand (VoD) streaming video
network-control	Network control plane traffic
signaling	Signaling traffic that supports IP voice and video telephony
ops-admin-mgmt	Network operations, administration, and management traffic
transactional-data	Interactive data applications
bulk-data	Non-interactive data applications

Attribute: business-relevance

The business-relevance attribute specifies whether the application is considered relevant to the business activity of the organization. The default values reflect typical usage and business relevance, but the values can be customized according to the specific requirements of an organization.

The following table describes the values for business-relevance.

Table 5: Values for business-relevance

Value	Description
business-relevant	Application critical for an organization's business activity
default	Application used for an organization's business activity
business-irrelevant	Application not relevant to an organization's business activity

Configuring Attribute-based Protocol Match Using Categories and Sub-categories

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map** [**type**] [**match-all** | **match-any**] *class-map-name*
4. **match protocol attribute application-group** *application-group* [*application-name*]
5. **match protocol attribute category** *application-category* [*application-name*]
6. **match protocol attribute encrypted** {**encrypted-no** | **encrypted-unassigned** | **encrypted-yes**} [*application-name*]
7. **match protocol attribute sub-category** *application-category* [*application-name*]
8. **match protocol attribute tunnel** {**tunnel-no** | **tunnel-unassigned** | **tunnel-yes**} [*application-name*]
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

Step 3	**class-map** [**type**] [**match-all** | **match-any**] *class-map-name*
	Example:
	`Device(config)# class-map cmap1`
		Creates a class map to be used for matching packets to a specified class and enters QoS class-map mode.
		• Enter the name of the class map.

Step 4	**match protocol attribute application-group** *application-group* [*application-name*] **Example:** `Device(config-cmap)# match protocol attribute application-group skype`	Configures the specified application group as the match criterion. • (Optional) Use the *application-name* argument to configure the application and not the application group as the match criterion. The configuration is saved as **match protocol** *application-name* instead of **match protocol attribute application-group** *application-group*.
Step 5	**match protocol attribute category** *application-category* [*application-name*] **Example:** `Device(config-cmap)# match protocol attribute category email`	Configures the specified category as the match criteria attribute. • (Optional) Use the *application-name* argument to configure a specific application, and not the application category, as the match criterion. The configuration is saved as **match protocol** *application-name* instead of **match protocol attribute category** *application-category*.
Step 6	**match protocol attribute encrypted** {**encrypted-no** | **encrypted-unassigned** | **encrypted-yes**} [*application-name*] **Example:** `Device(config-cmap)# match protocol attribute encrypted encrypted-yes`	Configures the specified encryption status as the match criterion. • (Optional) Use the *application-name* argument to configure application within the specified encrypted status as the match criterion. The configuration is saved as **match protocol** *application-name* instead of **match protocol attribute encrypted** {**encrypted-no** | **encrypted-unassigned** | **encrypted-yes**}.
Step 7	**match protocol attribute sub-category** *application-category* [*application-name*] **Example:** `Device(config-cmap)# match protocol attribute sub-category client-server`	Configures the specified sub-category as the match criteria attribute. • (Optional) Use the *application-name* argument to configure a specific application, and not the sub-category, as the match criterion. The configuration is saved as **match protocol** *application-name* instead of **match protocol attribute sub-category** *application-category*.
Step 8	**match protocol attribute tunnel** {**tunnel-no** | **tunnel-unassigned** | **tunnel-yes**} [*application-name*]	Configures the specified encryption status as the match criterion. • (Optional) Use the *application-name* argument to configure a specific application within the specified tunneling status as the

	Command or Action	Purpose
	Example: `Device(config-cmap)# match protocol attribute tunnel tunnel-yes`	match criterion. The configuration is saved as **match protocol** *application-name* instead of **match protocol attribute tunnel** {**tunnel-no** | **tunnel-unassigned** | **tunnel-yes**}.

Step 9	**end**
	Example:
	`Device(config-cmap)# end`
		Exits Qos class-map mode and returns to privileged EXEC mode.

Configuring Attribute-based Protocol Match Using SRND

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map** [**type**] [**match-all** | **match-any**] *class-map-name*
4. **match protocol attribute traffic-class** *traffic-class-option*
5. **match protocol attribute business-relevance** *business-relevance-option*
6. **end**

DETAILED STEPS

	Command or Action	Purpose
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	**class-map** [**type**] [**match-all** | **match-any**] *class-map-name*
	Example:
	`Device(config)# class-map cmap1`
		Creates a class map to be used for matching packets to a specified class and enters QoS class-map mode.
		• Enter the name of the class map.

Step 4	**match protocol attribute traffic-class** *traffic-class-option*	Configures the specified traffic class as the match criterion.

	Command or Action	Purpose
	Example: `Device(config-cmap)# match protocol attribute traffic-class voip-telephony`	• *traff-class-option* possible values: voip-telephony, broadcast-video, real-time-interactive, multimedia-conferencing, multimedia-streaming, network-control, signaling, ops-admin- mgmt, transactional-data, bulk-data
Step 5	**match protocol attribute business-relevance** *business-relevance-option* **Example:** `Device(config-cmap)# match protocol attribute business-relevance business-relevant`	Configures the specified category as the match criteria attribute. • *business-relevance-option* possible values: business-relevant, default, business-irrelevant

Step 6	**end**
	Example:
	`Device(config-cmap)# end`
		Exits QoS class-map mode and returns to privileged EXEC mode.

SRND Configuration: Typical Class-Map, Policy-Map

The following sections show a typical example of a class-map and policy-map for an SRND implementation. It illustrates how the **traffic-class** and **business-relevance** attributes address the 12-class SRND QoS model.

Class-map

```
class-map match-all VOICE
    match protocol attribute traffic-class voip-telephony
    match protocol attribute business-relevance business-relevant

class-map match-all BROADCAST-VIDEO
    match protocol attribute traffic-class broadcast-video
    match protocol attribute business-relevance business-relevant

class-map match-all INTERACTIVE-VIDEO
    match protocol attribute traffic-class real-time-interactive
    match protocol attribute business-relevance business-relevant

class-map match-all MULTIMEDIA-CONFERENCING
    match protocol attribute traffic-class multimedia-conferencing
    match protocol attribute business-relevance business-relevant

class-map match-all MULTIMEDIA-STREAMING
    match protocol attribute traffic-class multimedia-streaming
    match protocol attribute business-relevance business-relevant

class-map match-all SIGNALING
    match protocol attribute traffic-class signaling
    match protocol attribute business-relevance business-relevant

class-map match-all NETWORK-CONTROL
    match protocol attribute traffic-class network-control
     match protocol attribute business-relevance business-relevant

class-map match-all NETWORK-MANAGEMENT
```

```
    match protocol attribute traffic-class ops-admin-mgmt
    match protocol attribute business-relevance business-relevant

class-map match-all TRANSACTIONAL-DATA
    match protocol attribute traffic-class transactional-data
    match protocol attribute business-relevance business-relevant

class-map match-all BULK-DATA
    match protocol attribute traffic-class bulk-data
    match protocol attribute business-relevance business-relevant

class-map match-all SCAVENGER
    match protocol attribute business-relevance business-irrelevant
```

Policy-map

```
policy-map 12-cls-marking

class VOICE
    set dscp ef

class BROADCAST-VIDEO
    set dscp cs5

class INTERACTIVE-VIDEO
    set dscp cs4

class MULTIMEDIA-CONFERENCING
    set dscp af41

class MULTIMEDIA-STREAMING
    set dscp af31

class SIGNALING
    set dscp cs3

class NETWORK-CONTROL
    set dscp cs6

class NETWORK-MANAGEMENT
    set dscp cs2

class TRANSACTIONAL-DATA
    set dscp af21

class BULK-DATA
    set dscp af11

class SCAVENGER
    set dscp cs1

class class-default
    set dscp default
```

Configuration Examples for Classifying Network Traffic Using NBAR in Cisco Software

Example: Classification of HTTP Traffic Using the HTTP Header Fields

In the following example, any request message that contains “somebody@cisco.com” in the user-agent, referer, or from field will be classified by NBAR. Typically, a term with a format similar to "somebody@cisco.com" would be found in the From header field of the HTTP request message.

```
Device(config)# class-map match-all class1
Device(config-cmap)# match protocol http from “somebody@cisco.com”
```

In the following example, any request message that contains "http://www.cisco.com/routers" in the User-Agent, Referer, or From field will be classified by NBAR. Typically, a term with a format similar to "http://www.cisco.com/routers" would be found in the Referer header field of the HTTP request message.

```
Device(config)# class-map match-all class2
Device(config-cmap)# match protocol http referer “http://www.cisco.com/routers”
```

In the following example, any request message that contains "CERN-LineMode/2.15" in the User-Agent, Referer, or From header field will be classified by NBAR. Typically, a term with a format similar to "CERN-LineMode/2.15" would be found in the User-Agent header field of the HTTP request message.

```
Device(config)# class-map match-all class3
Device(config-cmap)# match protocol http user-agent “CERN-LineMode/2.15”
```

In the following example, any response message that contains "CERN/3.0" in the Content-Base (if available), Content-Encoding, Location, or Server header field will be classified by NBAR. Typically, a term with a format similar to "CERN/3.0" would be found in the Server header field of the response message.

```
Device(config)# class-map match-all class4
Device(config-cmap)# match protocol http server “CERN/3.0”
```

In the following example, any response message that contains “http://www.cisco.com/routers” in the Content-Base (if available), Content-Encoding, Location, or Server header field will be classified by NBAR. Typically, a term with a format similar to “http://www.cisco.com/routers” would be found in the Content-Base (if available) or Location header field of the response message.

```
Device(config)# class-map match-all class5
Device(config-cmap)# match protocol http location “http://www.cisco.com/routers”
```

In the following example, any response message that contains “gzip” in the Content-Base (if available), Content-Encoding, Location, or Server header field will be classified by NBAR. Typically, the term “gzip” would be found in the Content-Encoding header field of the response message.

```
Device(config)# class-map match-all class6
Device(config-cmap)# match protocol http content-encoding “gzip”
```

Example: Combinations of Classification of HTTP Headers and URL Host or MIME Type to Identify HTTP Traffic

In the following example, HTTP header fields are combined with a URL to classify traffic. In this example, traffic with a User-Agent field of “CERN-LineMode/3.0” and a Server field of “CERN/3.0”, along with host name “cisco.com” and URL “/routers”, are classified using NBAR:

```
Device(config)# class-map match-all c-http
Device(config-cmap)# match protocol http user-agent “CERN-LineMode/3.0”
Device(config-cmap)# match protocol http server "CERN/3.0"
Device(config-cmap)# match protocol http host cisco*
Device(config-cmap)# match protocol http url /routers
```

Example: NBAR and Classification of Custom Protocols and Applications

In the following example, the custom protocol app-sales1 will identify TCP packets that have a source port of 4567 and that contain the term “SALES” in the fifth byte of the payload:

```
Device(config)# ip nbar custom app-sales1 5 ascii SALES source tcp 4567
```

In the following example, the custom protocol virus-home will identify UDP packets that have a destination port of 3000 and that contain “0x56” in the seventh byte of the payload:

```
Device(config)# ip nbar custom virus-home 7 hex 0x56 destination udp 3000
```

In the following example, the custom protocol media_new will identify TCP packets that have a destination or source port of 4500 and that have a value of 90 at the sixth byte of the payload:

```
Device(config)# ip nbar custom media_new 6 decimal 90 tcp 4500
```

In the following example, the custom protocol msn1 will look for TCP packets that have a destination or source port of 6700:

```
Device(config)# ip nbar custom msn1 tcp 6700
```

In the following example, the custom protocol mail_x will look for UDP packets that have a destination port of 8202:

```
Device(config)# ip nbar custom mail_x destination udp 8202
```

In the following example, the custom protocol mail_y will look for UDP packets that have destination ports between 3000 and 4000 inclusive:

```
Device(config)# ip nbar custom mail_y destination udp range 3000 4000
```

Example: NBAR and Classification of Peer-to-Peer File-Sharing Applications

The **match protocol gnutella file-transfer** *regular-expression* and **match protocol fasttrack file-transfer** *regular-expression* commands are used to enable Gnutella and FastTrack classification in a traffic class. The **file-transfer** keyword indicates that a regular expression variable will be used to identify specific Gnutella or FastTrack traffic. The *regular-expression* variable can be expressed as “*” to indicate that all FastTrack or Gnutella traffic be classified by a traffic class.

In the following example, all FastTrack traffic is classified into class map nbar:

```
Device(config)# class-map match-all nbar
Device(config-cmap)# match protocol fasttrack file-transfer “*”
```

Similarly, all Gnutella traffic is classified into class map nbar in the following example:

```
Device(config)# class-map match-all nbar
Device(config-cmap)# match protocol gnutella file-transfer “*”
```

Wildcard characters in a regular expression can also be used to identify specified Gnutella and FastTrack traffic. These regular expression matches can be used to match on the basis of a filename extension or a particular string in a filename.

In the following example, all Gnutella files that have the .mpeg extension are classified into class map nbar:

```
Device(config)# class-map match-all nbar
Device(config-cmap)# match protocol gnutella file-transfer “*.mpeg”
```

In the following example, only Gnutella traffic that contains the characters "cisco" is classified:

```
Device(config)# class-map match-all nbar
Device(config-cmap)# match protocol gnutella file-transfer “*cisco*”
```

The same examples can be used for FastTrack traffic:

```
Device(config)# class-map match-all nbar
Device(config-cmap)# match protocol fasttrack file-transfer “*.mpeg”
```

or

```
Device(config)# class-map match-all nbar
Device(config-cmap)# match protocol fasttrack file-transfer “*cisco*”
```

Example: Configuring Attribute-Based Protocol Match

The **match protocol attributes** command is used to configure different attributes as the match criteria for application recognition.

In the following example, the email-related applications category is configured as the match criterion:

```
Device# configure terminal
Device(config)# class-map mygroup
Device(config-cmap)# match protocol attribute category email
```

In the following example, skype-group applications are configured as the match criterion:

```
Device# configure terminal
Device(config)# class-map apps
Device(config-cmap)# match protocol attribute application-group skype-group
```

In the following example, encrypted applications are configured as the match criterion:

```
Device# configure terminal
Device(config)# class-map my-class
Device(config-cmap)# match protocol encrypted encrypted-yes
```

In the following example, Client-server subcategory applications are configured as the match criterion:

```
Device# configure terminal
Device(config)# class-map newmap
Device(config-cmap)# match protocol attribute sub-category client-server
```

In the following example, tunneled applications are configured as the match criterion:

```
Device# configure terminal
Device(config)# class-map mygroup
Device(config-cmap)# match protocol attribute tunnel tunnel-yes
```

The following sample output from the **show ip nbar attribute** command displays the details of all the attributes:

```
Device# show ip nbar attribute

      Name :  category
      Help :  category attribute
      Type :  group
    Groups :  email, newsgroup, location-based-services, instant-messaging, netg
      Need :  Mandatory
   Default :  other

      Name :  sub-category
      Help :  sub-category attribute
      Type :  group
    Groups :  routing-protocol, terminal, epayment, remote-access-terminal, nen
      Need :  Mandatory
   Default :  other

      Name :  application-group
      Help :  application-group attribute
      Type :  group
    Groups :  skype-group, wap-group, pop3-group, kerberos-group, tftp-group, bp
      Need :  Mandatory
   Default :  other

      Name :  tunnel
      Help :  Tunnelled applications
      Type :  group
    Groups :  tunnel-no, tunnel-yes, tunnel-unassigned
      Need :  Mandatory
   Default :  tunnel-unassigned

      Name :  encrypted
      Help :  Encrypted applications
      Type :  group
    Groups :  encrypted-yes, encrypted-no, encrypted-unassigned
      Need :  Mandatory
   Default :  encrypted-unassigned
```

The following sample output from the **show ip nbar protocol-attribute** command displays the details of the protocols:

```
Device# show ip nbar protocol-attribute

           Protocol Name :  ftp
                category :  file-sharing
            sub-category :  client-server
       application-group :  ftp-group
                  tunnel :  tunnel-no
               encrypted :  encrypted-no

           Protocol Name :  http
                category :  browsing
            sub-category :  other
       application-group :  other
                  tunnel :  tunnel-no
               encrypted :  encrypted-no

           Protocol Name :  egp
                category :  net-admin
            sub-category :  routing-protocol
       application-group :  other
                  tunnel :  tunnel-no
               encrypted :  encrypted-no

           Protocol Name :  gre
                category :  net-admin
            sub-category :  tunneling-protocols
       application-group :  other
                  tunnel :  tunnel-yes
               encrypted :  encrypted-no
```

Example: SRND Configuration - Reclassifying an Application as Business-relevant

Skype is a consumer VoIP product typically not used in business. In SRND-specific protocol mapping, Skype is classified as business-irrelevant by default. However, some organizations may use Skype as a business-critical application. This examples shows how to reclassify Skype as business-relevant.

1 Show the current protocol attributes for Skype. The results indicate (in the last two lines) that Skype is classified as a voip-telephony technology, and is business-irrelevant.

```
show ip nbar protocol-attribute skype
encrypted            encrypted-yes
tunnel               tunnel-no
category             voice-and-video
sub-category         consumer-multimedia-messaging
application-group    skype-group
p2p-technology       p2p-tech-yes
traffic-class        voip-telephony
business-relevance   business-irrelevant
```

At this stage, Skype will be matched by the SCAVENGER class-map, which is part of the standard default SRND class-map configuration.

```
class-map match-all SCAVENGER
    match protocol attribute business-relevance business-irrelevant
```

2 Change the value of business-relevance for Skype to business-relevant.

```
ip nbar attribute-map demo
    attribute business-relevance business-relevant
ip nbar attribute-set skype demo
```

At this stage, Skype will be matched by the VOIP-TELEPHONY class-map, which is part of the standard default SRND class-map configuration.

```
class-map match-all VOIP-TELEPHONY
    match protocol attribute traffic-class voip-telephony
    match protocol attribute business-relevance business-relevant
```

3 Confirm that Skype is now classified as business-relevant. The new value appears on the last line of the following results.

```
show ip nbar protocol-attribute skype
encrypted            encrypted-yes
tunnel               tunnel-no
category             voice-and-video
sub-category         consumer-multimedia-messaging
application-group    skype-group
p2p-technology       p2p-tech-yes
traffic-class        voip-telephony
business-relevance   business-relevant
```

Additional References

The following sections provide references related to enabling Protocol Discovery.

Related Documents

Related Topic	Document Title
QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	*Cisco IOS Quality of Service Solutions Command Reference*
Concepts and information about NBAR	"Classifying Network Traffic Using NBAR" module
Configuring NBAR using the MQC	"Configuring NBAR Using the MQC" module
Adding application recognition modules (also known as PDLMs)	"Adding Application Recognition Modules" module
Creating a custom protocol	"Creating a Custom Protocol" module

Technical Assistance

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

Feature Information for Classifying Network Traffic Using NBAR

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 6: Feature Information for Classifying Network Traffic Using NBAR

Feature Name	Releases	Feature Information
Additional PDL Support for NBAR	Cisco IOS XE Release 3.1S	The additional PDL Support for NBAR feature provides support for additional PDLs. The following section provides information about this feature: NBAR and Classification of HTTP Traffic
Enable NBAR URI Extraction for HTTP Transactions for Persistent Connections	Cisco IOS XE Release 3.9S	The Enable NBAR URI Extraction for HTTP Transactions for Persistent Connections feature supports extraction and export of URL field per transaction. The following section provides information about this feature: Classification of HTTP Traffic by a URL Host or MIME.
Enhanced NBAR	Cisco IOS XE Release 3.2S	The Enhanced NBAR feature provides additional PDLs for Cisco IOS XE Release 3.2S. The following section provides information about this feature: NBAR-Supported Protocols
NBAR Classification Enhancements for IOS-XE3.5	Cisco IOS XE Release 3.5S	The NBAR Classification Enhancements feature provides additional classification support for native IPv6 classification and classification of flows inside tunneled IPv6 over IPv4. The following section provides information about this feature: NBAR Support for IPv6 The following commands were introduced or modified: **ip nbar classification tunneled-traffic**, **option** (FNF).

Feature Name	Releases	Feature Information
NBAR PDLM Supported in ASR 1000 Release 2.5	Cisco IOS XE Release 2.5 Cisco IOS XE Release 3.1S Cisco IOS XE Release 3.3S	This feature was integrated into Cisco IOS XE Release 2.5. NBAR-supported protocols were added for this release. The following section provides information about this feature: NBAR-Supported Protocols The following command was modified: **match protocol** (NBAR).
NBAR Protocols	Cisco IOS XE Release 2.3	This feature was integrated into Cisco IOS XE Release 2.3. NBAR-supported protocols were added for this release. The following section provides information about this feature: NBAR-Supported Protocols The following command was modified: **match protocol**(NBAR).
NBAR Real-time Transport Protocol Payload Classification	Cisco IOS XE Release 2.1	This feature was introduced on Cisco ASR 1000 Series Aggregation Services Routers. The following section provides information about this feature: NBAR-Supported Protocols
NBAR Static IPv4 IANA Protocols Pack1	Cisco IOS XE Release 3.1S	This feature was introduced on Cisco ASR 1000 Series Aggregation Services Routers. The following section provides information about this feature: NBAR-Supported Protocols
NBAR VRF-Aware	Cisco IOS XE Release 3.3S	This feature was introduced on Cisco ASR 1000 Series Aggregation Services Routers. The following section provides information about this feature: NBAR Scalability

Feature Name	Releases	Feature Information
NBAR Multi stage Classification	Cisco IOS XE Release 3.7S	This feature was introduced on Cisco ASR 1000 Series Aggregation Services Routers. The following section provides information about this feature: NBAR Multi-stage Classification.
NBAR2: Add/Rename Static Attributes	Cisco IOS XE Release 3.11S	The custom values enable you to name the attributes based on grouping of protocols. You can create custom values for the attributes application-group, category, and sub-category. The following section provides information about this feature: NBAR Categorization and Attributes. The following commands were introduced or modified: **ip nbar attribute**, **show ip nbar attribute-custom**, and **show ip nbar category**.
NBAR2 GETVPN (Cryptomap) Support	Cisco IOS XE Release 3.11S	This feature was introduced on Cisco ASR 1000 Series Aggregation Services Routers. The following section provides information about this feature: NBAR Support for GETVPN, on page 25
NBAR Support for CAPWAP	Cisco IOS XE Release 3.17S	CAPWAP (Control And Provisioning of Wireless Access Points) is a protocol is used in wireless traffic, providing point-to-point encapsulation (tunnel) for application traffic. NBAR provides a CAPWAP recognition mode that enables NBAR classification of the application traffic within a CAPWAP tunnel. The following section provides information about this feature: NBAR Support for CAPWAP

Feature Name	Releases	Feature Information
NBAR DNS-based Classification	Cisco IOS XE Release 3.17S	This feature can improve traffic classification by using DNS transaction information exchanged when a user initiates a connection with an application server. This method offers the significant advantage of classifying flows from the first packet in the flow. The following section provides information about this feature: NBAR DNS-based Classification

Glossary

Encryption—Encryption is the application of a specific algorithm to data so as to alter the appearance of the data, making it incomprehensible to those who are not authorized to see the information.

