Security Configuration Guide: Zone-Based Policy Firewall Cisco IOS Release 12.4T

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Zone-Based Policy Firewall

This module describes the Cisco IOS unidirectional firewall policy between groups of interfaces known as zones. Prior to the release of Cisco IOS unidirectional firewall policy, Cisco IOS firewalls were configured as an inspect rule only on interfaces. Traffic entering or leaving the configured interface was inspected based on the direction that the inspect rule was applied.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

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 Zone-Based Policy Firewall

- Before you create zones, you must consider what should constitute zones. The general guideline is that you should group interfaces that are similar when they are viewed from a security perspective.
- The Wide Area Application Services (WAAS) and Cisco IOS firewall interoperability capability applies only on the Cisco IOS Zone-Based Policy Firewall feature in Release 12.4(11)T2 and later releases. The Cisco IOS firewall that preceded Cisco IOS Release 12.4(11)T2 does not incorporate the Cisco WAAS interoperability enhancement.

Restrictions for Zone-Based Policy Firewall

- If a configuration includes both security zones and inspect rules on interfaces (the old methodology), the configuration may work, but that type of configuration is not recommend.
- The cumulative counters in the **show policy-map type inspect zone-pair** command output do not increment for **match** statements in a nested class-map configuration in Cisco IOS Releases 12.4(20)T and 12.4(15)T. The problem with the counters exists regardless of whether the top level class map uses the **match-any** or **match-all** keyword. For more information, see "Example: Protocol Match Data Not Incrementing for a Class Map, page 74."
- In Cisco IOS Release 12.4(15)T, if the Simple Mail Transfer Protocol (SMTP) is configured for inspection in a class map and you need to configure the Extended Simple Mail Transfer Protocol (ESMTP) for inspection, then the **no match protocol smtp** command must be entered before adding the **match protocol smtp extended** command. To revert to regular SMTP inspection, use the **no match protocol smtp extended** command and then enter the **match protocol smtp** command. If these commands are not configured in the proper order, the following error is displayed:
  ```
  %Cannot add this filter. Remove match protocol smtp filter and then add this filter.
  ```
- In a WAAS and Cisco IOS firewall configuration, all packets processed by a Wide Area Application Engine (WAE) device must go over the Cisco IOS firewall in both directions to support the Web Cache Coordination Protocol (WCCP). This situation occurs because the Layer 2 redirect is not available in Cisco IOS Release 12.4T. If Layer 2 redirect is configured on the WAE, the system defaults to the generic routing encapsulation (GRE) redirect to continue to function.
- When an in-to-out zone-based policy is configured to match the Internet Control Message Protocol (ICMP) on a Windows system, the **traceroute** command works. However, the same configuration on an Apple system does not work because it uses a UDP-based traceroute. To overcome this issue, configure an out-to-in zone-based policy with the **icmp time-exceeded** and **icmp host unreachable** commands with the **pass** command (not the **inspect** command).
- In a WAAS and Cisco IOS firewall configuration, WCCP does not support traffic redirection using policy-based routing (PBR).
- Stateful inspection support for multicast traffic is not supported between any zones, including the self zone. Use Control Plane Policing for protection of the control plane against multicast traffic.
- A UDP-based traceroute is not supported through ICMP inspection.
- To allow GRE and Encapsulating Security Payload (ESP) protocol traffic through a zone-based policy firewall, you must use the **pass** command. The GRE and ESP protocols do not support stateful inspection and if you use the **inspect** command, the traffic for these protocols is dropped.

Information About Zone-Based Policy Firewall

Top-Level Class Maps and Policy Maps

Top-level class maps allow you to identify the traffic stream at a high level. This is accomplished by using the **match access-group** and **match protocol** commands. Top-level class maps are also referred to as Layer 3 and Layer 4 class maps.

Top-level policy maps allow you to define high-level actions by using the **inspect**, **drop**, **pass**, and **urlfilter** keywords. You can attach maps to a target (zone pair).

Note Only inspect type policies can be configured on a zone pair.

Application-Specific Class Maps and Policy Maps

Application-specific class maps allow you to identify traffic based on the attributes of a given protocol. All the match conditions in these class maps are specific to an application (for example, HTTP or SMTP). Application-specific class maps are identified by an additional subtype that generally is the protocol name (HTTP or SMTP) in addition to the type **inspect**.