HTTP—Hypertext Transfer Protocol. The protocol used by web browsers and web servers to transfer files, such as text and graphic files.

IANA—Internet Assigned Numbers Authority. An organization operated under the auspices of the Internet Society (ISOC) as a part of the Internet Architecture Board (IAB). IANA delegates authority for IP address-space allocation and domain-name assignment to the InterNIC and other organizations. IANA also maintains a database of assigned protocol identifiers used in the TCP/IP stack, including autonomous system numbers.

LAN—Local-area network. A high-speed, low-error data network that covers a relatively small geographic area (up to a few thousand meters). LANs connect workstations, peripherals, terminals, and other devices in a single building or other geographically limited area. LAN standards specify cabling and signaling at the physical and data link layers of the Open System Interconnection (OSI) model. Ethernet, FDDI, and Token Ring are widely used LAN technologies.

MIME—Multipurpose Internet Mail Extension. The standard for transmitting nontext data (or data that cannot be represented in plain ASCII code) in Internet mail, such as binary, foreign language text (such as Russian or Chinese), audio, and video data. MIME is defined in RFC 2045, *Multipurpose Internet Mail Extension (MIME) Part One: Format of Internet Message Bodies* .

MPLS—Multiprotocol Label Switching. A switching method that forwards IP traffic using a label. This label instructs the routers and the switches in the network where to forward the packets based on preestablished IP routing information.

MQC—Modular quality of service command-line interface. A CLI that allows you to define traffic classes, create and configure traffic policies (policy maps), and then attach the policy maps to interfaces. Policy maps are used to apply the appropriate quality of service (QoS) to network traffic.

Protocol Discovery—A feature included with NBAR. Protocol Discovery provides a way to discover the application protocols that are operating on an interface.

QoS—Quality of service. A measure of performance for a transmission system that reflects its transmission quality and service availability.

RTCP—RTP Control Protocol. A protocol that monitors the QoS of an IPv6 real-time transport protocol (RTP) connection and conveys information about the ongoing session.

Stateful protocol—A protocol that uses TCP and UDP port numbers that are determined at connection time.

Static protocol—A protocol that uses well-defined (predetermined) TCP and UDP ports for communication.

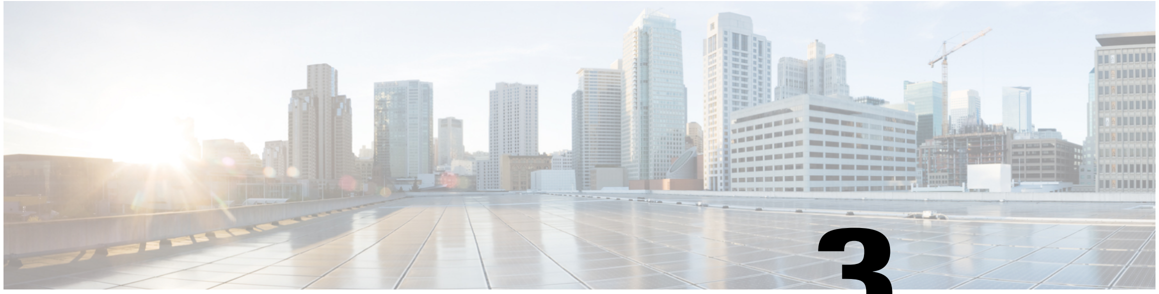
Subport classification—The classification of network traffic by information that is contained in the packet payload, that is, information found beyond the TCP or UDP port number.

TCP—Transmission Control Protocol. A connection-oriented transport layer protocol that provides reliable full-duplex data transmission. TCP is part of the TCP/IP protocol stack.

Tunneling—Tunneling is an architecture that is designed to provide the services necessary to implement any standard point-to-point encapsulation scheme.

UDP—User Datagram Protocol. A connectionless transport layer protocol in the TCP /IP protocol stack. UDP is a simple protocol that exchanges datagrams without acknowledgments or guaranteed delivery, requiring that error processing and retransmission be handled by other protocols. UDP is defined in RFC 768, *User Datagram Protocol* .

WAN—Wide-area network. A data communications network that serves users across a broad geographic area and often uses transmission devices provided by common carriers.



CHAPTER 3

Enabling Protocol Discovery

Network-Based Application Recognition (NBAR) includes a feature called Protocol Discovery. Protocol discovery provides an easy way to discover the application protocol packets that are passing through an interface. When you configure NBAR, the first task is to enable protocol discovery.

This module contains concepts and tasks for enabling the Protocol Discovery feature.

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 Enabling Protocol Discovery

Before enabling Protocol Discovery, read the information in the "Classifying Network Traffic Using NBAR" module.

Restrictions for Enabling Protocol Discovery

NBAR protocol discovery does not support the following:

- Asymmetric flows with stateful protocols.

Note In the NBAR context, asymmetric flows are the flows in which different packets of the flow go through different routers, for reasons such as load balancing implementation or asymmetric routing where packets flow through different routes to different directions.

- NBAR processing. By design, NBAR processing is temporarily disabled during the In-Service Software Upgrade (ISSU). The following syslog message indicates restart of NBAR classification once ISSU is complete.

"%NBAR_HA-5-NBAR_INFO: NBAR sync DONE!"

- Multicast packet classification.
- Multiprotocol Label Switching (MPLS)-labeled packets. NBAR classifies IP packets only. You can, however, use NBAR to classify IP traffic before the traffic is handed over to MPLS. Use the modular quality of service (QoS) CLI (MQC) to set the IP differentiated services code point (DSCP) field on the NBAR-classified packets and make MPLS map the DSCP setting to the MPLS experimental (EXP) setting inside the MPLS header.
- Non-IP traffic.
- Packets that originate from or that are destined to the router running NBAR.

NBAR is not supported on the following logical interfaces:

- Dialer interfaces
- Dynamic tunnels such as Dynamic Virtual Tunnel Interface (DVTI)
- Fast Etherchannels
- IPv6 tunnels that terminate on the device
- MPLS
- Overlay Transport Virtualization (OTV) overlay interfaces

Note In cases where encapsulation is not supported by NBAR on some links, you can apply NBAR on other interfaces of the device to perform input classification. For example, you can configure NBAR on LAN interfaces to classify output traffic on the WAN link.

The following virtual interfaces are supported depending on the image of your Cisco IOS:

- Generic routing encapsulation (GRE)
- IPsec IPv4 tunnel (including tunneled IPv6) in protocol discovery mode and MQC mode

- IPsec IPv6 tunnel in protocol discovery mode but not in MQC mode
- Multipoint GRE/Dynamic Multipoint VPN (DMVPN) in protocol discovery mode

Note NBAR requires more CPU power when NBAR is enabled on tunneled interfaces.

If protocol discovery is enabled on both the tunnel interface and the physical interface on which the tunnel interface is configured, the packets that are designated to the tunnel interface are counted on both interfaces. On the physical interface, the packets are classified and are counted based on the encapsulation. On the tunnel interface, packets are classified and are counted based on the Layer 7 protocol.

Note You cannot use NBAR to classify output traffic on a WAN link where tunneling or encryption is used. Therefore, you should configure NBAR on other interfaces of the router (such as a LAN link) to perform input classification before the traffic is switched to the WAN link.

Information About Protocol Discovery

Protocol Discovery Overview

The Protocol Discovery feature of NBAR provides an easy way of discovering the application protocols passing through an interface so that appropriate QoS features can be applied.

NBAR determines which protocols and applications are currently running on your network. Protocol discovery provides an easy way of discovering the application protocols that are operating on an interface so that appropriate QoS features can be applied. With protocol discovery, you can discover any protocol traffic that is supported by NBAR and obtain statistics that are associated with that protocol.

Protocol discovery maintains the following per-protocol statistics for enabled interfaces:

- Total number of input packets and bytes
- Total number of output packets and bytes
- Input bit rates
- Output bit rates

These statistics can be used when you define classes and traffic policies (sometimes known as policy maps) for each traffic class. The traffic policies (policy maps) are used to apply specific QoS features and functionality to the traffic classes.

Interface Scalability

Depending on your release, there is a limit on the number of interfaces on which protocol discovery can be enabled.

The following table provides the details of the protocol discovery supported interface and the release number:

Table 7: Release and Protocol Discovery Interface Support

Release	Number of Interfaces Supported with Protocol Discovery
Releases prior to Cisco IOS XE Release 2.5	No restriction
Cisco IOS XE Release 2.5	128
Cisco IOS XE Release 2.6	256
Cisco IOS XE Release 2.7	32
Cisco IOS XE Release 3.2S and later	32

How to Enable Protocol Discovery

Enabling Protocol Discovery on an Interface

Perform this task to enable protocol discovery on an interface.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number* [*name-tag*]
4. **ip nbar protocol-discovery** [**ipv4** | **ipv6**]
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* [*name-tag*]	Configures an interface type and enters interface configuration mode.

	Command or Action	Purpose
	Example: `Router(config)# interface fastethernet1/1/1`	- Enter the interface type and the interface number.
Step 4	**ip nbar protocol-discovery** [**ipv4** | **ipv6**] **Example:** `Router(config-if)# ip nbar protocol-discovery`	Configures NBAR to discover traffic for all protocols that are known to NBAR on a particular interface. - (Optional) Enter the **ipv4** keyword to enable protocol discovery statistics collection for IPv4 packets, or enter the **ipv6** keyword to enable protocol discovery statistics collection for IPv6 packets. - Specifying either of these keywords enables the protocol discovery statistics collection for the specified IP version only. If neither keywords is specified, statistics collection is enabled for both IPv4 and IPv6. - The **no** form of this command is not required to disable a keyword because the statistics collection is enabled for the specified keyword only.

Step 5	**end**
	Example:
	`Router(config-if)# end`
		(Optional) Exits interface configuration mode.

Reporting Protocol Discovery Statistics

Perform this task to display a report of the protocol discovery statistics per interface.

SUMMARY STEPS

1. **enable**
2. **show policy-map interface** *type number*
3. **show ip nbar protocol-discovery** [**interface** *type number*] [**stats** {**byte-count** | **bit-rate** | **packet-count**| **max-bit-rate**}] [**protocol** *protocol-name* | **top-n** *number*]
4. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: `Router> enable`	• Enter your password if prompted.
Step 2	**show policy-map interface** *type number* **Example:** `Router# show policy-map interface FastEthernet 1/1/1`	(Optional) Displays the packet and class statistics for all policy maps on the specified interface. • Enter the interface type and interface number.
Step 3	**show ip nbar protocol-discovery** [**interface** *type number*] [**stats** {**byte-count** | **bit-rate** | **packet-count**| **max-bit-rate**}] [**protocol** *protocol-name* | **top-n** *number*] **Example:** `Router# show ip nbar protocol-discovery interface Fastethernet1/1/1`	Displays the statistics gathered by the NBAR Protocol Discovery feature. • (Optional) Enter keywords and arguments to fine-tune the statistics displayed. For more information on each of the keywords, refer to the **show ip nbar protocol-discovery** command in Cisco IOS Quality of Service Solutions Command Reference.
Step 4	**exit** **Example:** `Router# exit`	(Optional) Exits privileged EXEC mode.

Configuration Examples for Protocol Discovery

Example: Enabling Protocol Discovery on an Interface

In the following sample configuration, protocol discovery is enabled on Fast Ethernet interface 1/1/1:

```
Router> enable
Router# configure terminal
Router(config)# interface fastethernet1/1/1
Router(config-if)# ip nbar protocol-discovery
Router(config-if)# end
```

In the following sample configuration, protocol discovery is enabled on Fast Ethernet interface 1/1/2 for IPv6 packets:

```
Router> enable

Router# configure terminal

Router(config)# interface fastethernet1/1/2

Router(config-if)# ip nbar protocol-discovery ipv6

Router(config-if)# end
```

In the following sample configuration, protocol discovery is enabled on Fast Ethernet interface 1/1/2 for IPv6 packets. Later, the protocol discovery is enabled for IPv4 packets and this does not require the **no** form for the **ipv6** keyword.

```
Router> enable

Router# configure terminal

Router(config)# interface fastethernet1/1/2

Router(config-if)# ip nbar protocol-discovery ipv6

Router(config-if)# ip nbar protocol-discovery ipv4

Router(config-if)# end
```

Example: Reporting Protocol Discovery Statistics

The following sample output from the **show ip nbar protocol-discovery** command displays the five most active protocols on the Fast Ethernet interface 2/0/1:

```
Router# show ip nbar protocol-discovery top-n 5

 FastEthernet2/0/1
                            Input                    Output
                            -----                    ------
  Protocol                  Packet Count             Packet Count
                            Byte Count               Byte Count
                            30sec Bit Rate (bps)     30sec Bit Rate (bps)
                            30sec Max Bit Rate (bps) 30sec Max Bit Rate (bps)
--------------------------- ------------------------ ------------------------
   rtp                      3272685                  3272685
                            242050604                242050604
                            768000                   768000
                            2002000                  2002000
   gnutella                 513574                   513574
                            118779716                118779716
                            383000                   383000
                            987000                   987000
   ftp                      482183                   482183
                            37606237                 37606237
                            121000                   121000
                            312000                   312000
   http                     144709                   144709
                            32351383                 32351383
                            105000                   105000
                            269000                   269000
   netbios                  96606                    96606
```

```
                         10627650                 10627650
                         36000                    36000
                         88000                    88000
 unknown                 1724428                  1724428
                         534038683                534038683
                         2754000                  2754000
                         4405000                  4405000
 Total                   6298724                  6298724
                         989303872                989303872
                         4213000                  4213000
                         8177000                  8177000
```

Additional References

Related Documents

Related Topic	**Document Title**
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	*Cisco IOS Quality of Service Solutions Command Reference*
Concepts and information about NBAR	"Classifying Network Traffic Using NBAR" module
MQC	"Applying QoS Features Using the MQC" module

Standards

Standard	**Title**
No new or modified standards are supported, and support for existing standards has not been modified.	--

MIBs

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

Technical Assistance

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

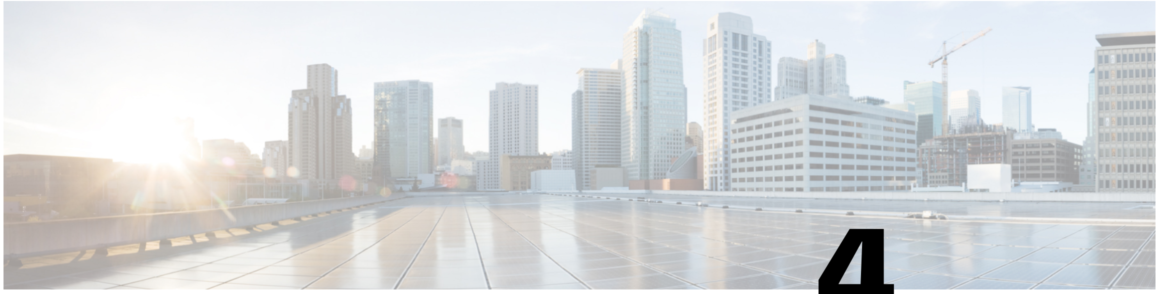
Feature Information for Enabling Protocol Discovery

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 Enabling Protocol Discovery

Feature Name	Releases	Feature Information
Protocol Discovery	Cisco IOS XE 2.1 Cisco IOS XE 3.3S	This feature was introduced on Cisco ASR 1000 Series Routers. The following sections provide information about this feature: The following commands were introduced: **ip nbar protocol discovery, show ip nbar protocol discovery.**



CHAPTER 4

Configuring NBAR Using the MQC

After you enable Protocol Discovery, you can configure Network-Based Application Recognition (NBAR) using the functionality of the Modular Quality of Service (QoS) Command-Line Interface (CLI) (MQC). The MQC uses traffic classes and traffic policies (policy maps) to apply QoS features to classes of traffic and applications recognized by NBAR.

This module contains concepts and tasks for configuring NBAR using the MQC.

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 Configuring NBAR Using the MQC

- Before configuring NBAR using the MQC, read the information in the "Classifying Network Traffic Using NBAR" module.

- As applicable, enable Protocol Discovery and use it to obtain statistics about the protocols and applications that are used in your network. You will need this information when using the MQC.

Note This prerequisite assumes that you do not already have this information about the protocols and applications in use in your network.

Information About NBAR Coarse-Grain Classification

NBAR and the MQC Functionality

To configure NBAR using the MQC, you must define a traffic class, configure a traffic policy (policy map), and then attach that traffic policy to the appropriate interface. These three tasks can be accomplished by using the MQC. The MQC is a command-line interface that allows you to define traffic classes, create and configure traffic policies (policy maps), and then attach these traffic policies to interfaces.

In the MQC, the **class-map** command is used to define a traffic class (which is then associated with a traffic policy). The purpose of a traffic class is to classify traffic.

Using the MQC to configure NBAR consists of the following:

- Defining a traffic class with the **class-map** command.
- Creating a traffic policy by associating the traffic class with one or more QoS features (using the **policy-map** command).
- Attaching the traffic policy to the interface with the **service-policy** command.

A traffic class contains three major elements: a name, one or more **match** commands, and, if more than one **match** command exists in the traffic class, an instruction on how to evaluate these **match** commands (that is, **match-all** or **match-any**). The traffic class is named in the **class-map** command line; for example, if you enter the **class-map cisco** command while configuring the traffic class in the CLI, the traffic class would be named "cisco."

The **match** commands are used to specify various criteria for classifying packets. Packets are checked to determine whether they match the criteria specified in the **match** commands. If a packet matches the specified criteria, that packet is considered a member of the class and is forwarded according to the QoS specifications set in the traffic policy. Packets that fail to meet any of the matching criteria are classified as members of the default traffic class.

Note For NBAR, the **match protocol** commands are used to specify the match criteria, as described in the NBAR and the match protocol Commands, on page 57.

NBAR and the match protocol Commands

NBAR recognizes specific network protocols and network applications that are used in your network. Once a protocol or application is recognized by NBAR, you can use the MQC to group the packets associated with those protocols or applications into classes. These classes are grouped on the basis of whether the packets conform to certain criteria.

For NBAR, the criterion is whether the packet matches a specific protocol or application known to NBAR. Using the MQC, network traffic with one network protocol (citrix, for example) can be placed into one traffic class, while traffic that matches a different network protocol (gnutella, for example) can be placed into another traffic class. Later, the network traffic within each class can be given the appropriate QoS treatment by using a traffic policy (policy map).

You specify the criteria used to classify traffic by using a **match protocol**command. The table below lists some of the available **match protocol**commands and the corresponding protocol or traffic type recognized and supported by NBAR.

Note For a more complete list of the protocol types supported by NBAR, see the "Classifying Network Traffic Using NBAR" module.

Table 9: match protocol Commands and Corresponding Protocol or Traffic Type

match protocol Command[1]	Protocol Type
match protocol (NBAR)	Protocol type supported by NBAR
match protocol citrix	Citrix protocol
match protocol fasttrack	FastTrack peer-to-peer traffic
match protocol gnutella	Gnutella peer-to-peer traffic
match protocol http	Hypertext Transfer Protocol
match protocol rtp	Real-Time Transport Protocol traffic
match protocol unknown [final]	All unknown and/or unclassified traffic

[1] Cisco IOS match protocol commands can vary by release. For more information, see the command documentation for the Cisco IOS release that you are using.

How to Configure NBAR Using the MQC

Configuring DSCP-Based Layer 3 Custom Applications

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nbar custom** *name* **transport tcp id** *id*
4. **ip nbar custom** *name* **transport udp-tcp**
5. **dscp** *dscp-value*
6. **exit**

DETAILED STEPS

	Command or Action	Purpose
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	**ip nbar custom** *name* **transport tcp id** *id* **Example:** `Device(config)# ip nbar custom mycustom transport tcp id 100`	Specifies TCP or UDP as the transport protocol and enters custom configuration mode.
Step 4	**ip nbar custom** *name* **transport udp-tcp** **Example:** `Device(config)# ip nbar custom mycustom transport udp-tcp`	Specifies TCP and UDP as the transport protocol and enters custom configuration mode.
Step 5	**dscp** *dscp-value* **Example:** `Device(config-custom)# dscp ef`	Specifies the differentiated service code points (DSCP) value. **Note** In cases where two custom applications have the same filters, the priority is set according to the order of configuration.

	Command or Action	Purpose
Step 6	**exit** **Example:** `Device(config-custom)# exit`	Exits custom configuration mode.

Managing Unclassified and Unknown Traffic

Some protocols require the analysis of more than one packet for NBAR classification. So packets sent until such a classification occurs are considered **unknown**. **unknown final** excludes these temporarily classified packets, and includes only those packets that are determined as unknown after the NBAR classification process.

By default, all traffic not matched to the unknown, are matched to a default class, as is the case with MQC.

Before You Begin

Ensure that NBAR is fully configured (i.e Protocol Discovery and others). If NBAR is configured to match only a partial set of protocols, then all inactivate protocols are considered as unclassified traffic and hence unknown.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map** [**match-all** | **match-any**] **unknown**
4. **match protocol unknown [final]**
5. **end**

DETAILED STEPS

	Command or Action	Purpose
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.

	Command or Action	Purpose

Step 3	**class-map** [**match-all** | **match-any**] **unknown**
	Example:
	`Device(config)# class-map match-all my-unknown`
		Creates a class map to be used for matching unknown traffic to a new class and enters class-map configuration mode.

Step 4	**match protocol unknown [final]** **Example:** `Device(config-cmap)# match protocol unknown final`	Configures NBAR to match unknown traffic. • The **unknown** keyword signifies any traffic that is unclassified • The **unknown final** signifies traffic that is determined by NBAR as unknown.

Step 5	**end**
	Example:
	`Device(config-cmap)# end`
		(Optional) Returns to privileged EXEC mode.

You can now configure the following tasks

1. Configuring a Traffic Policy
2. Attaching a Traffic Policy to an Interface or sub-interface

Configuring a Traffic Policy

Traffic that matches a user-specified criterion can be organized into a specific class that can, in turn, receive specific user-defined QoS treatment when that class is included in a policy map.

To configure a traffic policy, perform the following steps.

Note The **bandwidth** command is shown in Step Configuring a Traffic Policy The **bandwidth** command configures the QoS feature class-based weighted fair queuing (CBWFQ). CBWFQ is just an example of a QoS feature that can be configured. Use the appropriate command for the QoS feature that you want to use. As of Cisco IOS Release 12.2(18)ZY, CBWFQ is not supported on the Catalyst 6500 series switch that is equipped with a Supervisor 32/programmable intelligent services accelerator (PISA).

Note For Cisco IOS Release 12.2(18)ZY, an existing traffic policy (policy map) cannot be modified if the traffic policy is already attached to the interface. To remove the policy map from the interface, use the **no** form of the **service-policy** command.

>

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map** *policy-map-name*
4. **class** {*class-name* | **class-default**}
5. **bandwidth** {*bandwidth-kbps*| **remaining percent** *percentage*| **percent** *percentage*}
6. **end**

DETAILED STEPS

	Command or Action	Purpose
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	**policy-map** *policy-map-name* **Example:** `Device(config)# policy-map policy1`	Creates or modifies a policy map that can be attached to one or more interfaces and enters policy-map configuration mode. • Enter the name of the policy map.

Step 4	**class** {*class-name* | **class-default**}
	Example:
	`Device(config-pmap)# class class1`
		Specifies the name of the class whose policy you want to create or change and enters policy-map class configuration mode.
		• Enter the specific class name or enter the **class-default**keyword.

Step 5	**bandwidth** {*bandwidth-kbps*| **remaining percent** *percentage*| **percent** *percentage*}
	Example:
	`Device(config-pmap-c)# bandwidth percent 50`
		(Optional) Specifies or modifies the bandwidth allocated for a class belonging to a policy map.
		• Enter the amount of bandwidth as a number of kbps, a relative percentage of bandwidth, or an absolute amount of bandwidth.

	Command or Action	Purpose
	Example:	**Note** The **bandwidth** command configures the QoS feature class-based weighted fair queuing (CBWFQ). CBWFQ is just an example of a QoS feature that can be configured. Use the appropriate command for the QoS feature that you want to use. **Note** As of Cisco IOS Release 12.2(18)ZY, CBWFQ is not supported on the Catalyst 6500 series switch that is equipped with a Supervisor 32/PISA.

Step 6	**end**
	Example:
	`Device(config-pmap-c)# end`
		(Optional) Returns to privileged EXEC mode.

Attaching a Traffic Policy to an Interface or Subinterface

After a policy map is created, the next step is to attach the traffic policy (sometimes called a policy map) to an interface or subinterface. Traffic policies can be attached to either the input or output direction of the interface or subinterface.

Note Depending on the needs of your network, you may need to attach the traffic policy to an ATM PVC, a Frame Relay data-link connection identifier (DLCI), or other type of interface.

To attach a traffic policy (policy map) to an interface, perform the following steps.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number* [*name-tag*]
4. **pvc** [*name*] *vpi* / *vci* [**ilmi**| **qsaal**| **smds**| **l2transport**]
5. **exit**
6. **service-policy** {**input** | **output**} *policy-map-name*
7. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: `Device> enable`	- Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* [*name-tag*] **Example:** `Device(config)# interface ethernet 2/4`	Configures an interface type and enters interface configuration mode. - Enter the interface type and the interface number.
Step 4	**pvc** [*name*] *vpi* / *vci* [**ilmi**| **qsaal**| **smds**| **l2transport**] **Example:** `Device(config-if)# pvc cisco 0/16`	(Optional) Creates or assigns a name to an ATM permanent virtual circuit (PVC), specifies the encapsulation type on an ATM PVC, and enters ATM virtual circuit configuration mode. - Enter the PVC name, the ATM network virtual path identifier, and the network virtual channel identifier. **Note** This step is required only if you are attaching the policy map to an ATM PVC. If you are not attaching the policy map to an ATM PVC, advance to Attaching a Traffic Policy to an Interface or Subinterface.
Step 5	**exit** **Example:** `Device(config-atm-vc)# exit`	(Optional) Returns to interface configuration mode. **Note** This step is required only if you are attaching the policy map to an ATM PVC and you completed Attaching a Traffic Policy to an Interface or Subinterface. If you are not attaching the policy map to an ATM PVC, advance to Attaching a Traffic Policy to an Interface or Subinterface.

Step 6	**service-policy** {**input** | **output**} *policy-map-name*
	Example:
	`Device(config-if)# service-policy input policy1`
		Attaches a policy map (traffic policy) to an input or output interface.
		- Specify either the **input** or **output** keyword, and enter the policy map name.
		Note Policy maps can be configured on ingress or egress Devices. They can also be attached in the input or output direction of an interface. The direction (input or output) and the Device (ingress or egress) to which the policy map should be attached vary according your network configuration. When using the **service-policy** command to attach the policy map to an interface, be sure to choose the Device and the interface direction that are appropriate for your network configuration.
		Note After you use the **service-policy** command, you may see two messages similar to the following:
		`%PISA-6-NBAR_ENABLED: feature accelerated on input direction of:`
		`[`*`interface name and type`*
		`]`

	Command or Action	Purpose
		`%PISA-6-NBAR_ENABLED: feature accelerated on output direction of: [interface name and type` While both of these messages appear, NBAR is enabled in the direction specified by the **input** or **output** keyword only.

Step 7	**end**
	Example:
	`Device(config-if)# end`
		(Optional) Returns to privileged EXEC mode.

Verifying NBAR Using the MCQ

After you create the traffic classes and traffic policies (policy maps), you may want to verify that the end result is the one you intended. That is, you may want to verify whether your traffic is being classified correctly and whether it is receiving the QoS treatment as intended. You may also want to verify that the protocol-to-port mappings are correct.

To verify the NBAR traffic classes, traffic policies, and protocol-to-port mappings, perform the following steps.

SUMMARY STEPS

1. **show class-map** [*class-map-name*]
2. **show policy-map** [*policy-map*]
3. **show policy-map interface** *type number*
4. **show ip nbar port-map** [*protocol-name*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show class-map** [*class-map-name*] **Example:** `Device# show class-map`	(Optional) Displays all class maps and their matching criteria. • (Optional) Enter the name of a specific class map.
Step 2	**show policy-map** [*policy-map*] **Example:** `Device# show policy-map`	(Optional) Displays the configuration of all classes for a specified service policy map or all classes for all existing policy maps. • (Optional) Enter the name of a specific policy map.

	Command or Action	Purpose
Step 3	**show policy-map interface** *type number* **Example:** `Device# show policy-map interface Fastethernet 6/0`	(Optional) Displays the packet and class statistics for all policy maps on the specified interface. • Enter the interface type and the interface number.
Step 4	**show ip nbar port-map** [*protocol-name*] **Example:** `Device# show ip nbar port-map`	(Optional) Displays the current protocol-to-port mappings in use by NBAR. • (Optional) Enter a specific protocol name.

Verifying Unknown and Unclassified Traffic Management

To verify the management of unknown and unclassified traffic, perform the following steps.

SUMMARY STEPS

1. **show ip nbar protocol-id unknown**
2. **show ip nbar link-age unknown**
3. **show ip nbar protocol-attribute unknown**

DETAILED STEPS

	Command or Action	Purpose

Step 1	**show ip nbar protocol-id unknown**
	Example:
	`Device# show ip nbar protocol-id unknown`
	`Protocol Name             id            type`
	`----------------------------------------------`
	`unknown                  1            L7 STANDARD`
		(Optional) Displays protocol classification ID for unknown and unclassified traffic.

Step 2	**show ip nbar link-age unknown**
	Example:
	`Device# show ip nbar link-age unknown`
	`Protocol                  Link Age (seconds)`
	`unknown                      60`
		(Optional) Displays the protocol link age for unknown and unclassified traffic.

	Command or Action	Purpose
Step 3	**show ip nbar protocol-attribute unknown** **Example:**	(Optional) Displays list of configured attributes for unknown and unclassified traffic.

```
Device# show ip nbar protocol-attribute unknown

           Protocol Name : unknown
               encrypted : encrypted-no
                  tunnel : tunnel-no
                category : other
            sub-category : other
       application-group : other
          p2p-technology : p2p-tech-no
```

Configuration Examples for Configuring DSCP-Based Layer 3 Custom Applications

Example Configuring a Traffic Class

In the following example, a class called cmap1 has been configured. All traffic that matches the citrix protocol will be placed in the cmap1 class.

```
Device> enable

Device# configure terminal

Device(config)# class-map cmap1

Device(config-cmap)# match protocol citrix

Device(config-cmap)# end
```

Example Configuring a Traffic Policy

In the following example, a traffic policy (policy map) called policy1 has been configured. Policy1 contains a class called class1, within which CBWFQ has been enabled.

```
Device> enable

Device# configure terminal

Device(config)# policy-map policy1

Device(config-pmap)# class class1

Device(config-pmap-c)# bandwidth percent 50

Device(config-pmap-c)# end
```

Note In the above example, the **bandwidth** command is used to enable Class-Based Weighted Fair Queuing (CBWFQ). CBWFQ is only an example of one QoS feature that can be applied in a policy map. Use the appropriate command for the QoS feature that you want to use. As of Cisco IOS Release 12.2(18)ZY, CBWFQ is not supported on the Catalyst 6500 series switch that is equipped with a Supervisor 32/PISA.

Example Attaching a Traffic Policy to an Interface or Subinterface

In the following example, the traffic policy (policy map) called policy1 has been attached to Ethernet interface 2/4 in the input direction of the interface.

```
Device> enable

Device# configure terminal

Device(config)# interface ethernet 2/4


Device(config-if)# service-policy input policy1

Device(config-if)# end
```

Example Verifying the NBAR Protocol-to-Port Mappings

The following is sample output of the **show ip nbar port-map** command. This command displays the current protocol-to-port mappings in use by NBAR. Use the display to verify that these mappings are correct.

```
Device# show ip nbar port-map
port-map bgp      udp 179
port-map bgp      tcp 179
port-map cuseeme  udp 7648 7649
port-map cuseeme  tcp 7648 7649
port-map dhcp     udp 67 68
port-map dhcp     tcp 67 68
```

If the **ip nbar port-map** command has been used, the **show ip nbar port-map** command displays the ports assigned to the protocol.

If the **no ip nbar port-map**command has been used, the **show ip nbar port-map** command displays the default ports. To limit the display to a specific protocol, use the *protocol-name* argument of the **show ip nbar port-map** command.

Example: L3 Custom any IP Port

```
Device> enable
Device# configuration terminal
Device (config)# ip nbar custom mycustom transport udp-tcp
Device(config-custom)# dscp ef
Device (config-custom)# exit
```

Where to Go Next

To add application recognition modules (also known as Packet Description Language Modules or PDLMs) to your network, see the "Adding Application Recognition Modules" module.

To classify network traffic on the basis of a custom protocol, see the "Creating a Custom Protocol" module.

Additional References

The following sections provide references related to configuring NBAR using the MQC.

Related Documents

Related Topic	Document Title
QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	*Cisco IOS Quality of Service Solutions Command Reference*
QoS features and functionality on the Catalyst 6500 series switch	"Configuring PFC QoS" chapter of the *Catalyst Supervisor Engine 32 PISA Cisco IOS Software Configuration Guide* , Release 12.2ZY
MQC, traffic policies (policy maps), and traffic classes	"Applying QoS Features Using the MQC" module
CBWFQ	"Configuring Weighted Fair Queueing" module
Concepts and information about NBAR	"Classifying Network Traffic Using NBAR" module
Information about enabling Protocol Discovery	"Enabling Protocol Discovery" module

Related Topic	Document Title
Information about adding application recognition modules (also known as PDLMs)	"Adding Application Recognition Modules" module
Creating a custom protocol	"Creating a Custom Protocol" module

Technical Assistance

Description	Link
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.	http://www.cisco.com/techsupport

Feature Information for Configuring NBAR Using the MQC

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 10: Feature Information for Configuring NBAR Using the MQC

Feature Name	Releases	Feature Information
NBAR MQC Support for Pre-resolved and Unknown Applications	IOS Release 15.5(1)T IOS XE Release 3.14S	The NBAR MQC Support for Pre-resolved and Unknown Applications feature provides support for matching all unknown and unclassified traffic using MQC. The following commands were modified: **class-map**, **match protocol**

Feature Name	Releases	Feature Information
QoS: DirectConnect PDLM	12.4(4)T	Provides support for the DirectConnect protocol and Packet Description Language Module (PDLM). The DirectConnect protocol can now be recognized when using the MQC to classify traffic. The following sections provide information about the QoS: DirectConnect PDLM feature:
QoS: Skype Classification	12.4(4)T	Provides support for the Skype protocol. The Skype protocol can now be recognized when using the MQC to classify traffic. **Note** Cisco currently supports Skype Version 1 only. The following sections provide information about the QoS: Skype Classification feature:
NBAR--BitTorrent PDLM	12.4(2)T	Provides support for the BitTorrent PDLM and protocol. The BitTorrent protocol can now be recognized when using the MQC to classify traffic. The following sections provide information about the NBAR-BitTorrent PDLM feature:
NBAR--Citrix ICA Published Applications	12.4(2)T	Enables NBAR to classify traffic on the basis of the Citrix Independent Computing Architecture (ICA) published application name and tag number. The following sections provide information about the NBAR-Citrix ICA Published Applications feature:

Feature Name	Releases	Feature Information
NBAR--Multiple Matches Per Port	12.4(2)T	Provides the ability for NBAR to distinguish between values of an attribute within the traffic stream of a particular application on a TCP or UDP port. The following sections provide information about the NBAR-Multiple Matches Per Port feature:
NBAR Extended Inspection for HTTP Traffic	12.3(4)T	Allows NBAR to scan TCP ports that are not well known and identify HTTP traffic that traverses these ports. The following sections provide information about the NBAR Extended Inspection for HTTP Traffic feature:
NBAR Real-Time Transport Protocol Payload Classification	12.2(15)T	Enables stateful identification of real-time audio and video traffic. The following section provides information about the NBAR Real-Time Transport Protocol Payload Classification feature:
NBAR--Network-Based Application Recognition	12.2(18)ZYA	Integrates NBAR and Firewall Service Module (FWSM) functionality on the Catalyst 6500 series switch that is equipped with a Supervisor 32/programmable intelligent services accelerator (PISA). Additional protocols are now recognized by NBAR. The following sections provide information about the NBAR feature: The following command was modified: **match protocol (NBAR)**.

Feature Name	Releases	Feature Information
NBAR--Network-Based Application Recognition (Hardware Accelerated NBAR)	12.2(18)ZY	Enables NBAR functionality on the Catalyst 6500 series switch that is equipped with a Supervisor 32/programmable intelligent services accelerator (PISA). The following section provides information about the NBAR--Network-Based Application Recognition (Hardware Accelerated NBAR) feature:

CHAPTER 5

DSCP-Based Layer 3 Custom Applications

Network-Based Application Recognition (NBAR) supports the use of custom protocols to identify customer-specific applications and applications that NBAR does not support. IP address and port-based custom protocol includes supporting an IP subnet or a list of IP addresses with a specific TCP or UDP transport. DSCP-Based Layer 3 Custom Applications feature is an enhancement that enables the customer to identify traffic that belongs to Layer 3 or Layer 4 custom applications by using Differentiated Services Code Point (DSCP) values in the traffic.

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.

Restriction of DSCP-Based Layer 3 Custom Applications

DSCP-Based Layer 3 Custom Applications feature treats the Differentiated Services Code Point (DSCP) classification as a property of the flow and checks only the DSCP value of the first packet in the flow. To identify different packets in the flow and apply policies on them, use the **match dscp** command.

DSCP-Based Layer 3 Custom Applications Overview

Network-Based Application Recognition (NBAR) supports the use of custom protocols to identify customer specific applications and applications that NBAR does not support. IP address and port-based custom protocol includes supporting an IP subnet or a list of IP addresses with a specific TCP or UDP transport. DSCP-based Layer 3 Custom Application feature is an enhancement that enables the customer to identify traffic that belongs to Layer 3 or Layer 4 custom applications by using Differentiated Services Code Point (DSCP) values in the traffic. You define a custom protocol transport by using the keywords and arguments of the **ip nbar custom transport** command.

How to configure NBAR Customization Assistance Based on SSL or HTTP

Configuring DSCP-Based Layer 3 Custom Applications

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nbar custom** *name* **transport tcp id** *id*
4. **ip nbar custom** *name* **transport udp-tcp**
5. **dscp** *dscp-value*
6. **exit**

DETAILED STEPS

	Command or Action	Purpose
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.

	Command or Action	Purpose
Step 3	**ip nbar custom** *name* **transport tcp id** *id* **Example:** `Device(config)# ip nbar custom mycustom transport tcp id 100`	Specifies TCP or UDP as the transport protocol and enters custom configuration mode.
Step 4	**ip nbar custom** *name* **transport udp-tcp** **Example:** `Device(config)# ip nbar custom mycustom transport udp-tcp`	Specifies TCP and UDP as the transport protocol and enters custom configuration mode.
Step 5	**dscp** *dscp-value* **Example:** `Device(config-custom)# dscp ef`	Specifies the differentiated service code points (DSCP) value. **Note** In cases where two custom applications have the same filters, the priority is set according to the order of configuration.
Step 6	**exit** **Example:** `Device(config-custom)# exit`	Exits custom configuration mode.

Configuration Examples for Configuring DSCP-Based Layer 3 Custom Applications

Example: DSCP-Based Layer 3 Custom Applications

```
Device> enable
Device# configuration terminal
Device (config)# ip nbar custom mycustom transport tcp id 100
Device(config-custom)# dscp ef
Device (config-custom)# exit
```

Example: L3 Custom any IP Port

```
Device> enable
Device# configuration terminal
Device (config)# ip nbar custom mycustom transport udp-tcp
Device(config-custom)# dscp ef
Device (config-custom)# exit
```

Additional References for DSCP-Based Layer 3 Custom Applications

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	Cisco IOS Quality of Service Solutions Command Reference

Technical Assistance

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

Feature Information for DSCP-based Layer 3 Custom Applications

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 11: Feature Information for DSCP-based Layer 3 Custom Applications

Feature Name	Releases	Feature Information
L3 custom any IP/Port	Cisco IOS XE 3.16S	NBAR supports the use of custom protocols to identify customer specific applications and applications that NBAR does not support. IP address and port-based custom protocol includes supporting an IP subnet or a list of IP addresses with a specific TCP or UDP transport or TCP and UDP transport. DSCP-based Layer 3 Custom Application feature is an enhancement that enables the customer to identify traffic that belongs to Layer 3 or Layer 4 custom applications by using DSCP values in the traffic. The L3 Custom any IP/Port feature is an enhancement that enable users to to configure L3 or L4 custom applications over non UDP/TCP or over both UDP and TCP transport. The following command was introduced or modified: **ip nbar custom**

CHAPTER 6

MQC Based on Transport Hierarchy

The MQC Based on Transport Hierarchy(TPH) feature enables the use of TPH to apply policies according to a specific underlying protocol, instead of only according to the final classified protocol, for example, an email application over HTTP. A new MQC filter configured within a class-map matches all traffic which has this protocol in the hierarchy.

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 MQC Based on Transport Hierarchy

- The MQC Based on Transport Hierarchy feature is supported only for HTTP, RTP, and SSL.
- Does not allow adding the match of the protocol and in-app-hierarchy to the same class-map.
- Match protocol http in-app-hierarchy and match protocol rtp in-app-hierarchy are not supported while match protocol attribute tunnel is configured, even on a different class-map.

Information About MQC Based on Transport Hierarchy

MQC Based on Transport Hierarchy Overview

The MQC based on transport hierarchy(TPH) feature enables NBAR to use TPH to apply policies according to a specific underlying protocol, instead of only according to the final classified protocol. The TPH of a particular application is the stack of protocols on which the application is delivered. For example, an application is being transported over HTTP and HTTP runs over TCP.

Prior to the configuartion of the MQC based on transport hierarchy(TPH) feature, it is only possible to apply a class-map filter on the final classified protocol using the **match protocol** *protocol-id* class-map filter. However, to apply QoS policies on all the traffic of HTTP, then include all the protocols which run over HTTP into the class-map makes the configuration of such use-cases considerably difficult. A solution for this problem is an in-app-hierarchy class-map filter which uses TPH to apply policies according to a specific underlying protocol, instead of only according to the final classified protocol. For example, the rule **match protocol** *http* **in-app-hierarchy** matches if HTTP is present in the hierarchy.

How to Configure MQC Based on Transport Hierarchy

Configuring MQC Based on Transport Hierarchy

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map** [**match-all** | **match-any**] *class-map-name*
4. **match protocol** *protocol-name* **in-app-hierarchy**
5. **end**
6. **configure terminal**
7. **policy-map** *policy-map-name*
8. **class** { *class-name* |**class-default**}
9. **end**
10. **configure terminal**
11. **interface** *type number*
12. **service-policy** { **input** |**output** } *policy-map-name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: `Device> enable`	• Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

Step 3	**class-map** [**match-all** | **match-any**] *class-map-name*
	Example:
	`Device(config)# class-map match-all C1`
		Creates a class map to be used for matching packets to a specified class and enters QoS class-map mode.
		• Enter the name of the class map.

Step 4	**match protocol** *protocol-name* **in-app-hierarchy** **Example:** `Device(config-cmap)# match protocol http in-app-hierarchy`	Configures the match criterion for a class map on the basis of the specified protocol. The keyword in-app-hierarchy matches if the protocol is present in the transport hierarchy.

Step 5	**end**
	Example:
	`Device(config-cmap)# end`
		Exits class-map mode and returns to privileged EXEC mode.

Step 6	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 7	**policy-map** *policy-map-name* **Example:** `Device(config)# policy-map P1`	Specifies the name of the policy map and enters policy-map configuration mode.

Step 8	**class** { *class-name* |**class-default**}
	Example:
	`Device(config-pmap)# class C1`
		Specifies the name of the class whose policy you want to create and enters policy-map class configuration mode.

Step 9	**end**
	Example:
	`Device(config-cmap)# end`
		Exits class-map mode and returns to privileged EXEC mode.

Step 10	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 11	**interface** *type number* **Example:** `Device(config)# interface GigabitEthernet 0/0/1`	Configures an interface type and enters interface configuration mode.
Step 12	**service-policy** { **input** |**output** } *policy-map-name* **Example:** `Device(config-if)# service-policy input P1`	Specifies the name of the policy map to be attached to the input or output direction of the interface.

Verifying MQC Based on Transport Hierarchy

To verify the MQC Based on Transport Hierarchy feature perform the following steps:

SUMMARY STEPS

1. **enable**
2. **show policy-map interface** *type number*
3. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device# enable`	(Optional) Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show policy-map interface** *type number* **Example:** `Device# show policy-map interface GigabitEthernet0/0/1`	Displays the packet statistics of all classes that are configured for allservice policies either on the specified interface • Enter the interface type and the interface number.
Step 3	**exit** **Example:** `Device# exit`	(Optional) Exits privileged EXEC mode.

Configuration Examples for MQC Based on Transport Hierarchy

Example: Configuring MQC Based on Transport Hierarchy

The following is an example of the configuring MQC based on Transport Hierarchy feature:

```
Device> enable
Device# configure terminal
Device(config)# class-map match-all C1
Device(config-cmap)# match protocol http in-app-hierarchy
Device(config-cmap)# match protocol youtube
Device(config-cmap)# end
Device# configure terminal
Device(config)# policy-map P1
Device(config-pmap)# class C1
Device(config-cmap)# end
Device# configure terminal
Device(config)# interface GigabitEthernet 0/0/1
Device(config-if)# service-policy input P1
```

A traffic policy called P1 is configured. P1 contains a class called C1 for which QoS bandwidth limitation is configured as an example. All traffic that has final classification of Youtube with HTTP as a transport will be placed in the C1 class. Other possible transports for Youtube, such as SSL or RTSP, will not be matched by this class-map

Example: Verifying the MQC Based on Transport Hierarchy configuration

The following is a sample output from the **show policy-map interface** command:

```
Device#  show policy-map interface GigabitEthernet0/0/1

GigabitEthernet0/0/1
  Service-policy input: P1

Class-map: C1 (match-all)
      17 packets, 0 bytes
      5 minute offered rate 0000 bps, drop rate 0000 bps
      Match: protocol http in-app-hierarchy
      Match: protocol youtube

    Class-map: class-default (match-any)
      3 packets, 0 bytes
      5 minute offered rate 0000 bps, drop rate 0000 bps
      Match: any
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases

Related Topic	Document Title
QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	Cisco IOS Quality of Service Solutions Command Reference

Technical Assistance

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

Feature Information for MQC Based on Transport Hierarchy

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 12: Feature Information for MQC Based on Transport Hierarchy

Feature Name	Releases	Feature Information
MQC Based on Transport Hierarchy	Cisco IOS XE 3.14S	The MQC Based on Transport Hierarchy feature enables the use of Transport Hierarchy to apply policies according to a specific underlying protocol, instead of only according to the final classified protocol. A new MQC filter is introduced which can be configured within a class-map. The following command was modified: **match protocol**

CHAPTER 7

NBAR Categorization and Attributes

NBAR Categorization and Attributes feature provides the mechanism to match protocols or applications based on statically assigned attributes such as application-group, category, sub-category, encrypted and tunnel. Categorizing the protocols and applications into different groups helps with reporting and applying Quality of Service (QoS) policies.

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 NBAR2 Custom Protocol

NBAR Categorization and Attributes

The NBAR Categorization and Attributes feature provides the mechanism to match protocols or applications based on certain attributes. Categorizing the protocols and applications into different groups will help with reporting and performing group actions, such as applying QoS policies, on them. Attributes are statically assigned to each protocol or application, and they are not dependent on the traffic. The following attributes are available to configure the match criteria using the **match protocol attribute** command:

- **application-group**: The **application-group** keyword allows the configuration of applications grouped together based on the same networking application as the match criteria. For example, Yahoo-Messenger, Yahoo-VoIP-messenger, and Yahoo-VoIP-over-SIP are grouped together under the yahoo-messenger-group.
- **category**: The **category** keyword allows you to configure applications that are grouped together based on the first level of categorization for each protocol as the match criteria. Similar applications are grouped together under one category. For example, the email category contains all email applications such as, Internet Mail Access Protocol (IMAP), Simple Mail Transfer Protocol (SMTP), Lotus Notes, and so forth.
- **sub-category**: The **sub-category** keyword provides the option to configure applications grouped together based on the second level of categorization for each protocol as the match criteria. For example, clearcase, dbase, rda, mysql and other database applications are grouped under the database group.
- **encrypted**: The **encrypted** keyword provides the option to configure applications grouped together based on whether the protocol is an encrypted protocol or not as the match criteria. Applications are grouped together based on the encrypted and nonencrypted status of the applications. Protocols for which the NBAR does not provide any value are categorized under the unassigned encrypted group.
- **tunnel**: The **tunnel** keyword provides the option to configure protocols based on whether or not a protocol tunnels the traffic of other protocols. Protocols for which the NBAR does not provide any value are categorized under the unassigned tunnel group. For example, Layer 2 Tunneling Protocols (L2TP).
- **p2p-technology**: The **p2p(Peer-to-Peer)-technology** attribute provides the option to indicate whether or not a protocol uses p2p technology.

Note Attribute-based protocol match configurations do not impact the granularity of classification either in reporting or in the Protocol Discovery information.

You can create custom values for the attributes application-group, category, and sub-category. The custom values enable you to name the attributes based on grouping of protocols. Use the **ip nbar attribute application-group custom application-group-name**, **ip nbar attribute category custom category-name**, and **ip nbar attribute sub-category custom sub-category-name** commands to add custom values for the attributes application-group, category, and sub-category, respectively.

The dynamically created custom attribute values can be used for attribute-map creation when using the **ip nbar attribute-map** command, and for configuring the match criterion for a class-map when using the **match protocol attribute** command.

The output from the **show ip nbar attribute-custom** command displays the number of custom values that can be defined for attributes, and the custom values that are currently defined. The **show ip nbar attribute** command displays all the attributes including the custom attributes used by NBAR.

To remove the custom values, use the **no ip nbar attribute** command.

Overview of NBAR2 Custom Protocol

Network-Based Application Recognition (NBAR) supports the use of custom protocols to identify custom applications. Custom protocols support static port-based protocols and applications that NBAR does not support.

For more information about custom protocols, refer to "Creating a Custom Protocol" module.

How to Configure NBAR2 Custom Protocol

Customizing NBAR Attributes

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nbar attribute-map** *profile-name*
4. **attribute category** *category-name*
5. **attribute sub-category** *sub-category-name*
6. **attribute application-group** *application-group-name*
7. **attribute tunnel** *tunnel-info*
8. **attribute encrypted** *encrypted-info*
9. **attribute p2p-technology** *p2p-technology-info*
10. **ip nbar attribute-set** *protocol-name profile-name*
11. **end**

DETAILED STEPS

	Command or Action	Purpose
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.

	Command or Action	Purpose
Step 3	**ip nbar attribute-map** *profile-name* **Example:** `Device(config)# ip nbar attribute-map actdir-attrib`	Creates an attribute profile with the name that you specify, and enters the attribute-map configuration mode.
Step 4	**attribute category** *category-name* **Example:** `Device(config-attribute-map)# attribute category net-admin`	Adds attribute values from the application-group attribute, on to your profile.
Step 5	**attribute sub-category** *sub-category-name* **Example:** `Device(config-attribute-map)# attribute sub-category network-management`	Adds attribute values from the sub-category attribute, on to your profile.
Step 6	**attribute application-group** *application-group-name* **Example:** `Device(config-attribute-map)# attribute application-group other`	Adds attribute values from the application-group attribute, on to your profile.
Step 7	**attribute tunnel** *tunnel-info* **Example:** `Device(config-attribute-map)# attribute tunnel no`	Adds attribute values from the tunnel attribute, on to your profile.
Step 8	**attribute encrypted** *encrypted-info* **Example:** `Device(config-attribute-map)# attribute encrypted no`	Adds attribute values from the encrypted attribute, on to your profile.
Step 9	**attribute p2p-technology** *p2p-technology-info* **Example:** `Device(config-attribute-map)# attribute p2p-technology no`	Adds attribute values from the p2p-technology attribute, on to your profile.
Step 10	**ip nbar attribute-set** *protocol-name profile-name* **Example:** `Device(config-attribute-map)# ip nbar attribute-set active-directory actdir-attrib`	Adds attribute values from the specified profile to the specified protocol.

	Command or Action	Purpose

Step 11	**end**
	Example:
	`Device(config-attribute-map)# end`
		Returns to privileged EXEC mode.

Configuration Examples for NBAR2 Custom Protocol

Example: Adding Custom Values for Attributes

The following example shows how to add custom values for the attributes application-group, category, and sub-category:

```
Device> enable
Device# configure terminal
Device(config)# ip nbar attribute application-group custom Home_grown_finance_group "our
finance tools network traffic"
Device(config)# ip nbar attribute category custom dc_backup_category "Data center backup
traffic"
Device(config)# ip nbar attribute sub-category custom hr_sub_category "HR custom applications
 traffic"
Device(config)# exit
```

Examples: Viewing the Information About Custom Values for Attributes

The following sample output from the **show ip nbar attribute-custom** command displays the number of custom values that can be defined, and the custom values that are currently defined for the attributes:

```
Device# show ip nbar attribute-custom

                  Name :  category
                  Help :  category attribute
   Custom Groups Limit :  1
 Custom Groups Created :  dc_backup_category

                  Name :  sub-category
                  Help :  sub-category attribute
   Custom Groups Limit :  1
 Custom Groups Created :  hr_sub_category

                  Name :  application-group
                  Help :  application-group attribute
   Custom Groups Limit :  1
 Custom Groups Created :  Home_grown_finance_group
```

The following sample output from the **show ip nbar attribute category** command displays the details about the Category attribute:

```
Device# show ip nbar attribute category

      Name :  category
```

```
   Help :  category attribute
   Type :  group
 Groups :  newsgroup
        :  instant-messaging
        :  net-admin
        :  trojan
        :  email
        :  file-sharing
        :  industrial-protocols
        :  business-and-productivity-tools
        :  internet-privacy
        :  social-networking
        :  layer3-over-ip
        :  obsolete
        :  streaming
        :  location-based-services
        :  voice-and-video
        :  other
        :  gaming
        :  browsing
        :  dc_backup_category
Need :  Mandatory
Default :  other
```

Example: Creating a Profile and Configuring Attributes for the Profile

The following example shows how to create an attribute profile with attributes configured for the Network News Transfer Protocol (NNTP) protocol:

```
Device> enable
Device# configure terminal
Device(config)# ip nbar attribute-map nntp-attrib
Device(config-attribute-map)# attribute category newsgroup
Device(config-attribute-map)# attribute application-group nntp-group
Device(config-attribute-map)# attribute tunnel tunnel-no
Device(config-attribute-map)# attribute encrypted encrypted-yes
Device(config-attribute-map)# attribute p2p-technology p2p-tech-no
Device(config-attribute-map)# end
```

The following example shows how to verify the above configuration:

```
Device> enable
Device# show ip nbar attribute-map nntp-attrib
Device# Profile Name :  nntp-attrib
            category :  newsgroup
   application-group :  nntp-group
           encrypted :  encrypted-yes
Device# end
```

Example: Attaching an Attribute Profile to a Protocol

The following example shows how to set an attribute profile to the Application Communication Protocol (ACP) protocol:

```
Device> enable
Device# configure terminal
Device(config)# ip nbar attribute-set acp test-profile
Device(config)# exit
```

Additional References for NBAR2 Custom Protocol

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
Cisco IOS LAN switching commands	Cisco IOS LAN Switching Command Reference
Cisco IOS QoS configuration information	*QoS Configuration Guide*

Technical Assistance

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

Feature Information for NBAR Categorization and Attributes

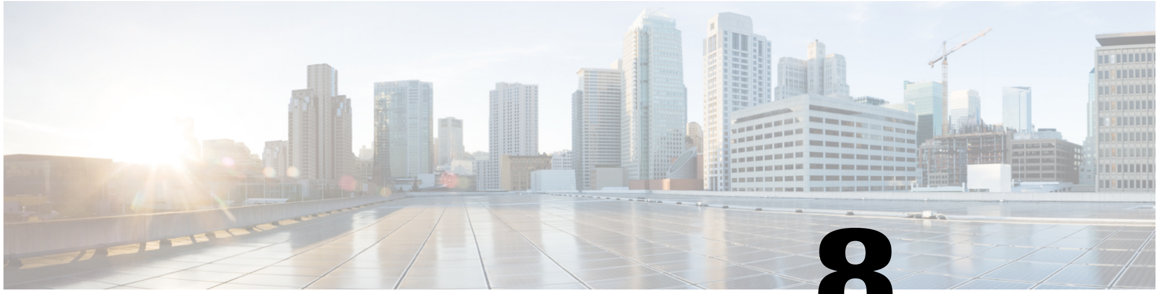
The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train 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 13: Feature Information for NBAR2 Custom Protocol

Feature Name	Releases	Feature Information
NBAR Categorization and Attributes	Cisco IOS XE Release 3.4S	This feature was introduced on Cisco ASR 1000 series Aggregation Services Routers. The following command was introduced or modified: **ip nbar custom**

Feature Name	Releases	Feature Information
NBAR2 Custom Protocol	Cisco IOS XE Release 3.8S	The NBAR2 Custom Protocol feature configures attributes profiles for protocols, and maps profiles to protocols. The following command was introduced or modified: **ip nbar attribute-map**, **ip nbar attribute-set**.



CHAPTER 8

Reporting Extracted Fields Through Flexible NetFlow

The Reporting Extracted Fields Through Flexible NetFlow feature allows Network-Based Application Recognition (NBAR) to send subapplication table fields to the collector through Flexible NetFlow.

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 Reporting Extracted Fields Through Flexible NetFlow

Subapplication Table Fields

Use the **option sub-application-table** command to send an options table periodically to the collector, thereby enabling the collector to map NBAR subapplication tags, subapplication names, and subapplication descriptions provided in the flow records to application IDs.

How to Report Extracted Fields Through Flexible NetFlow

Reporting Subapplication Table Fields

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **flow exporter** *exporter-name*
4. **option sub-application-table**
5. **exit**

DETAILED STEPS

	Command or Action	Purpose
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	**flow exporter** *exporter-name* **Example:** `Device(config)# flow exporter EXPORTER-1`	Enters Flexible NetFlow flow exporter configuration mode.

	Command or Action	Purpose
Step 4	**option sub-application-table** **Example:** `Device(config-flow-exporter)# option sub-application-table`	Enables periodic sending of an options table that allows the collector to map NBAR subapplication tags, subapplication names, and subapplication descriptions provided in flow records to application IDs.
Step 5	**exit** **Example:** `Device(config-flow-exporter)# exit`	Exits Flexible NetFlow flow exporter configuration mode and returns to global configuration mode.

Configuration Examples for Reporting Extracted Fields Through Flexible NetFlow

Example: Reporting Subapplication Fields

The following example shows how to enable the periodic sending of an options table, which allows the collector to map NBAR subapplication tags, subapplication names, and subapplication descriptions provided in the flow records to application IDs:

```
Device(config)# flow exporter FLOW-EXPORTER-1
Device(config-flow-exporter)# option sub-application-table
```

Additional References

The following sections provide references related to configuring NBAR using the MQC.

Related Documents

Related Topic	Document Title
QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	*Cisco IOS Quality of Service Solutions Command Reference*
QoS features and functionality on the Catalyst 6500 series switch	"Configuring PFC QoS" chapter of the *Catalyst Supervisor Engine 32 PISA Cisco IOS Software Configuration Guide* , Release 12.2ZY

Related Topic	Document Title
MQC, traffic policies (policy maps), and traffic classes	"Applying QoS Features Using the MQC" module
CBWFQ	"Configuring Weighted Fair Queueing" module
Concepts and information about NBAR	"Classifying Network Traffic Using NBAR" module
Information about enabling Protocol Discovery	"Enabling Protocol Discovery" module
Information about adding application recognition modules (also known as PDLMs)	"Adding Application Recognition Modules" module
Creating a custom protocol	"Creating a Custom Protocol" module

Technical Assistance

Description	Link
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.	http://www.cisco.com/techsupport

Feature Information for Reporting Extracted Fields Through Flexible NetFlow

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 14: Feature Information for Reporting Extracted Fields Through Flexible NetFlow

Feature Name	Releases	Feature Information
Reporting Extracted Fields Through Flexible NetFlow	Cisco IOS XE Release 3.7	The Reporting Extracted Fields Through Flexible NetFlow feature allows NBAR to send subapplication table fields to the collector through Flexible NetFlow. The following command was introduced or modified: **option (Flexible NetFlow)**.

CHAPTER 9

NBAR Protocol Pack

The NBAR protocol pack provides an easy way to update protocols supported by NBAR without replacing the base IOS image that is already present in the device. A protocol pack is a set of protocols developed and packed together. For more information about loading an NBAR Protocol Pack, see *QoS: NBAR Configuration Guide*. To view the list of protocols supported in a protocol pack, see NBAR Protocol Library.

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 the NBAR Protocol Pack

The protocol pack must be copied to your local disk to avoid any errors after rebooting.

Note It is strongly recommended to load the NBAR protocol pack that is the exact match for the NBAR engine, and also load the latest rebuild of Cisco software.

Restrictions for the NBAR Protocol Pack

Only one protocol pack is supported per device.

Information About the NBAR Protocol Pack

Protocol Pack Overview

NBAR protocol packs are software packages that update the NBAR protocol support on a device without replacing the Cisco software on the device. An NBAR protocol pack contains a set of signatures that is supported by NBAR.

Protocol packs provide the following features:

- They are easy to load.
- They are easy to upgrade to a higher version protocol pack or revert to a lower version protocol pack.
- They provide only the required set of protocols.

Cisco provides users with two different protocol packs—the Standard Protocol Pack and the Advanced Protocol Pack—depending on whether they are using an unlicensed or licensed Cisco image.

Cisco provides a specific identity number for the organization (also known as the “publisher”) that creates the protocol packs and uses Cisco tools and processes to create new protocol packs. The organization that creates the protocol pack owns the pack.

Cisco provides the Advanced Protocol Pack as the base protocol pack with a licensed Cisco image on a device. The Advanced Protocol Pack has the complete set of Protocol Description Language (PDL) files available for a release. On the Advanced Protocol Pack, only a PDLM with the NAME field as Advanced Protocol Pack can be loaded.

Cisco provides the Standard Protocol Pack as the base protocol pack with an unlicensed Cisco image on a device. The Standard Protocol Pack has limited features and functionality. Some of the features, such as Category and Attributes, Field Extraction, and Tunneled Classification, are not supported. On the Standard Protocol Pack, only a PDLM with the NAME field as Standard Protocol Pack can be loaded.

To view the list of protocols supported in a protocol pack, see NBAR Protocol Library.

The NBAR taxonomy file contains the information such as common name, description, underlying protocol, for every protocol that is available in the protocol pack. Use the **show ip nbar protocol-pack active taxonomy**, **show ip nbar protocol-pack inactive taxonomy** , and **show ip nbar protocol-pack loaded taxonomy** commands to view the taxonomy file for an active, inactive, and all loaded protocol-packs respectively.

The nbar taxonomy file generally contains the information for more than 1000 protocols, and the taxonomy file size is ~2 MB. It is recommended to redirect the output from the **show ip nbar protocol-pack** [**active** |

inactive | **loaded**] taxonomy command to a file by using the redirect output modifier, for example, **show ip nbar protocol-pack active taxonomy** | **redirect harddisk:***nbar_taxonomy.xml*.

SSL Unique-name Sub-classification

With NBAR2 Protocol Pack 7.0.0, a new sub-classification parameter called 'unique-name' is introduced for Secure Socket Layer (SSL). The unique-name parameter can be used to match SSL sessions of servers that are not known globally, or are not yet supported by NBAR. The unique-name will match the server name indication (SNI) field in the client request if the SNI field exists, or it will match the common name (CN) field in the first certificate of the server's response.

NBAR2 Protocol Pack 7.0.0 also supports cases of SSL sessions that use session-id than the SSL sessions that use handshake.

Note The SSL sub-classification parameters have priority over the built in signatures. Therefore, when a unique-name defined by a user matches a known application such as Facebook, it will not match the built-in protocol but will match SSL with the configured sub-classification.

Note Similar to the other sub-classification features, the classification result (for example, as seen in protocol-discovery), does not change and will remain as SSL. However, the flows matching the class maps will receive the services such as QoS and Performance monitor configured for them. To view the detailed matching statistics, refer to the policy map counters.

For more information on SSL, see http://tools.ietf.org/html/rfc6101.

RTP Dynamic Payload Type Sub-classification

With NBAR2 Protocol Pack 7.0.0, the existing sub-classification parameters for Real-time Transport Protocol (RTP) audio and RTP video are enhanced to detect RTP flows that use dynamic payload types (PT). Dynamic PTs are PTs in the dynamic range from 96 to 127 as defined in RTP RFC, and are selected online through the signaling protocols such as SIP and RTSP, for each session. In this protocol pack, only RTP sessions initiated using SIP will match by dynamic payload type.

Note The RTP audio/video sub-classification parameters are generic in nature and will match only on generic RTP traffic. More specific classification such as ms-lync-audio, cisco-jabber-audio, facetime, and cisco-phone will not match as RTP, and therefore will not match the audio/video sub-classification.

New Categories and Sub-categories for QoS and Reporting in NBAR2 Protocol Pack 9.0.0

In NBAR2 Protocol Pack 9.0.0, there are new categories and sub-categories which make QOS configuration easier and AVC reports more meaningful. Therefore, the category and sub-category assignments of many protocols have been updated to better reflect their categorization in enterprise networks.

The new categories allow more granularity in reports that are based on Category.

The new sub-categories can be used for generating even more granular reports, and are very useful for implementing QOS policies, following the Cisco SRND QOS model. The new sub-categories divide applications into business and consumer, as well as the different media types so that it is easy to build an MQC class map to map a specific sub-category to the desired SRND class of service and apply QOS. For more information about SRND, see http://www.cisco.com/en/US/docs/solutions/Enterprise/WAN_and_MAN/QoS_SRND_40/QoSIntro_40.html#wp61104.

It is also easier to customize the QOS definitions, without changing the MQC class map but rather using attribute-maps and reassigning a specific application to a different sub-category than it is assigned by default.

For a complete list of protocols and their mappings, refer to the specific protocols in the protocol book, or use the **show ip nbar attribute category** or the **show ip nbar attribute sub-category** command.

Categories and Sub-categories Supported in NBAR2 Protocol Pack 9.0.0

The following is the list of Categories supported in NBAR2 Protocol Pack 9.0.0:

- anonymizers
- backup-and-storage
- browsing
- business-and-productivity-tools
- database
- email
- epayment
- file-sharing
- gaming
- industrial-protocols
- instant-messaging
- internet-security
- inter-process-rpc
- layer3-over-ip
- location-based-services
- net-admin
- newsgroup

- other
- social-networking
- software-updates
- trojan
- voice-and-video

The following is the list of Sub-categories supported in NBAR2 Protocol Pack 9.0.0:

- authentication-services
- backup-systems
- consumer-audio-streaming
- consumer-cloud-storage
- consumer-multimedia-messaging
- consumer-video-streaming
- consumer-web-browsing
- control-and-signaling
- desktop-virtualization
- enterprise-cloud-data-storage
- enterprise-data-center-storage
- enterprise-data-center-storage
- enterprise-multimedia-conferencing
- enterprise-realtime-applications
- enterprise-rich-media-content
- enterprise-software-deployment-tools
- enterprise-transactional-applications
- enterprise-video-broadcast
- enterprise-voice-collaboration
- file-transfer
- naming-services
- network-management
- os-updates
- other
- p2p-file-transfer
- p2p-networking
- remote-access-terminal

- routing-protocol
- tunneling-protocols

Note In this update, some categories and sub-categories that are not in common use have been removed, or renamed. Some values have moved from sub-category to category to provide better granularity at the category level. Therefore existing class-maps that contain matches based on removed or renamed values would be automatically removed when the protocol is installed, but the command would not be replaced. Refer to the list of removed/renamed values below to verify that none of the existing policies is affected by the change.

The following categories are removed in NBAR2 Protocol Pack 9.0.0:

- internet-privacy
- streaming

The following sub-categories are removed in NBAR2 Protocol Pack 9.0.0:

- client-server
- commercial-media-distribution
- database
- epayment
- file-sharing
- internet-privacy
- inter-process-rpc
- license-manager
- network-protocol
- rich-media-http-content
- storage
- streaming
- terminal
- voice-video-chat-collaboration

How to Load the NBAR Protocol Pack

Loading the NBAR Protocol Pack

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nbar protocol-pack** *protocol-pack* [**force**]
4. **exit**
5. **show ip nbar protocol-pack** {protocol-pack | **active**} [**detail**]

DETAILED STEPS

	Command or Action	Purpose
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	**ip nbar protocol-pack** *protocol-pack* [**force**] **Example:** `Device(config)# ip nbar protocol-pack harddisk:defProtoPack`	Loads the protocol pack. • Use the **force** keyword to specify and load a protocol pack of a lower version, which is different from the base protocol pack version.
Step 4	**exit** **Example:** `Device(config)# exit`	Returns to privileged EXEC mode.
Step 5	**show ip nbar protocol-pack** {protocol-pack | **active**} [**detail**] **Example:** `Device(config)# show ip nbar protocol-pack active`	Displays the protocol pack information. • Verify the loaded protocol pack version, publisher, and other details using this command. • Use the *protocol-pack* argument to display information about the specified protocol pack.

	Command or Action	Purpose
		• Use the **active** keyword to display active protocol pack information. • Use the **detail** keyword to display detailed protocol pack information.

Configuration Examples for the NBAR Protocol Pack

Example: Loading the NBAR Protocol Pack

The following example shows how to load an NBAR protocol pack named defProtoPack from the harddisk:

```
Device> enable
Device# configure terminal
Device(config)# ip nbar protocol-pack harddisk:defProtoPack
Device(config)# exit
```

The following example shows how to revert to the base image version of NBAR protocol pack:

```
Device> enable
Device# configure terminal
Device(config)# default ip nbar protocol-pack
Device(config)# exit
```

The following example shows how to load a protocol pack of a lower version using the **force** keyword:

```
Device> enable
Device# configure terminal
Device(config)# ip nbar protocol-pack harddisk:olddefProtoPack force
Device(config)# exit
```

Example: Verifying the Loaded NBAR Protocol Pack

The following sample output from the **show ip nbar protocol-pack active** command shows information about the protocol pack that is provided by default with a licensed Cisco image on a device:

```
Device# show ip nbar protocol-pack active

ACTIVE protocol pack:
Name:                            Advanced Protocol Pack
Version:                         1.0
Publisher:                       Cisco Systems Inc.
NBAR Engine Version:             14
```

The following sample output from the **show ip nbar protocol-pack active detail** command shows detailed information about the active protocol pack that is provided by default with a licensed Cisco image on a device:

```
Device# show ip nbar protocol-pack active detail
```

```
ACTIVE protocol pack:
Name:                            Advanced Protocol Pack
Version:                         1.0
Publisher:                       Cisco Systems Inc.
NBAR Engine Version:             14
Protocols:
base                             Mv: 4
ftp                              Mv: 5
http                             Mv: 18
static                           Mv: 6
socks                            Mv: 2
nntp                             Mv: 2
tftp                             Mv: 2
exchange                         Mv: 3
vdolive                          Mv: 1
sqlnet                           Mv: 2
netshow                          Mv: 3
sunrpc                           Mv: 3
streamwork                       Mv: 2
citrix                           Mv: 11
fasttrack                        Mv: 3
gnutella                         Mv: 7
kazaa2                           Mv: 11
```

The following sample output from the **show ip nbar protocol-pack** command shows the protocol pack information of an advanced protocol pack that is present in the specified device location:

```
Device# show ip nbar protocol-pack disk:0ppsmall_higherversion

Name:                            Advanced Protocol Pack
Version:                         2.0
Publisher:                       Cisco Systems Inc.
NBAR Engine Version:             14
Creation time:                   Mon Jul 16 09:29:34 UTC 2012
```

The following sample output from the **show ip nbar protocol-pack** command shows detailed protocol pack information present in the specified disk location:

```
Device# show ip nbar protocol-pack disk:0ppsmall_higherversion detail

Name:                            Advanced Protocol Pack
Version:                         2.0
Publisher:                       Cisco Systems Inc.
NBAR Engine Version:             14
Creation time:                   Mon Jul 16 09:29:34 UTC 2012
Protocol Pack contents:
iana                     Mv: 1
base                     Mv: 4
tftp                     Mv: 2
```

The following sample output from the **show ip nbar protocol-pack** command shows information about the active protocol pack with an unlicensed Cisco image on a device:

```
Device# show ip nbar protocol-pack active

ACTIVE protocol pack:
Name:                            Standard Protocol Pack
Version:                         1.0
Publisher:                       Cisco Systems Inc.
```

Example: Viewing the NBAR Taxonomy Information

The following sample output from the **show ip nbar protocol-pack active taxonomy** command shows the information about the protocols in the active protocol pack:

```
Device# show ip nbar protocol-pack active taxonomy

Protocol Pack Taxonomy for Advanced Protocol Pack:
<?xml version="1.0"?>
<NBAR2-Taxonomy>
  <protocol>
    <name>active-directory</name>
    <engine-id>7</engine-id>
    <enabled>true</enabled>
    <selector-id>473</selector-id>
    <help-string>Active Directory Traffic</help-string>
    <global-id>L7:473</global-id>
    <common-name>Active Directory</common-name>
    <static>false</static>
    <attributes>
      <category>net-admin</category>
      <application-group>other</application-group>
      <p2p-technology>false</p2p-technology>
      <tunnel>false</tunnel>
      <encrypted>false</encrypted>
      <sub-category>network-management</sub-category>
    </attributes>
    <ip-version>
      <ipv4>true</ipv4>
      <ipv6>true</ipv6>
    </ip-version>

<references>http://www.microsoft.com/en-us/server-cloud/windows-server/active-directory.aspx</references>

    <id>1194</id>
    <underlying-protocols>cifs,ldap,ssl,ms-rpc</underlying-protocols>
    <long-description-is-final>true</long-description-is-final>
   <long-description>a directory service created by Microsoft for Windows domain networks,
 responsible for authenticating and authorizing all users and computers within a network
of Windows domain type, assigning and enforcing security policies for all computers in a
network and installing or updating software on network computers</long-description>
    <pdl-version>1</pdl-version>
    <uses-bundling>false</uses-bundling>
  </protocol>
  <protocol>
    <name>activesync</name>
    <engine-id>7</engine-id>
    <enabled>true</enabled>
    <selector-id>490</selector-id>
    <help-string>Microsoft Activesync protocol </help-string>
    <global-id>L7:490</global-id>
    <common-name>ActiveSync</common-name>
    <static>false</static>
    <attributes>
      <category>business-and-productivity-tools</category>
      <application-group>other</application-group>
      <p2p-technology>false</p2p-technology>
      <tunnel>false</tunnel>
      <encrypted>true</encrypted>
      <sub-category>client-server</sub-category>
    </attributes>
    <ip-version>
      <ipv4>true</ipv4>
      <ipv6>true</ipv6>
    </ip-version>
   <references>http://msdn.microsoft.com/en-us/library/dd299446(v=exchg.80).aspx</references>

    <id>1419</id>
    <underlying-protocols>http</underlying-protocols>
    <long-description-is-final>true</long-description-is-final>
    <long-description>ActiveSync is a mobile data synchronization technology and protocol
based on HTTP, developed by Microsoft. There are two implementations of the technology: one
 which synchronizes data and information with handheld devices with a specific desktop
computer, and another technology, commonly known as Exchange ActiveSync (or EAS), which
provides push synchronization of contacts, calendars, tasks, and email between
ActiveSync-enabled servers and devices.</long-description>
    <pdl-version>1</pdl-version>
    <uses-bundling>false</uses-bundling>
  </protocol>
  .
  .
  .
  .
```

Example: Classifying SSL Sessions

The following example shows how an SSL-based service with the server name as 'finance.cisco.com' is matched using **unique-name**:

```
Device> enable
Device# configure terminal
Device(config)# class-map match-any cisco-finance
Device(config-cmap)# match protocol ssl unique-name finance.cisco.com
```

Example: Classifying RTP Dynamic Payload Type

The following example shows how to detect RTP audio flows that include both static and dynamic PT:

```
Device> enable
Device# configure terminal
Device(config)# class-map match-any generic-rtp-audio
Device(config)# match protocol rtp audio
```

Additional References for NBAR Protocol Pack

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
Cisco IOS LAN Switching commands	Cisco IOS LAN Switching Command Reference
Cisco IOS QoS configuration information	*QoS Configuration Guide*

Standards and RFCs

Standards/RFCs	Document Title
RFC 3551	RTP Profile for Audio and Video Conferences with Minimal Control
RFC 6101	The Secure Sockets Layer (SSL) Protocol Version 3.0

Technical Assistance

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

Feature Information for NBAR Protocol Pack

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 15: Feature Information for NBAR Protocol Pack

Feature Name	Releases	Feature Information
NBAR Protocol Pack	Cisco IOS XE Release 3.3S	This feature was introduced on Cisco ASR 1000 Series Aggregation Services Routers. The NBAR Protocol Pack feature provides an easy way to configure the protocol pack, which is a set of protocols developed and packed together. The following commands were introduced or modified: **default ip nbar protocol-pack**, **ip nbar protocol-pack**, **show ip nbar protocol pack**.
NBAR2 Protocol Pack 7.0.0	Cisco IOS XE Release 3.9S	This feature was introduced on Cisco ASR 1000 Series Aggregation Services Routers. The following section provides information about this feature: SSL Unique-name Sub-classification, *on page 101* and RTP Dynamic Payload Type Sub-classification, *on page 101*.
NBAR2: Integrate NBAR Taxonomy into the Router	Cisco IOS XE Release 3.11S	The NBAR taxonomy contains the information such as common name, description, underlying protocol, for every protocol that is available in the protocol pack. The following commands were introduced or modified: **show ip nbar protocol-pack**.
NBAR2 Protocol Pack 9.0.0	Cisco IOS XE Release 3.13S	This feature was introduced on Cisco ASR 1000 Series Aggregation Services Routers. The following section provides information about this feature: New Categories and Sub-categories for QoS and Reporting in NBAR2 Protocol Pack 9.0.0, *on page 102*.

CHAPTER 10

NBAR Protocol Pack Auto Update

Cisco provides periodic releases of NBAR protocol packs to improve NBAR traffic recognition capabilities on an ongoing basis. The Protocol Pack Auto Update feature assists in updating any number of routers with the latest compatible protocol pack.

Advantages

- **Automation**: When a new protocol pack becomes available, download the protocol pack file to a server reachable by each of the routers, and indicate the file path within a simple configuration file. The routers within your network that have Auto Update enabled will check the server periodically. If a newer protocol pack is available and compatible, the router downloads the protocol pack file and installs it automatically.
- **Centralized System Administration**: Protocol Pack Auto Update provides a powerful tool to network administrators. Administrators can control protocol pack deployment on any number of devices, using a single centralized configuration file.

Setting Up Protocol Pack Auto Update

Setting up Protocol Pack Auto Update requires a few simple steps on each router participating in auto update, as well as setting up two servers (or a single server performing both roles) to manage the centralized activities. For details, see NBAR Protocol Pack Auto Update Deployment, on page 114.

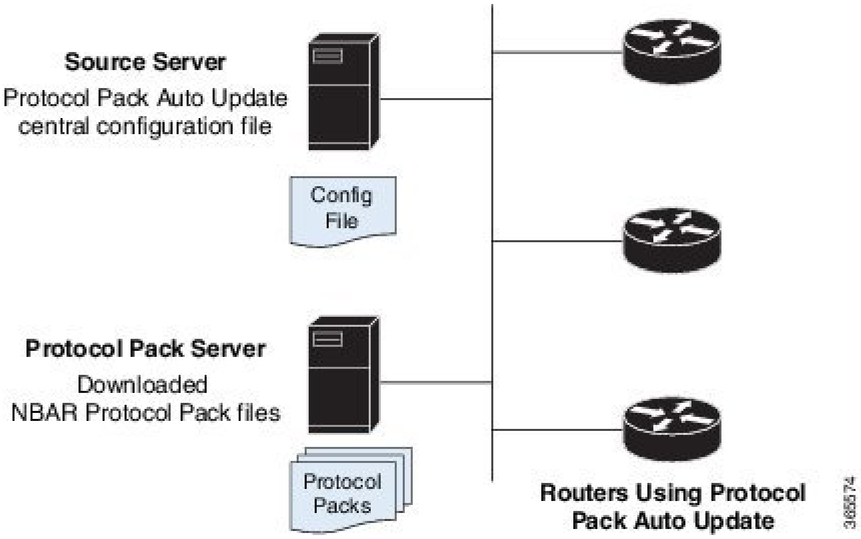
NBAR Protocol Pack Auto Update Deployment

Elements

Using Protocol Pack Auto Update involves two servers, or a single server providing both functions, and any number of participating routers.

- **Protocol Pack Server**: Contains:
  - Downloaded protocol pack installation files
- **Source Server**: Contains:
  - Configuration file, NBAR_PROTOCOL_PACK_DETAILS.json, specifying the **Protocol Pack Server** location and Protocol Pack Auto Update settings
  - Protocol Pack Auto Update log files
- **Routers**: One or more routers with Protocol Pack Auto Update enabled (see Enabling Protocol Pack Auto Update, on page 118)

Figure 2: Protocol Pack Auto Update


Source Server
Protocol Pack Auto Update central configuration file
Config File
Protocol Pack Server
Downloaded NBAR Protocol Pack files
Protocol Packs
Routers Using Protocol Pack Auto Update
365574

Deployment Steps

1. Set up a server reachable by all participating routers, to function as the **Protocol Pack Server**. Download the latest protocol pack files and store the files on the server.
2. Set up a server reachable by all participating routers, to function as the **Source Server**. On the server, create the JSON-format configuration file specifying the location of the Protocol Pack Server and Auto Update settings.

See Setting Up a Source Server for Protocol Pack Auto Update, on page 115.

Note A single server can perform the functions of both the **Protocol Pack Server** and **Source Server**.

3 On participating routers, enable Protocol Pack Auto Update.

See Enabling Protocol Pack Auto Update, on page 118.

Example:

```
Device#configure terminal
Device(config)#ip nbar protocol-pack-auto-update
Device(config-pp-auto-update)#source-server tftp://10.20.300.400/NbarAutoUpdate
Device(config-pp-auto-update)#exit
```

4 (Optional) If required, use Protocol Pack Auto Update CLI commands on individual routers to locally override settings specified in the configuration file.

See Configuring Local Protocol Pack Auto Update Settings on a Router, on page 122.

5 When new protocol pack releases are available, download them to the **Protocol Pack Server** and add the locations to the configuration file on the **Source Server**.

Setting Up a Source Server for Protocol Pack Auto Update

To set up a **Source Server** for Protocol Pack Auto Update, use the following procedure.

1 Set up a server in a network location reachable by all participating routers.

Note A single server can perform the functions of both the **Protocol Pack Server** and **Source Server**.

2 In a directory on the server, create a text file called NBAR_PROTOCOL_PACK_DETAILS.json. This is the JSON-format configuration file controlling Protocol Pack Auto Update functionality on participating routers.

See Protocol Pack Auto Update Configuration File, on page 115.

3 Note the network location of the server, and the path to the directory containing the configuration file. Use this location when specifying the **Source Server** on participating routers. Do not include the configuration filename in the path.

Example: tftp://10.20.300.400/NbarAutoUpdate

Protocol Pack Auto Update Configuration File

The Protocol Pack Auto Update configuration file specifies:

- **Protocol Pack Server** location
- Locations of protocol pack files on the **Protocol Pack Server**
- Schedule for participating routers to check the **Protocol Pack Server** for updates

Configuration File Format and Filename

The configuration file format is JSON. The required filename is: NBAR_PROTOCOL_PACK_DETAILS.json

Specifying Protocol Pack File Locations

The configuration file provides the path for each available protocol pack file. Participating routers use these paths to download and install the protocol pack files automatically.

The complete path is formed by combining the specified **Protocol Pack Server** location together with the file path. A router downloading the protocol pack uses this complete path to download the file. Example:

- **Protocol Pack Server** location: tftp://10.20.200.1/NbarAutoUpdate/pp_server/
- Directory and filename: protocolpack_dir/pp1
- Complete path for downloading the protocol pack:
  tftp://10.20.200.1/NbarAutoUpdate/pp_server/protocolpack_dir/pp1

Organization of the Configuration File

Within the configuration file, protocol pack file locations are organized by platform and NBAR engine:

- Platform

  Examples: ASR, CSR, ISR

- NBAR engine version (example: 22)

  The NBAR engine version number identifies each version of NBAR, and can be displayed using the **show ip nbar version** command on a router.

Routers of Same Type Operating Different Versions of NBAR

Routers of the same platform type (for example, ISR) may be using different versions of NBAR—for example, two Cisco ISR 4451 routers, one operating with Cisco IOS XE 3.15 and the other with 3.17. The configuration file should specify protocol pack files for both NBAR versions.

Configuration File Parameters

The following parameters are used in the NBAR_PROTOCOL_PACK_DETAILS.json configuration file. Each router using Protocol Pack Auto Update may override these parameters using local CLI commands.

Parameter	Description
protocol-pack-server	(Mandatory) Location of protocol pack server. Example: tftp://10.20.200.1/NbarAutoUpdate/pp_server/
nbar_pp_files	(Mandatory) Provides file locations for protocol pack files for various platforms and NBAR engines, identified by NBAR engine ID.

Parameter	Description
schedule {**daily** | **weekly**: | **monthly**:} [*day*] {**hh**: *hh*, **mm**: *mm*}	Schedule for the NBAR protocol pack auto-update upgrade interval. Participating routers check regularly for updates at the scheduled time. • monthly: Day of the month • weekly: Day of the week (0 to 6) • hh: Hour (24-hour time) • mm: Minute The actual run time depends on the **update-window** option. Default: Daily at 00:00
update-window	Maintenance window (in minutes) for NBAR protocol pack auto-update to operate within. The maintenance window is scheduled according to the time configured by the **schedule** parameters. Default: 60
clear-previous	**enable**: Causes unneeded protocol-pack files to be removed after a cool-down period. **disable**: Configures the feature to not remove any files. Default: enable
force-upgrade	**enable**: New protocol pack updates will be applied with the "force" flag. **disable**: New protocol pack updates will not be applied with the "force" flag. Default: disable

Configuration Files: Minimal Example

Example of a minimal configuration file, containing only the top-level **nbar_auto_update_config**, and mandatory fields. Because no schedule is configured, routers use the default schedule of checking daily at 00:00.

```
{
"nbar_auto_update_config":{
"protocol-pack-server":"tftp://10.20.200.1/NbarAutoUpdate/pp_server/"
},
"nbar_pp_files":{
"ISR":{"25":"/ProtoPack"},
"ASR":{"25":"/ProtoPack"},
"CSR":{"25":"/ProtoPack"},
"OTHER":{"25":"/ProtoPack"}
}
}
```

Configuration Files: Typical Example

Example of a typical configuration file, containing the top-level **nbar_auto_update_config**, plus mandatory and optional fields. In this example, the update schedule is weekly on Saturdays at 2:30 AM. Participating routers check for available updates at the scheduled time.

```
{
  "nbar_auto_update_config": {
    "protocol-pack-server": "tftp://10.20.200.1/NbarAutoUpdate/pp_server/",
    "update-window":0,
    "force-upgrade":true,
    "clear-previous":true,
    "schedule": {
      "weekly": 6,
      "hh": 02,
      "mm": 30
    },
  },
  "nbar_pp_files": {
    "ISR": {
      "22":"isr_protocolpack_dir/pp22",
      "23":"isr_protocolpack_dir/pp23"
    },
    "ASR": {
      "23":"asr_protocolpack_dir/pp23"
    },
    "CSR": {
      "23":["csr_protocolpack_dir/pp23"]
    },
    "OTHER": {
      "23":["other_pp1","other_pp23"]
    }
  }
}
```

Enabling Protocol Pack Auto Update

Enabling Protocol Pack Auto Update on a router requires:

- Enabling the feature
- Specifying the **Source Server** to use, or ensuring that it has been specified already

SUMMARY STEPS

1. **configure terminal**
2. **ip nbar protocol-pack-auto-update**
3. **source-server** *server*
4. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device#configure terminal`	Enters global configuration mode.

Step 2	**ip nbar protocol-pack-auto-update**
	Example:
	`Device(config)#ip nbar protocol-pack-auto-update`
	`Device(config-auto-pp-update)#`
		Enables NBAR protocol pack auto update.

Step 3	**source-server** *server* **Example:** `Device(config-auto-pp-update)#source-server tftp://10.20.300.400/NbarAutoUpdate`	(Required only if the **Source Server** has not already been specified) Specifies the location of the **Source Server** and the directory containing the Protocol Pack Auto Update configuration file, NBAR_PROTOCOL_PACK_DETAILS.json.
Step 4	**exit** **Example:** `Device(config-auto-pp-update)#exit`	Exits global configuration mode.

Disabling Protocol Pack Auto Update

Disables Protocol Pack Auto Update on a router.

SUMMARY STEPS

1. **configure terminal**
2. **no ip protocol-pack-auto-update**
3. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 2	**no ip protocol-pack-auto-update** **Example:** `Device(config)# no ip nbar protocol-pack-auto-update`	Disables NBAR protocol pack auto update.
Step 3	**exit** **Example:** `Device(config)# exit`	Exits global configuration mode.

Initiating Immediate Protocol Pack Update Using Auto Update

Initiates an immediate protocol pack update using the Protocol Pack Auto Update mechanism.

SUMMARY STEPS

1. **configure terminal**
2. **ip nbar protocol-pack-auto-update now**
3. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**ip nbar protocol-pack-auto-update now** **Example:** `Device(config)# ip nbar protocol-pack-auto-update now`	Initiates a protocol pack update using the auto update mechanism.
Step 3	**exit** **Example:** `Device(config)# exit`	Exits global configuration mode.

Displaying Protocol Pack Auto Update Information

Displays the Protocol Pack Auto Update configuration, copied files, and statistics.

SUMMARY STEPS

1. **show ip nbar protocol-pack auto-update**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show ip nbar protocol-pack auto-update** **Example:** `Device# show ip nbar protocol-pack-auto-update`	Displays the protocol pack auto update configuration, copied files, and statistics.

Example

The following example shows the information provided in the output of this command.

```
Device# show ip nbar protocol-pack-auto-update

NBAR Auto-Update:
=================

Configuration:
=============
force-upgrade               : (Default)  Enabled
clear-previous              : (Default)  Enabled
update-window               : (Default)  30
source-server               :                 tftp://10.20.200.1/NbarAutoUpdate/
protocol-pack-directory     : (Default)  harddisk:
schedule                    : (Default)  03:22

Copied files:
==========
File            : harddisk:/NbarAutoUpdate/AsrNbarPP
Copied          : *11:29:11.000 UTC Mon Jan 5 2015


Last run result: SUCCESS
Last auto-update run                     : *11:29:12.000 UTC Mon Jan 5 2015
Last auto-update success                 : *11:29:12.000 UTC Mon Jan 5 2015
Last auto-update successful update       : *11:29:12.000 UTC Mon Jan 5 2015

Last auto-update server-config update    : *16:15:13.000 UTC Mon Jan 5 2015
Success count                             : 3
Failure count                             : 0
Success rate                              : 100 percent

Next AU maintenance estimated to run at  : *17:15:13.000 UTC Mon Jan 5 2015
Next AU update estimated to run at       : *03:41:00.000 UTC Tue Jan 6 2015
```

Configuring Local Protocol Pack Auto Update Settings on a Router

To configure local Protocol Pack Auto Update settings on a router, use the command sub-mode described here. Configuring local settings on the router overrides settings specified in the centralized configuration file.

SUMMARY STEPS

1. **configure terminal**
2. **ip nbar protocol-pack-auto-update**
3. Use one or more of the sub-mode commands. Use **exit** when finished to exit the command sub-mode.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device#configure terminal`	Enters global configuration mode.

Step 2	**ip nbar protocol-pack-auto-update**
	Example:
	`Device(config)#ip nbar protocol-pack-auto-update`
	`Device(config-auto-pp-update)#`
		Enters Protocol Pack Auto Update configuration sub-mode, indicated by a change in the prompt to include "(config-auto-pp-update)".

Step 3	Use one or more of the sub-mode commands. Use **exit** when finished to exit the command sub-mode.	See Protocol Pack Auto Update Sub-mode Commands, on page 122.

Protocol Pack Auto Update Sub-mode Commands

Protocol Pack Auto Update sub-mode commands configure local Auto Update settings on a router. For information on entering the command sub-mode, see Configuring Local Protocol Pack Auto Update Settings on a Router, on page 122.

Use **exit** when finished to exit the command sub-mode.

Command	Description
clear-previous {**enable** | **disable**}	**enable**: Causes unneeded protocol-pack files to be removed after a cool-down period. **disable**: Configures the feature to not remove any files. Default: Enable

Command	Description
force-upgrade {**enable** | **disable**}	**enable**: New protocol pack updates will be applied with the "force" flag. **disable**: New protocol pack updates will not be applied with the "force" flag. Default: Disable
protocol-pack-directory *directory*	Local directory in which to save new protocol pack files. Default: File system with highest space availability
schedule {**daily** | **weekly** | **monthly**} [*day*] [*hh:mm*]	Schedule the NBAR protocol pack auto-update upgrade interval. The actual run time depends on the **update-window** option. Default: Daily at 00:00
update-window *minutes*	Maintenance window (in minutes) for NBAR protocol pack auto-update to operate within. The maintenance window occurs according to the time configured by the **schedule** option. Range: 0 to 60 Default: 60

Example: Overriding Update Window

The following command sets the update window to 10 minutes, overriding the setting specified in the Protocol Pack Auto Update configuration file.

```
Device# configure terminal
Device(config)# ip nbar protocol-pack-auto-update
Device(config-auto-pp-update)# update-window 10
```

CHAPTER 11

NBAR2 Custom Protocol

Network-Based Application Recognition (NBAR) supports the use of custom protocols to identify custom applications. Custom protocols support static port-based protocols and applications that NBAR does not support.

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 Creating a Custom Protocol

Before creating a custom protocol, read the information in the "Classifying Network Traffic Using NBAR" module.

Information About Creating a Custom Protocol

NBAR and Custom Protocols

NBAR supports the use of custom protocols to identify custom applications. Custom protocols support static port-based protocols and applications that NBAR does not currently support.

Note For a list of NBAR-supported protocols, see the "Classifying Network Traffic Using NBAR" module.

With NBAR supporting the use of custom protocols, NBAR can map static TCP and UDP port numbers to the custom protocols.

Initially, NBAR included the following features related to custom protocols and applications:

- Custom protocols had to be named custom-xx, with xx being a number.
- Ten custom applications can be assigned using NBAR, and each custom application can have up to 16 TCP and 16 UDP ports each mapped to the individual custom protocol. The real-time statistics of each custom protocol can be monitored using Protocol Discovery.

NBAR includes the following characteristics related to user-defined custom protocols and applications:

- The ability to inspect the payload for certain matching string patterns at a specific offset.
- The ability to allow users to define the names of their custom protocol applications. The user-named protocol can then be used by Protocol Discovery, the Protocol Discovery MIB, the **match protocol** command, and the **ip nbar port-map** command as an NBAR-supported protocol.
- The ability of NBAR to inspect the custom protocols specified by traffic direction (that is, traffic heading toward a source or a destination rather than traffic in both directions).
- CLI support that allows a user configuring a custom application to specify a range of ports rather than specify each port individually.
- The **http**/**dns**/**ssl** keyword group that lets you add custom host and URL signatures.

Note Defining a user-defined custom protocol restarts the NBAR feature, whereas defining predefined custom protocol does not restart the NBAR feature.

MQC and NBAR Custom Protocols

NBAR recognizes and classifies network traffic by protocol or application. You can extend the set of protocols and applications that NBAR recognizes by creating a custom protocol. Custom protocols extend the capability of NBAR Protocol Discovery to classify and monitor additional static port applications and allow NBAR to classify nonsupported static port traffic. You define a custom protocol by using the keywords and arguments of the **ip nbar custom** command. However, after you define the custom protocol, you must create a traffic class and configure a traffic policy (policy map) to use the custom protocol when NBAR classifies traffic. To create traffic classes and configure traffic polices, use the functionality of the Modular Quality of Service (QoS) Command-Line Interface (CLI) (MQC). The MQC is a command-line interface that allows you to define traffic classes, create and configure traffic policies (policy maps), and then attach these traffic policies to interfaces. For more information about NBAR and the functionality of the MQC, see the "Configuring NBAR Using the MQC" module.

IP Address and Port-based Custom Protocol

IP address and port-based custom protocol includes supporting an IP subnet or a list of IP addresses with a specific TCP or UDP transport. This enables Network-Based Application Recognition (NBAR) to recognize traffic based on IP addresses and to associate an application ID to traffic from and to specified IP addresses. You define a custom protocol transport by using the keywords and arguments of the **ip nbar custom transport** command.

To support the IP address and port-based custom protocol option, the custom configuration mode (config-custom) is introduced with the **ip nbar custom transport** command. This mode supports options to specify a maximum of eight individual IP addresses, subnet IP addresses, and subnet mask length. You can also specify a list of eight ports or a start port range and an end port range.

IP address-based custom application gets classification from syn packet.

Comparison of Custom NBAR Protocols: Based on a Single Network Protocol or Based on Multiple Network Protocols

Note In this description, the term "protocol" is used in two ways: as an NBAR protocol used for identifying traffic, and as a network protocol (HTTP, SSL, and so on).

NBAR provides:

- **Custom NBAR protocols based on single network protocol**

  Useful for identifying a single type of traffic (HTTP, SSL, and so on) according to a specified pattern.

  Syntax: ip nbar custom <protocol_name> <traffic_type> <criteria>

- **Custom NBAR protocols based on multiple network protocols** (called a "composite" custom NBAR protocol)

  Useful for identifying traffic using signatures for multiple network protocols. Currently, the composite method provides an option, "server-name" (value for <composite_option> in the CLI syntax) that identifies all HTTP, SSL, and DNS traffic associated with a specific server.

  Useful for identifying multiple types of traffic (HTTP, SSL, and so on) according to a specified pattern, using a single protocol.

  Syntax: ip nbar custom <protocol_name> composite <composite_option> <criteria>

Example Use Case: Custom NBAR Protocol Based on Multiple Network Protocols

- **Objective**: Identify all HTTP, SSL, and DNS traffic associated with the abc_example.com server.

- **Preferred method**: Use a composite custom NBAR protocol.
- **CLI**: `ip nbar custom abc_example_custom composite server-name *abc_example`

Limitations of Custom Protocols

The following limitations apply to custom protocols:

- NBAR supports a maximum of 120 custom protocols. All custom protocols are included in this maximum, including single-signature and composite protocols.
- Cannot define two custom protocols for the same target regular expression.

  For example, after configuring ip nbar custom 1abcd http url www.abcdef.com, cannot then configure:

  ip nbar custom 2abcd http url www.abcdef.com

  Attempting to do so results in an error.
- Maximum length for the regular expression that defines the custom protocol: 30 characters

How to Create a Custom Protocol

Defining a Custom NBAR Protocol Based on a Single Network Protocol

Custom protocols extend the capability of NBAR Protocol Discovery to classify and monitor additional static port applications and allow NBAR to classify non-supported static port traffic.

This procedure creates a custom NBAR protocol based on a single network protocol (HTTP, SSL, and so on).

Note NBAR supports a maximum of 120 custom protocols. All custom protocols are included in this maximum, including single-signature and composite protocols.

To define a custom protocol, perform the following steps.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nbar custom** *protocol-name* [*offset* [*format value*]] [**variable** *field-name field-length*] [*source* | *destination*] [**tcp** | **udp**] [**range** *start end* | *port-number*]
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ip nbar custom** *protocol-name* [*offset* [*format value*]] [**variable** *field-name field-length*] [*source* | *destination*] [**tcp** | **udp**] [**range** *start end* | *port-number*] **Example:** `Router(config)# ip nbar custom app_sales1 5 ascii SALES source tcp 4567`	Extends the capability of NBAR Protocol Discovery to classify and monitor additional static port applications or allows NBAR to classify non-supported static port traffic. • Creates a custom NBAR protocol that identifies traffic based on a single network protocol. • Useful for identifying a single type of traffic (HTTP, SSL, and so on) according to a specified pattern. • Enter the custom protocol name and any other optional keywords and arguments.

Step 4	**end**
	Example:
	`Router(config)# end`
		(Optional) Exits global configuration mode.

Examples

Custom Application Examples for Cisco IOS Releases Prior to 12.3(4)T

In the following example, a gaming application that runs on TCP port 8877 needs to be classified using NBAR. You can use custom-01 to map TCP port 8877 by entering the following command:

```
Router(config)# ip nbar custom-01 tcp 8877
```

Note The configuration shown in this example is supported in subsequent Cisco IOS releases but is required in all prior releases.

Custom Application Examples for Cisco IOS Release 12.3(4)T and Later Releases

In the following example, the custom protocol app_sales1 will identify TCP packets that have a source port of 4567 and that contain the term "SALES" in the first payload packet:

```
Router(config)# ip nbar custom app_sales1 5 ascii SALES source tcp 4567
```

In the following example, the custom protocol virus_home will identify UDP packets that have a destination port of 3000 and that contain "0x56" in the seventh byte of the first packet of the flow:

```
Router(config)#
ip nbar custom virus_home 7 hex 0x56 destination udp 3000
```

In the following example, the custom protocol media_new will identify TCP packets that have a destination or source port of 4500 and that have a value of 90 at the sixth byte of the payload. Only the first packet of the flow is checked for value 90 at offset 6.

```
Router(config)# ip nbar custom media_new 6 decimal 90 tcp 4500
```

In the following example, the custom protocol msn1 will look for TCP packets that have a destination or source port of 6700:

```
Router(config)#
ip nbar custom msn1 tcp 6700
```

In the following example, the custom protocol mail_x will look for UDP packets that have a destination port of 8202:

```
Router(config)# ip nbar custom mail_x destination udp 8202
```

In the following example, the custom protocol mail_y will look for UDP packets that have destination ports between 3000 and 4000 inclusive:

```
Router(config)# ip nbar custom mail_y destination udp range 3000 4000
```

Defining a Custom NBAR Protocol Based on Multiple Network Protocols

Custom protocols extend the capability of NBAR Protocol Discovery to classify and monitor additional static port applications and allow NBAR to classify non-supported static port traffic.

This procedure creates a custom NBAR protocol based on multiple network protocols.

Note In this description, the term "protocol" is used in two ways: as an NBAR protocol used for identifying traffic, and as a network protocol (HTTP, SSL, and so on).

Note NBAR supports a maximum of 120 custom protocols. All custom protocols are included in this maximum, including single-signature and composite protocols.

To define a composite-signature custom protocol, perform the following steps.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nbar custom** *protocol-name* **composite server-name** *server-name*
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ip nbar custom** *protocol-name* **composite server-name** *server-name* **Example:** `Router(config)# ip nbar custom abc_example_custom composite server-name *abc_example`	Extends the capability of NBAR Protocol Discovery to classify and monitor additional static port applications or allows NBAR to classify non-supported static port traffic. • Creates a custom NBAR protocol that identifies traffic using signatures for multiple network protocols. Currently, the only option for *composite-option* is **server-name**, which identifies all HTTP, SSL, and DNS traffic associated with a specific server. • Useful for identifying multiple types of traffic (HTTP, SSL, and so on) according to a specified pattern, using a single protocol. In the example, the objective is to identify all HTTP, SSL, and DNS traffic associated with the **abc_example.com** server.

Step 4	**end**
	Example:
	`Router(config)# end`
		(Optional) Exits global configuration mode.

Configuring a Traffic Class to Use the Custom Protocol

Traffic classes can be used to organize packets into groups on the basis of a user-specified criterion. For example, traffic classes can be configured to match packets on the basis of the protocol type or application recognized by NBAR. In this case, the traffic class is configured to match on the basis of the custom protocol.

To configure a traffic class to use the custom protocol, perform the following steps.

Note The **match protocol**command is shown at Step 4. For the *protocol-name* argument, enter the protocol name used as the match criteria. For a custom protocol, use the protocol specified by the *name* argument of the **ip nbar custom**command. (See Step 3 of the Defining a Custom Protocol task.)

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map** [**match-all** | **match-any**] *class-map-name*
4. **match protocol** *protocol-name*
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.

Step 3	**class-map** [**match-all** | **match-any**] *class-map-name*
	Example:
	`Router(config)# class-map cmap1`
		Creates a class map to be used for matching packets to a specified class and enters class-map configuration mode.
		• Enter the name of the class map.

Step 4	**match protocol** *protocol-name* **Example:** `Router(config-cmap)# match protocol app_sales1`	Configures NBAR to match traffic on the basis of the specified protocol. • For the *protocol-name* argument, enter the protocol name used as the match criterion. For a custom protocol, use the protocol specified by the *name* argument of the **ip nbar**

	Command or Action	Purpose
		customcommand. (See Step 3 of the "Defining a Custom Protocol" task.)

Step 5	**end**
	Example:
	`Router(config-cmap)# end`
		(Optional) Exits class-map configuration mode.

Examples

In the following example, the **variable** keyword is used while creating a custom protocol, and class maps are configured to classify different values within the variable field into different traffic classes. Specifically, in the example below, variable scid values 0x15, 0x21, and 0x27 will be classified into class map active-craft, while scid values 0x11, 0x22, and 0x25 will be classified into class map passive-craft.

```
Router(config)#
 ip nbar custom ftdd 23 variable scid 1 tcp range 5001 5005

Router(config)#
class-map active-craft
Router(config-cmap)# match protocol ftdd scid 0x15
Router(config-cmap)# match protocol ftdd scid 0x21
Router(config-cmap)# match protocol ftdd scid 0x27

Router(config)#
class-map passive-craft
Router(config-cmap)# match protocol ftdd scid 0x11
Router(config-cmap)# match protocol ftdd scid 0x22
Router(config-cmap)# match protocol ftdd scid 0x25
```

Configuring a Traffic Policy

Traffic that matches a user-specified criterion can be organized into specific classes. The traffic in those classes can, in turn, receive specific QoS treatment when that class is included in a policy map.

To configure a traffic policy, perform the following steps.

Note The **bandwidth** command is shown at Step 5. The **bandwidth** command configures the QoS feature class-based weighted fair queuing (CBWFQ). CBWFQ is just an example of a QoS feature that can be configured. Use the appropriate command for the QoS feature that you want to use.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map** *policy-map-name*
4. **class** {*class-name* | **class-default**}
5. **bandwidth** {*bandwidth-kbps*| **remaining percent** *percentage*| **percent** *percentage*}
6. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**policy-map** *policy-map-name* **Example:** `Router(config)# policy-map policy1`	Creates or modifies a policy map that can be attached to one or more interfaces and enters policy-map configuration mode. • Enter the name of the policy map.

Step 4	**class** {*class-name* | **class-default**}
	Example:
	`Router(config-pmap)# class class1`
		Specifies the name of the class whose policy you want to create or change and enters policy-map class configuration mode.
		• Enter the specific class name or enter the **class-default**keyword.

Step 5	**bandwidth** {*bandwidth-kbps*| **remaining percent** *percentage*| **percent** *percentage*}
	Example:
	`Router(config-pmap-c)# bandwidth percent 50`
		(Optional) Specifies or modifies the bandwidth allocated for a class belonging to a policy map.
		• Enter the amount of bandwidth as a number of kbps, a relative percentage of bandwidth, or an absolute amount of bandwidth.
		Note The **bandwidth** command configures the QoS feature class-based weighted fair queuing (CBWFQ). CBWFQ is just an example of a QoS feature that can be configured. Use the appropriate command for the QoS feature that you want to use.

	Command or Action	Purpose

Step 6	**end**
	Example:
	`Router(config-pmap-c)# end`
		(Optional) Exits policy-map class configuration mode.

Attaching the Traffic Policy to an Interface

After a traffic policy (policy map) is created, the next step is to attach the policy map to an interface. Policy maps can be attached to either the input or output direction of the interface.

Note Depending on the needs of your network, you may need to attach the policy map to a subinterface, an ATM PVC, a Frame Relay DLCI, or other type of interface.

To attach the traffic policy to an interface, perform the following steps.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number* [*name-tag*]
4. **pvc** [*name*] *vpi* / *vci* [**ilmi**| **qsaal**| **smds**| **l2transport**]
5. **exit**
6. **service-policy** {**input** | **output**} *policy-map-name*
7. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**interface** *type number* [*name-tag*] **Example:** `Router(config)# interface ethernet 2/4`	Configures an interface type and enters interface configuration mode. • Enter the interface type and the interface number.
Step 4	**pvc** [*name*] *vpi* / *vci* [**ilmi**| **qsaal**| **smds**| **l2transport**] **Example:** `Router(config-if)# pvc cisco 0/16`	(Optional) Creates or assigns a name to an ATM permanent virtual circuit (PVC), specifies the encapsulation type on an ATM PVC, and enters ATM virtual circuit configuration mode. • Enter the PVC name, the ATM network virtual path identifier, and the network virtual channel identifier. **Note** This step is required only if you are attaching the policy map to an ATM PVC. If you are not attaching the policy map to an ATM PVC, advance to Attaching the Traffic Policy to an Interface.
Step 5	**exit** **Example:** `Router(config-atm-vc)# exit`	(Optional) Returns to interface configuration mode. **Note** This step is required only if you are attaching the policy map to an ATM PVC and you completed Attaching the Traffic Policy to an Interface. If you are not attaching the policy map to an ATM PVC, advance to Attaching the Traffic Policy to an Interface.
Step 6	**service-policy** {**input** | **output**} *policy-map-name* **Example:** `Router(config-if)# service-policy input policy1`	Attaches a policy map to an input or output interface. • Enter the name of the policy map. **Note** Policy maps can be configured on ingress or egress routers. They can also be attached in the input or output direction of an interface. The direction (input or output) and the router (ingress or egress) to which the policy map should be attached vary according to your network configuration. When using the **service-policy** command to attach the policy map to an interface, be sure to choose the router and the interface direction that are appropriate for your network configuration.

Step 7	**end**
	Example:
	`Router(config-if)# end`
		(Optional) Returns to privileged EXEC mode.

Displaying Custom Protocol Information

After you create a custom protocol and match traffic on the basis of that custom protocol, you can use the **show ip nbar port-map** command to display information about that custom protocol.

To display custom protocol information, complete the following steps.

SUMMARY STEPS

1. **enable**
2. **show ip nbar port-map** [*protocol-name*]
3. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show ip nbar port-map** [*protocol-name*] **Example:** `Router# show ip nbar port-map`	Displays the current protocol-to-port mappings in use by NBAR. • (Optional) Enter a specific protocol name.
Step 3	**exit** **Example:** `Router# exit`	(Optional) Exits privileged EXEC mode.

Configuring IP Address and Port-based Custom Protocol

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nbar custom** *name* **transport** {**tcp** | **udp**} {**id** *id* } **ip address** *ip-address* | **subnet** *subnet-ip subnet-mask*}| **ipv6 address** {*ipv6-address* | **subnet** *subnet-ipv6 ipv6-prefix*} | **port** {*port-number* | **range** *start-range end-range*} | **direction** {**any** | **destination** | **source**}
4. **ip nbar custom** *name* **transport** {**tcp** | **udp**} {**id** *id*}
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: `Device> enable`	• Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

Step 3	**ip nbar custom** *name* **transport {tcp | udp} {id** *id* **} ip address** *ip-address* **| subnet** *subnet-ip subnet-mask***}| ipv6 address** {*ipv6-address* **| subnet** *subnet-ipv6 ipv6-prefix*} **| port** {*port-number* **| range** *start-range end-range*} **| direction {any | destination | source}**
	Example:
	`Device(config)# ip nbar custom mycustom transport tcp id 100`
	`Device(config-custom)# ip address 10.2.1.1`
		Specifies the IP address and port-based custom protocol options in custom configuration mode.

Step 4	**ip nbar custom** *name* **transport {tcp | udp} {id** *id***}**
	Example:
	`Device(config)# ip nbar custom mycustom transport tcp id 100`
	`Device(config-custom)#`
		Specifies TCP or UDP as the transport protocol and enters custom configuration mode.

Step 5	**end**
	Example:
	`Device(config-custom)# end`
		(Optional) Exits custom configuration mode.

Configuration Examples for Creating a Custom Protocol

Example Creating a Custom Protocol

In the following example, the custom protocol called app_sales1 identifies TCP packets that have a source port of 4567 and that contain the term SALES in the first payload packet:

```
Router> enable
Router# configure terminal
Router(config)# ip nbar custom app_sales1 5 ascii SALES source tcp 4567
Router(config)# end
```

Example Configuring a Traffic Class to Use the Custom Protocol

In the following example, a class called cmap1 has been configured. All traffic that matches the custom app_sales1 protocol will be placed in the cmap1 class.

```
Router> enable
Router# configure terminal
Router(config)# class-map cmap1
Router(config-cmap)# match protocol app_sales1
Router(config-cmap)# end
```

Example Configuring a Traffic Policy

In the following example, a traffic policy (policy map) called policy1 has been configured. Policy1 contains a class called class1, within which CBWFQ has been enabled.

```
Router> enable
Router# configure terminal
Router(config)# policy-map policy1
Router(config-pmap)# class class1
Router(config-pmap-c)# bandwidth percent 50
Router(config-pmap-c)# end
```

Note In the above example, the **bandwidth** command is used to enable Class-Based Weighted Fair Queuing (CBWFQ). CBWFQ is only an example of one QoS feature that can be applied in a traffic policy (policy map). Use the appropriate command for the QoS feature that you want to use.

Example Attaching the Traffic Policy to an Interface

In the following example, the traffic policy (policy map) called policy1 has been attached to ethernet interface 2/4 in the input direction of the interface.

```
Router> enable

Router# configure terminal

Router(config)# interface ethernet 2/4


Router(config-if)# service-policy input policy1

Router(config-if)# end
```

Example Displaying Custom Protocol Information

The following is sample output of the **show ip nbar port-map** command. This command displays the current protocol-to-port mappings in use by NBAR. Use the display to verify that these mappings are correct.

```
Router# show ip nbar port-map
port-map bgp      udp 179
port-map bgp      tcp 179
port-map cuseeme  udp 7648 7649
port-map cuseeme  tcp 7648 7649
port-map dhcp     udp 67 68
port-map dhcp     tcp 67 68
```

If the **ip nbar port-map** command has been used, the **show ip nbar port-map** command displays the ports assigned to the protocol.

If the **no ip nbar port-map**command has been used, the **show ip nbar port-map** command displays the default ports. To limit the display to a specific protocol, use the *protocol-name* argument of the **show ip nbar port-map** command.

Example: Configuring IP Address and Port-based Custom Protocol

The following example shows how to enter custom configuration mode from global configuration mode and configure a subnet IP address and its mask length:

```
Device(config)#  ip nbar custom mycustom transport tcp id 100
Device(config-custom)# ip subnet 10.1.2.3 22
```

Additional References

The following sections provide references related to creating a custom protocol.

Related Documents

Related Topic	Document Title
QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	*Cisco IOS Quality of Service Solutions Command Reference*
MQC, traffic policies (policy maps), and traffic classes	"Applying QoS Features Using the MQC" module
Concepts and information about NBAR	"Classifying Network Traffic Using NBAR" module
Information about enabling Protocol Discovery	"Enabling Protocol Discovery" module
Configuring NBAR using the MQC	"Configuring NBAR Using the MQC" module
Adding application recognition modules (also known as PDLMs)	"Adding Application Recognition Modules" module

Technical Assistance

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

Feature Information for NBAR2 Custom Protocol

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 16: Feature Information for NBAR2 Custom Protocol

Feature Name	Releases	Feature Information
NBAR2 Custom Protocol	Cisco IOS XE Release 3.8S	This feature was introduced on Cisco ASR 1000 series Aggregation Services Routers. The following command was introduced or modified: **ip nbar custom**
NBAR2 Custom Protocol Enhancements Ph II	Cisco IOS XE Release 3.12S	The NBAR2 Custom Protocol Enhancements Phase II feature enables supporting an IP subnet or a list of IP addresses with a specific TCP or UDP transport. The following command was introduced or modified: **ip nbar custom**

CHAPTER 12

NBAR2 Protocol Pack Hitless Upgrade

The NBAR2 Protocol Pack Hitless Upgrade feature enables users to seamlessly upgrade a Network-Based Application Recognition (NBAR) protocol pack or change the NBAR configurations without impacting any of the current classification configurations on a device.

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 NBAR2 Protocol Pack Hitless Upgrade

Additional memory is required to support the NBAR2 Protocol Pack Hitless Upgrade feature because it holds together two configurations until the previous configuration is aged.

Information About NBAR2 Protocol Pack Hitless Upgrade

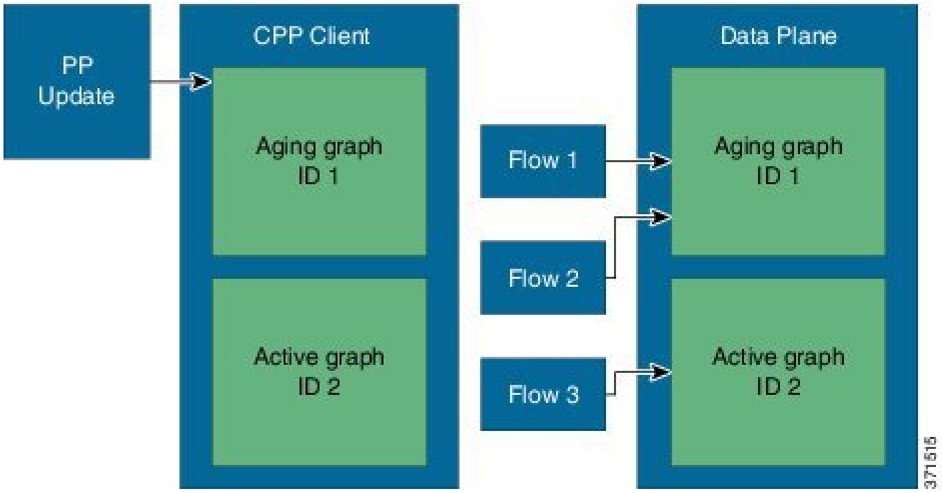
Overview of NBAR2 PP Hitless Upgrade

Hitless Upgrade is the method to upgrade the NBAR2 Protocol Pack (PP) components on an NBAR engine without incurring any service downtime. In earlier Cisco IOS software releases, NBAR could hold only a single configuration graph on the control plane client that is transferred to the data path. From Cisco IOS XE Release 3.12S onward, NBAR can hold several configurations graphs at a single time. When a new configuration change occurs, a new configuration graph is created on the control plane client. The new graph is downloaded to the data plane, and all new flows are directed to the new graph.

If a packet arrives from a flow that was being classified, the packet is directed to the correct configuration graph (the one that was active when the flow was created).

The following illustration displays the NBAR system state after a configuration or protocol pack update:

Figure 3: Aging a Graph



In the illustration above, when a new graph is created, the old graph is moved to the aging state. In an aged state, only flows that are associated with the graph are referenced with the graph. If a flow is not classified until aging time, it is reported as unknown by NBAR.

Note Due to memory limitations, it is important to limit the number of parallel existing graphs and aging graphs in the NBAR system. Currently, all platforms can hold a maximum two configurations at a given time.

Use the **show platform software nbar statistics** command to view the status of NBAR.

Benefits of NBAR2 Protocol Pack Hitless Upgrade

NBAR2 Protocol Pack Hitless Upgrade provides the following benefits:

- No loss of information for classified flows during a protocol upgrade

- No impact on new flows
- No impact on in-progress flows

Additional References for NBAR2 Protocol Pack Hitless Upgrade

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
NBAR Protocol Pack	*QoS: NBAR Configuration Guide*

Technical Assistance

Description	Link
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.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for NBAR2 Protocol Pack Hitless Upgrade

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 17: Feature Information for NBAR2 Protocol Pack Hitless Upgrade

Feature Name	Releases	Feature Information
NBAR2 Protocol Pack Hitless Upgrade	Cisco IOS XE Release 3.12S	The NBAR2 Protocol Pack Hitless Upgrade feature enables seamless upgrade of a NBAR protocol pack or NBAR configurations without impacting any of the current classification configurations on a device. In Cisco IOS XE Release 3.12S, support was added for the Cisco ASR 1000 Series Routers.

CHAPTER 13

NBAR Web-based Custom Protocols

The NBAR Web-based Custom Protocols feature provides the mechanism to define custom protocols to match based on HTTP URL and/or host name.

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 NBAR Web-based Custom Protocols

The HTTP URL and the Host name defined for custom protocol match should be unique. The length of the protocol name should be at least 4 characters long and the prefix of the protocol name should be different from the prefixes of any other protocol name.

Information About NBAR Web-based Custom Protocols

Overview of NBAR Web-based Custom Protocols

The NBAR Web-based Custom Protocols feature provides the mechanism to define custom protocols to match the traffic based on HTTP URL and/or host name.

All 120 custom protocols can be defined to match based on HTTP URL and/or host name. While matching web-based custom protocols, the custom protocol that has both HTTP URL and the host name defined has the highest priority, followed by HTTP URL as the second priority, and then followed by Host name as the last priority. Matching a web-based sub-protocol has higher priority than matching any type of web-based custom protocol, for example the **match protocol** *http url http-url* command has a higher priority than a custom priority with the same URL configuration.

How to Define NBAR Web-based Custom Protocols Match

Defining a Web-based Custom Protocol Match

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nbar custom** *custom-protocol-name* **http** {**host** *host-name* | **url** *http-url* [**host** *host-name*]} [**id** *selector-id*]
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ip nbar custom** *custom-protocol-name* **http** {**host** *host-name* | **url** *http-url* [**host** *host-name*]} [**id** *selector-id*]	Defines web-based custom protocol match.

	Command or Action	Purpose
	Example: `Router(config)# ip nbar custom app_sales1 http url www.example.com`	• Enter the custom protocol name and any other optional keywords and arguments. **Note** To add a custom protocol, use the **ip nbar custom** command. To enable the protolcol, use the **match protocol** command or **ip nbar protocol discovery** command.

Step 4	**end**
	Example:
	`Router(config)# end`
		(Optional) Exits global configuration mode.

Configuration Examples for NBAR Web-based Custom Protocols

Examples: Defining Web-based Custom Protocol Match

The following example displays how to match a custom protocol based on http url:

```
Router> enable
Router# configure terminal
Router(config)# ip nbar custom app_sales1 http url www.example.com
```

The following example displays how to match a custom protocol that contains the string 'example' as a part of host name:

```
Router> enable
Router# configure terminal
Router(config)# ip nbar custom app_sales1 http host *example*
```

Additional References for NBAR Web-based Custom Protocols

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
Custom Protocols	*Creating a Custom Protocol* module

Technical Assistance

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

Feature Information for NBAR Web-based Custom Protocols

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 18: Feature Information for NBAR Web-based Custom Protocols

Feature Name	Releases	Feature Information
NBAR Web-based Custom Protocols Scalability	Cisco IOS XE Release 3.13S	The NBAR Web-based Custom Protocols Scalability feature enables defining custom protocols match based on http host name and/or url. The following command was introduced or modified: **ip nbar custom**.

CHAPTER 14

NBAR2 HTTP-Based Visibility Dashboard

The NBAR2 HTTP-based Visibility Dashboard feature provides the functionality of graphical representation of traffic in a network.

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 NBAR2 HTTP-Based Visibility Dashboard

Overview of NBAR2 HTTP-Based Visibility Dashboard

With the NBAR HTTP-based Visibility Dashboard feature, you can have better visibility of the traffic and thereby have a good understanding of the requirement of a network.

After you enable the NBAR HTTP-based Visibility Dashboard feature on the router, a periodic task is created, which collects the NBAR discovery data per minute and stores the data in a database. This feature also provides an option to see the statistics over a defined period of time (for example, last 24 hours), which is the window size. Based on the window sizes (which are 2hr, 24hr, and 48hr window sizes), a WEB application is created, which you can access using the HTTP server utility option in the device. The Web application helps to view the NBAR data in a graphical way including interactive charts and a bandwidth graph for each window size.

How to Configure NBAR2 HTTP-Based Visibility Dashboard

Configuring NBAR2 HTTP-Based Visibility Dashboard

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nbar http-services**

DETAILED STEPS

	Command or Action	Purpose
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	**ip nbar http-services** **Example:** `Device(config)# ip nbar http-services`	Configures the http services for a periodic task that collects the NBAR discovery data every minute and stores the data in a 48hr database.

Configuration Examples for NBAR2 HTTP-Based Visibility Dashboard

Example: NBAR2 HTTP-Based Visibility Dashboard

Example: Enabling NBAR2 HTTP-Services

```
Device> enable
Device# configure terminal
Device(config)# ip nbar http-services
Device(config)# end
```

Accessing the NBAR2 HTTP-based Visibility Dashboard

Accessing the Visibility Dashboard

To access the dashboard, enter one of the following in a browser with access to the router:

- **http://<Router-IP-address>/flash/nbar2/home.html**
- **http://<Router-Hostname>/flash/nbar2/home.html** (if the router hostname has been defined)

Example:

```
http://192.168.0.1/flash/nbar2/home.html
```

Additional References for NBAR2 HTTP-Based Visibility Dashboard

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
Cisco IOS QoS configuration information	QoS Configuration Guide

Technical Assistance

Description	Link
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.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for NBAR2 HTTP-Based Visibility Dashboard

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 19: Feature Information for NBAR2 HTTP-Based Visibility Dashboard

Feature Name	Releases	Feature Information
NBAR2 HTTP-Based Visibility Dashboard	Cisco IOS XE Release 3.16S	The NBAR2 HTTP-based Visibility Dashboard feature provides the functionality of graphical representation of traffic in a network. The following command was modified or introduced by this feature: **ip nbar http-services** .

CHAPTER 15

NBAR Coarse-Grain Classification

NBAR provides two levels of application recognition—coarse-grain and fine-grain. In the Cisco IOS XE Release 3.14S, by default NBAR operates in the fine-grain mode, offering NBAR's full application recognition capabilities. By minimizing deep packet inspection, coarse-grain mode offers a performance advantage and reduces memory resource demands.

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 NBAR Coarse-Grain Classification

Overview of NBAR Coarse-Grain Classification

NBAR provides two levels of application recognition-coarse-grain and fine-grain. By default NBAR operates in the fine-grain mode, offering NBAR's full application recognition capabilities. The default NBAR fine-grain mode is equivalent to NBAR functionality and performance prior to introduction of separate fine-grain and coarse-grain modes. This provides full backward compatibility for existing configurations.

By minimizing deep packet inspection, coarse-grain mode offers a performance advantage and reduces memory resource demands. This mode is be used in scenarios where the full power of fine-grain classification is not required. We recommend that you use fine-grained mode when per-packet reporting is required. When specific per-packet reporting is not required, use the coarse-grained mode, as it offers performance and memory advantages.

Simplified Classification

Coarse-grain mode employs a simplified mode of classification, minimizing deep packet inspection. NBAR caches classification decisions made for earlier packets, then classifies later packets from the same server similarly.

Classification by First Packet

Most flows are classified based on the first packet of the flow, even in the case of a IP Synchronization (SYN) packet, because no payload inspection is performed. Consequently, policies apply to the entire flow rather than depending on the payload.

Limitations of Coarse-Grain Mode

Coarse-grain mode has the following limitations in metric reporting detail:

Field extraction and sub-classification—Only partially supported. In coarse-grain mode, the reported results of field extraction and sub-classification are less accurate and may be sampled.

Granularity—Caching may result in some reduction in the granularity. For example, NBAR might classify some traffic as **ms-office-365** instead of as the more specific **ms-office-web-apps**.

Evasive applications—Classification of evasive applications such as BitTorrent, eMule, and Skype, may be less effective than in fine-grain mode which is the default NBAR. Consequently, blocking or throttling may not work as well for these applications.

Comparison of Fine-grain and Coarse-grain Modes

Coarse-grain mode has the following limitations in metric reporting detail:

	Fine-Grain Mode	Coarse-Grain Mode
Classification	Full-power of deep packet inspection	Simplified classification Some classification according to similar earlier packets.
Performance	Slower	Faster
Memory Resources	Higher memory demands	Lower memory demands

	Fine-Grain Mode	Coarse-Grain Mode
Sub-classification	Full supported	Partial support
Field Extraction	Full supported	Partial support
Ideal usage	Per-packet policy Example: class-map that looks for specific url	When there is no requirement for specific per-packet operations.

How to Configure NBAR Coarse-Grain Classification

Configuring the NBAR Classification Modes

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nbar classification granularity coarse-grain**
4. **exit**
5. **end**

DETAILED STEPS

	Command or Action	Purpose
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	**ip nbar classification granularity coarse-grain** **Example:** `Device(config)# ip nbar classification granularity coarse-grain`	Configures the coarse-grain NBAR classification mode.

	Command or Action	Purpose
Step 4	**exit** **Example:** `Device(config)# exit`	Exits the global configuration mode and enters privileged EXEC mode.

Step 5	**end**
	Example:
	`Device(config-if)# end`
		Returns to privileged EXEC mode.

Configuring a Performance Monitor Context with Application Statistics

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **performance monitor context** *context-name* **coarse-grain***profile-name*
4. **traffic-monitor application-client-server-stats**
5. **exit**
6. **interface** *type slot/port/number*
7. **performance monitor context** *context-name*
8. **end**
9. **show ip nbar classification granularity**

DETAILED STEPS

	Command or Action	Purpose
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	**performance monitor context** *context-name* **coarse-grain***profile-name* **Example:** `Device (config)# performance monitor context xyz profile application-statistics`	Enters performance monitor configuration mode, and creates a context with application-statistics profile.

	Command or Action	Purpose
		Note Configuring an Easy Performance Monitor (ezPM) policy using the Application Statistics profile implicitly invokes the coarse-grain Network Based Application Recognition (NBAR) classification mode. However, if you need to configure fine-grain NBAR classification mode, use the **ip nbar classification granularity fine-grain** command after configuring the performance monitor context with application statistics profile.
Step 4	**traffic-monitor application-client-server-stats** **Example:** `Device(config-perf-mon)# traffic-monitor application-client-server-stats`	Configures the traffic monitor to monitor the specified metrics.
Step 5	**exit** **Example:** `Device(config-perf-mon)# exit`	Exits performance monitor configuration mode and enters global configuration mode.
Step 6	**interface** *type slot*/*port*/*number* **Example:** `Device(config)# interfcace 0/2/2`	Enters interface configuration mode.
Step 7	**performance monitor context** *context-name* **Example:** `Device (config-if)# performance monitor context xyz`	Configures the specified performance monitor context on the interface.

Step 8	**end**
	Example:
	`Device(config-if)# end`
		Returns to privileged EXEC mode.

Step 9	**show ip nbar classification granularity** **Example:** `Device# show ip nbar classification granularity`	Displays the currently configured NBAR classification mode.

Configuration Examples for NBAR Coarse-Grain Classification

Example: Configuring the NBAR Classification Mode

The following example shows how to configure the coarse-grain classification mode of NBAR:

```
Device> enable
Device# configure terminal
Device (config)# ip nbar classification granularity coarse-grain
Device (config)# end
```

Example: Configuring a Performance Monitor Context with Application Statistics Profile

The following example shows how to configure an Easy Performance Monitor (ezPM) policy using the Application Statistics profile and invoke coarse-grain NBAR classification mode:

```
Device> enable
Device# configure terminal
Device(config)# performance monitor context xyz profile application-statistics
Device(config-perf-mon)# traffic-monitor application-client-server-stats
Device(config-perf-mon)# exit
Device(config)# interface gigabitEthernet 0/2/2
Device(config-if)# performance monitor context xyz
Device(config-if)# end
```

Example: Configuring a Performance Monitor Context with Application Statistics Profile and Force-configure Fine-Grain NBAR Classification Mode

The following example shows how to configure an ezPM policy using the Application Statistics profile and to force-configure fine-grain NBAR classification mode:

```
Device> enable
Device# configure terminal
Device(config)# performance monitor context xyz profile application-statistics
Device(config-perf-mon)# traffic-monitor application-client-server-stats
Device(config-perf-mon)# exit
Device(config)# interface gigabitEthernet 0/2/2
Device(config-if)# performance monitor context xyz
Device(config-if)# end
Device (config)# ip nbar classification granularity fine-grain
```

Example: Verifying the NBAR Classification Mode

The following example shows how to verify the currently configured NBAR Classification Mode:

```
Device # show ip nbar classification granularity

NBAR classification granularity mode: coarse-grain
```

Additional References for NBAR Coarse-Grain Classification

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
AVC Configuration	AVC Configuration module

Technical Assistance

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

Feature Information for NBAR Coarse-Grain Classification

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 20: Feature Information for NBAR Coarse-Grain Classification

Feature Name	Releases	Feature Information
NBAR Coarse-Grain Classification	Cisco IOS XE Release 3.14S	Network Based Application Recognition (NBAR) provides two levels of application recognition—coarse-grain and fine-grain. By default NBAR operates in the fine-grain mode, offering NBAR's full application recognition capabilities. By minimizing deep packet inspection, coarse-grain mode offers a performance advantage and reduces memory resource demands. The following command was introduced or modified: **ip nbar classification granularity** and **show ip nbar classification granularity**.

CHAPTER 16

SSL Custom Application

SSL Custom Application feature enables users to customize applications that run on any protocol over Secure Socket Layer (SSL), including HTTP over Secure Socket Layer (HTTPS), using the server name, if it exists in the Client Hello extensions, or the common name from the certificate that the server sends to the client.

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 SSL Custom Application

Overview of SSL Custom Application

SSL Custom Application feature enables users to customize applications that run on any protocol over Secure Socket Layer (SSL), including HTTP over Secure Socket Layer (HTTPS), using the server name, if it exists in the Client Hello extensions, or the common name from the certificate that the server sends to the client.

HTTP over Secure Socket Layer (HTTPS) is a communication protocol for secure communication. HTTPS is the result of layering HTTP on SSL protocol.

In SSL sub-classification, the rule that ends later in the packet will match. For example, consider the server name ‘finance.example.com’, if there is a rule for ‘finance’ and another rule for example.com, then the rule for ‘example.com’ will match.

SSL Unique Name Sub-Classification

The SSL unique-name parameter is used to match SSL sessions of servers that are not known globally, or are not yet supported by NBAR. The unique-name matches the server name indication (SNI) field in the client request, if the SNI field exists, or it matches the common name (CN) field in the first certificate of the server's response.

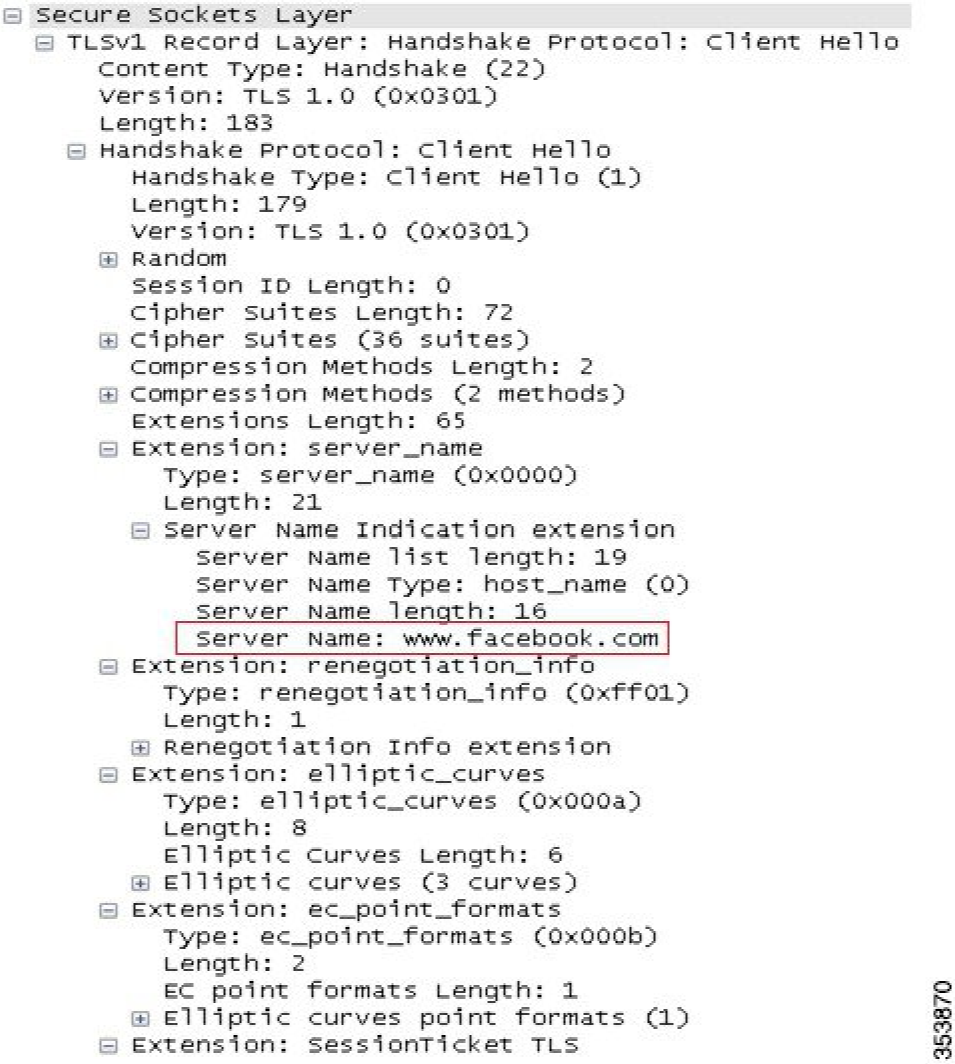
The feature also supports cases of SSL sessions that use session-id than the SSL sessions that use handshake.

The server name is available as part of a HTTPS URL itself. For example, in the URL https://www.facebook.com, the server name is www.facebook.com. However, the certificate is found in the browser. The user can observe the certificate information by clicking on the HTTPS icon.

The following two figures display the location of the server name and common name as it is visible to the user using Wireshark tool.

The figure below highlights the location of the SNI field:

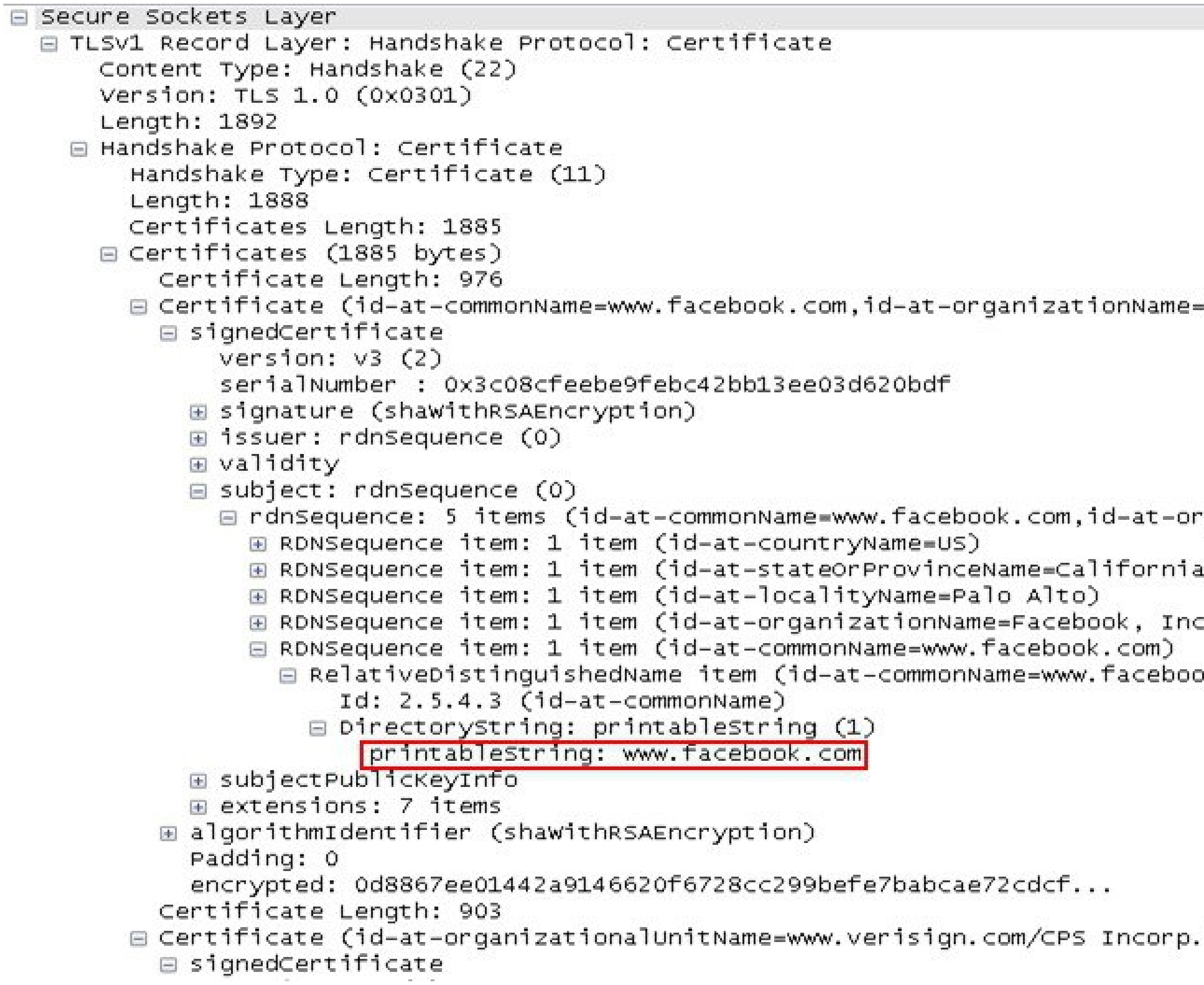
Figure 4: Server Name Indication Field



```
⊟ Secure Sockets Layer
  ⊟ TLSv1 Record Layer: Handshake Protocol: Client Hello
      Content Type: Handshake (22)
      Version: TLS 1.0 (0x0301)
      Length: 183
    ⊟ Handshake Protocol: Client Hello
        Handshake Type: Client Hello (1)
        Length: 179
        Version: TLS 1.0 (0x0301)
      ⊞ Random
        Session ID Length: 0
        Cipher Suites Length: 72
      ⊞ Cipher Suites (36 suites)
        Compression Methods Length: 2
      ⊞ Compression Methods (2 methods)
        Extensions Length: 65
      ⊟ Extension: server_name
          Type: server_name (0x0000)
          Length: 21
        ⊟ Server Name Indication extension
            Server Name list length: 19
            Server Name Type: host_name (0)
            Server Name length: 16
            Server Name: www.facebook.com
      ⊟ Extension: renegotiation_info
          Type: renegotiation_info (0xff01)
          Length: 1
        ⊞ Renegotiation Info extension
      ⊟ Extension: elliptic_curves
          Type: elliptic_curves (0x000a)
          Length: 8
          Elliptic Curves Length: 6
        ⊞ Elliptic curves (3 curves)
      ⊟ Extension: ec_point_formats
          Type: ec_point_formats (0x000b)
          Length: 2
          EC point formats Length: 1
        ⊞ Elliptic curves point formats (1)
      ⊟ Extension: SessionTicket TLS
```

The figure below highlights the location of the CN field:

Figure 5: Common Name Field



```
⊟ Secure Sockets Layer
  ⊟ TLSv1 Record Layer: Handshake Protocol: Certificate
      Content Type: Handshake (22)
      Version: TLS 1.0 (0x0301)
      Length: 1892
    ⊟ Handshake Protocol: Certificate
        Handshake Type: Certificate (11)
        Length: 1888
        Certificates Length: 1885
      ⊟ Certificates (1885 bytes)
          Certificate Length: 976
        ⊟ Certificate (id-at-commonName=www.facebook.com,id-at-organizationName=
          ⊟ signedCertificate
              version: v3 (2)
              serialNumber : 0x3c08cfeebe9febc42bb13ee03d620bdf
            ⊞ signature (shaWithRSAEncryption)
            ⊞ issuer: rdnSequence (0)
            ⊞ validity
            ⊟ subject: rdnSequence (0)
              ⊟ rdnSequence: 5 items (id-at-commonName=www.facebook.com,id-at-or
                ⊞ RDNSequence item: 1 item (id-at-countryName=US)
                ⊞ RDNSequence item: 1 item (id-at-stateOrProvinceName=California
                ⊞ RDNSequence item: 1 item (id-at-localityName=Palo Alto)
                ⊞ RDNSequence item: 1 item (id-at-organizationName=Facebook, Inc
                ⊟ RDNSequence item: 1 item (id-at-commonName=www.facebook.com)
                  ⊟ RelativeDistinguishedName item (id-at-commonName=www.facebo
                      Id: 2.5.4.3 (id-at-commonName)
                    ⊟ DirectoryString: printableString (1)
                        printableString: www.facebook.com
            ⊞ subjectPublicKeyInfo
            ⊞ extensions: 7 items
          ⊞ algorithmIdentifier (shaWithRSAEncryption)
            Padding: 0
            encrypted: 0d8867ee01442a9146620f6728cc299befe7babcae72cdcf...
          Certificate Length: 903
        ⊟ Certificate (id-at-organizationalUnitName=www.verisign.com/CPS Incorp.
          ⊟ signedCertificate
```

How to Configure SSL Custom Application

Configuring SSL Custom Application

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nbar custom** *custom-protocol-name* **ssl unique-name** *regex* **id** *selector-id*
4. **end**

DETAILED STEPS

	Command or Action	Purpose
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	**ip nbar custom** *custom-protocol-name* **ssl unique-name** *regex* **id** *selector-id* **Example:** `Device (config)# ip nbar custom name ssl unique-name www.example.com id  11`	Defines the SSL-based custom protocol match and provides a hostname in the form of a regular expression. **Note** The hostname that is configured in this command is found either in the Server Name Indication (SNI) field in the Client Hello extensions or in the Common Name (CN) field in the digital certificate that the server sends to the client.

Step 4	**end**
	Example:
	`Router(config)# end`
		(Optional) Exits global configuration mode.

Configuration Examples for the SSL Custom Application

Example: SSL Custom Applications

The following example displays how to configure SSL Custom Application. The hostname that is configured in this command is found either in the Server Name Indication (SNI) field in the Client Hello extensions or in the Common Name (CN) field in the digital certificate that the server sends to the client.

```
Device> enable
Device# configuration terminal
Device(config)# ip nbar custom name ssl unique-name  www.example.com id  11
Device(config)# exit
```

Additional References for SSL Custom Application

Related Documents for SSL Custom Application

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
SSL Sub-classification	NBAR Protocol Pack module

Technical Assistance

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

Feature Information for SSL Custom Application

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 21: Feature Information for SSL Custom Application

Feature Name	Releases	Feature Information
SSL Custom Application	Cisco IOS XE Release 3.15S	SSL Custom Application feature enables users to customize applications that run on any protocol over Secure Socket Layer (SSL), including HTTP over Secure Socket Layer (HTTPS), using the server name, if it exists in the Client Hello extensions, or the common name from the certificate that the server sends to the client. The following command was introduced or modified: **ip nbar custom**.

CHAPTER 17

Fine-Grain NBAR for Selective Applications

By default NBAR operates in the fine-grain mode, offering NBAR's full application recognition capabilities. Used when per-packet reporting is required, fine-grain mode offers a troubleshooting advantage. Cisco recommends using fine-grain mode only when detailed Layer 7 metrics is required to be extracted by NBAR for critical applications. The Fine-Grain NBAR for Selective Applications feature enables a customer to dynamically monitor critical applications including collection of detailed Layer 7 metrics. The feature helps troubleshoot slowness in a particular application while the rest of the applications are running in coarse-grain mode and thus preventing any impact on the performance of the system.

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 Fine-Grain NBAR for Selective Applications

Overview of Fine-Grain NBAR for Selective Applications

NBAR provides two levels of application recognition-coarse-grain and fine-grain. By default NBAR operates in the fine-grain mode, offering NBAR's full application recognition capabilities. The default NBAR fine-grain mode is equivalent to NBAR functionality and performance prior to introduction of separate fine-grain and coarse-grain modes. This provides full backward compatibility for existing configurations.

Used when per-packet reporting is required, fine-grain mode offers a troubleshooting advantage. Cisco recommends using fine-grain mode only when detailed Layer 7 metrics is required to be extracted by NBAR for critical applications. The fine-grain NBAR for Selective Applications feature enables a customer to dynamically monitor critical applications including collection of detailed Layer 7 metrics. The feature helps troubleshoot slowness in a particular application while the rest of the applications are running in in coarse-grain mode and thus preventing any impact on the performance of the system.

How to Configure Fine-Grain NBAR for Selective Applications

Configuring Fine-Grain NBAR for Selective Applications

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nbar classification granularity fine-grain protocol** *protocol-name*
4. **exit**
5. **show ip nbar classification granularity protocol** *protocol-name*

DETAILED STEPS

	Command or Action	Purpose
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.

	Command or Action	Purpose
Step 3	**ip nbar classification granularity fine-grain protocol** *protocol-name* **Example:** `Device(config)# ip nbar classification granularity fine-grain protocol 3pc`	Configures the fine-grain NBAR classification mode and specifies the protocol name which represents an application.
Step 4	**exit** **Example:** `Router(config)# exit`	Exits the global configuration mode and enters privileged EXEC mode.
Step 5	**show ip nbar classification granularity protocol** *protocol-name* **Example:** `Device(config)# show ip nbar classification granularity protocol 3pc`	Displays the currently configured NBAR classification mode.

Configuration Examples for Fine-Grained NBAR for Selective Applications

Example: Fine-Grain NBAR for Selective Applications

The following example shows how to configure the fine-grain classification mode of NBAR and select a protocol name that represents an application:

```
Device> enable
Device# configuration terminal
Device(config)# ip nbar classification granularity fine-grain protocol 3cp
Device(config)# exit
```

Example: Verifying the Fine-Grain NBAR for Selective Applications

The following example shows how to verify the classification granularity of the currently configured protocol:

```
Device # show ip nbar classification granularity protocol 3pc

Protocol                  Force mode
-------------------------------------
3pc                       fine-grain
```

Additional References for Fine-Grain NBAR for Selective Applications

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
AVC Configuration	AVC Configuration module

Technical Assistance

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

Feature Information for Fine-Grain NBAR for Selective Applications

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 22: Feature Information for Fine-Grain NBAR for Selective Applications

Feature Name	Releases	Feature Information
Fine-Grain NBAR for Selective Applications	Cisco IOS XE Release 3.15S	By default NBAR operates in the fine-grain mode, offering NBAR's full application recognition capabilities. Used when per-packet reporting is required, fine-grain mode offers a troubleshooting advantage. Cisco recommends using fine-grain mode only when detailed Layer 7 metrics is required to be extracted by NBAR for critical applications. The fine-grain NBAR for Selective Applications feature enables a customer to dynamically monitor critical applications including collection of detailed Layer 7 metrics. The feature helps troubleshoot slowness in a particular application while the rest of the applications are running in coarse-grain mode and thus preventing any impact on the performance of the system. The following command was introduced or modified: **ip nbar custom**.

CHAPTER 18

NBAR Custom Applications Based on DNS Name

NBAR Custom Applications based on DNS Name feature provides the mechanism to customize applications based on the Domain Name System (DNS) hostnames.

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 NBAR Custom Applications Based on DNS Name

You must have basic knowledge of domain names.

Restrictions for NBAR Custom Applications Based on DNS Name

To use Domain Name System (DNS), you must have a DNS name server on your network.

DNS permits reading of UDP type messages only and considers only those response packets which have a source port of 53.

Information About NBAR Custom Applications Based on DNS Name

Overview of NBAR Custom Applications Based on DNS Name

Network-Based Application Recognition (NBAR) recognizes and classifies network traffic on the basis of a set of protocols and application types. The user adds to the set of protocols and application types that NBAR recognizes by creating custom protocols.

The user provides the DNS hostname signatures using the**ip nbar custom** *custom1 dns domain-name regular-expression id* command in the form of a simplified regular expression, which the DNS server pushes to the DNS templates. The DNS-based classification functions only when the IP addresses derived as direct responses are added to the look up table (LUT) for future classification lookups.

The following types of domains are supported:

- A
- AAAA
- CNAME

When you define the **ip nbar custom myDns dns domain-name** **example* command, the DNS traffic for a domain name that matches the expression "example" reaches the device. NBAR stores the corresponding IP address A.B.C.D of domain that matches the domain name with the expression "example" in its tables. When any TCP or UDP traffic with IP address A.B.C.D arrives, it is classified as myDns protocol.

How to Configure NBAR Custom Applications Based on DNS Name

Configuring the NBAR Custom Applications Based on DNS Name

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nbar custom** *custom-name* **dns** *domain-name regular-expression* **id** *1*
4. **exit**

DETAILED STEPS

	Command or Action	Purpose
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	**ip nbar custom** *custom-name* **dns** *domain-name regular-expression* **id** *1* **Example:** `Device(config)# ip nbar custom cust1 dns dns-name *example.com id 1`	Configures the NBAR Custom Applications Based on DNS Name feature. **Note** You can provide either the full domain name or a part of it as a regular expression. For example: the expression “*example” will match any domain that contains the word “example”.
Step 4	**exit** **Example:** `Device(config)# exit`	Exits the global configuration mode and enters privileged EXEC mode.

Configuration Examples for NBAR Custom Applications Based on DNS Name

Example: Configuring NBAR Custom Applications Based on DNS Name

```
Device> enable
Device# configure terminal
Device(config)#  ip nbar custom custom1 dns domain-name *example id 11
Device(config)# exit
```

Additional References for NBAR Custom Applications Based on DNS Name

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases

Technical Assistance

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

Feature Information for NBAR Custom Applications Based on DNS Name

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 23: Feature Information for NBAR Custom Applications Based on DNS Name

Feature Name	Releases	Feature Information
NBAR Custom Applications Based on DNS Name	Cisco IOS XE Release 3.15S	NBAR custom applications based on Domain Name Service (DNS) Name feature provides the mechanism to customize applications based on the DNS hostnames. The following command was introduced or modified: **ip nbar custom**.

CHAPTER 19

NBAR Customized Assistance Based on SSL or HTTP

NBAR Customized Assistance based on SSL or HTTP feature enables the user to customize Secure Sockets Layer (SSL) traffic based on the hostname that is found either in the Server Name field in the Client Hello extensions or in the Common Name field in the digital certificate that the client sends to the server, and to customize HTTP traffic based on signatures that have hostnames.

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.

NBAR Customized Assistance Based on SSL or HTTP Overview

Network-Based Application Recognition (NBAR) supports the use of custom protocols to identify custom applications. Custom protocols support static port-based protocols and applications that NBAR does not support. NBAR Customized Assistance based on SSL or HTTP feature enables the user to customize Secure Sockets Layer (SSL) traffic based on the hostname that is found either in the Server Name field in the Client

Hello extensions or in the Common Name field in the digital certificate that the client sends to the server and to customize HTTP traffic based on signatures that have hostnames.

How to configure NBAR Customization Assistance Based on SSL or HTTP

Configuring NBAR Customized Assistance based on SSL or HTTP

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nbar classification auto-learn** [**top-hosts** | **top-ports**]
4. **ip nbar classification auto-learn top-portssample-rate** *N*
5. **exit**
6. **show ip nbar classification auto-learn** [**top-hosts** | **top-ports**] *N*[Detailed]
7. **clear ip nbar classification auto-learn** [**top-hosts** | **top-ports**] *statistics*
8. **clear ip nbar classification auto-learn top-hosts restart**

DETAILED STEPS

	Command or Action	Purpose
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	**ip nbar classification auto-learn** [**top-hosts** | **top-ports**]
	Example:
	`Device (config)# ip nbar classification auto-learn top-hosts`
	`Device (config)# ip nbar classification auto-learn top-ports`
		• (Optional) Enables Network Based Application Recognition's (NBAR's) ability to reveal the top hosts in the network traffic that is classified as generic.
		• (Optional) Enables Network Based Application Recognition's (NBAR's) ability to reveal the list of top server-side ports in the network traffic that is classified as generic.

	Command or Action	Purpose
Step 4	**ip nbar classification auto-learn top-portssample-rate** *N* **Example:** `Device (config)# ip nbar classification auto-learn top-ports sample-rate 5`	(Optional) Enables Network Based Application Recognition's (NBAR's) ability to change the sampling rate of top server-side ports in the network traffic.
Step 5	**exit** **Example:** `Device(config)# exit`	Exits global configuration mode.

Step 6	**show ip nbar classification auto-learn** [**top-hosts** | **top-ports**] *N*[Detailed]
	Example:
	`Device# show ip nbar classification auto-learn top-hosts 10 detailed`
	`Device# show ip nbar classification auto-learn top-ports 25`
		Prints the detailed output from the top hosts.
		Displays the statistics and database of the top hosts that are classified as generic and ports as unknown.

Step 7	**clear ip nbar classification auto-learn** [**top-hosts** | **top-ports**] *statistics*
	Example:
	`Device# clear ip nbar classification auto-learn top-hosts statistics`
	`Device# clear ip nbar classification auto-learn top-ports statistics`
		• Clears the display of statistics and database of the top hosts of the network traffic classified as generic.
		• Clears the statistics of top-ports of the network traffic classified as unknown, however, the top-ports database remains unchanged.

Step 8	**clear ip nbar classification auto-learn top-hosts restart** **Example:** `Device# clear ip nbar classification auto-learn top-ports restart`	Clears the display of top-ports statistics and database of traffic classified as unknown.

Configuration Examples for NBAR Customized Assistance Based on SSL or HTTP

Example: Configuring NBAR Customized Assistance Based on SSL or HTTP

```
Device> enable
Device# configuration terminal
Device (config)# ip nbar classification auto-learn top-hosts
Device (config)# exit
```

Additional References for NBAR Customized Assistance Based on SSL or HTTP

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	Cisco IOS Quality of Service Solutions Command Reference

Technical Assistance

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

Feature Information for NBAR Customization Assistance Based on SSL or HTTP

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 24: Feature Information for NBAR Customization Assistance Based on SSL or HTTP

Feature Name	Releases	Feature Information
Show unclassified port stats	Cisco IOS XE Release 3.16S	NBAR Customized Assistance based on SSL or HTTP feature enables the user to customize Secure Sockets Layer (SSL) traffic based on the ports that is found either in the Server Name field in the Client Hello extensions or in the Common Name field in the digital certificate that the client sends to the server, and to customize HTTP traffic based on signatures that have port names. The following commands were introduced or modified: **ip nbar classification auto-learn top-ports**, **ip nbar classification auto-learn top-ports sample-rate**, **show ip nbar classification auto-learn top-ports**, **clear ip nbar classification auto-learn top-ports restart**, and **clear ip nbar classification auto-learn top-ports statistics**