Application-specific policy maps are used to specify a policy for an application protocol. For example, if you want to drop HTTP traffic with Unique Resource Identifier (URI) lengths exceeding 256 bytes, you must configure an HTTP policy map to do that. Application-specific policy maps cannot be attached directly to a target (zone pair). They must be configured as “child” policies in a top-level Layer 3 or Layer 4 policy map.

Overview of Zones

A zone is a group of interfaces that have similar functions or features. Zones provide a way for you to specify where a Cisco IOS firewall is applied.

For example, on a router, Gigabit Ethernet interface 0/0/0 and Gigabit Ethernet interface 0/0/1 may be connected to the local LAN. These two interfaces are similar because they represent the internal network, so they can be grouped into a zone for firewall configurations.

By default, the traffic between interfaces in the same zone is not subjected to any policy. The traffic passes freely. Firewall zones are used for security features.

Note Zones may not span interfaces in different VPN routing and forwarding (VRF) instances.

When a zone-based policy firewall is enabled for TCP keepalive traffic and the host behind the firewall is undergoing an ungraceful disconnect, TCP keepalive works only when the configured TCP timeout is complete. On receiving an out-of-window reset (RST) packet, the firewall sends an empty acknowledge

(ACK) packet to the initiator of the RST packet. This ACK has the current sequence (SEQ) and the ACK number from the firewall session. On receiving this ACK, the client sends an RST packet with the SEQ number that is equal to the ACK number in the ACK packet. The firewall processes this RST packet, clears the firewall session, and passes the RST packet.

Security Zones

A security zone is a group of interfaces to which a policy can be applied.

Grouping interfaces into zones involves two procedures:

- Creating a zone so that interfaces can be attached to it.
- Configuring an interface to be a member of a given zone.

By default, traffic flows among interfaces that are members of the same zone.

When an interface is a member of a security zone, all traffic (except traffic going to the router or initiated by the router) between that interface and an interface within a different zone is dropped by default. To permit traffic to and from a zone-member interface and another interface, you must make that zone part of a zone pair and apply a policy to that zone pair. If the policy permits traffic (through **inspect** or **pass** actions), traffic can flow through the interface.

Basic rules to consider when setting up zones are as follows:

- Traffic from a zone interface to a nonzone interface or from a nonzone interface to a zone interface is always dropped; unless default zones are enabled (default zone is a nonzone interface).
- Traffic between two zone interfaces is inspected if there is a zone-pair relationship for each zone and if there is a configured policy for that zone pair.
- By default, all traffic between two interfaces in the same zone is always allowed.
- A zone pair can be configured with a zone as both the source and the destination zones. An inspect policy can be configured on this zone pair to inspect or drop the traffic between two interfaces in the same zone.

A policy is applied to the initiating packet of a traffic flow. After the initial packet has been classified and permitted, traffic flows between peers with no further reclassification of the packet (this means that bidirectional traffic flow is allowed after the initial classification). If you have a zone pair between Zone Z1 and Zone Z2, and no zone pair between Zone Z2 and Zone Z1, all traffic that is initiated from Zone Z2 is blocked. Traffic from Zone Z1 to Zone Z2 is permitted or denied based on the zone pair policy.

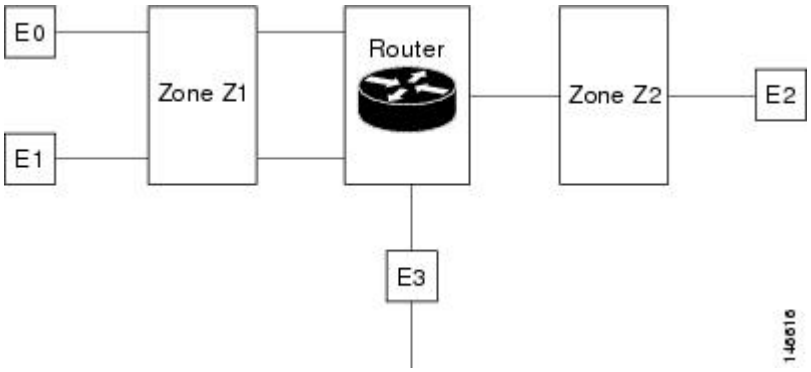
For traffic to flow among all the interfaces in a router, all interfaces must be members of security zones or the default zone.

It is not necessary for all router interfaces to be members of security zones.

The figure below illustrates the following:

- Interfaces E0 and E1 are members of security zone Z1.
- Interface E2 is a member of security zone Z2.
- Interface E3 is not a member of any security zone.

Figure 1 Security Zone Restrictions



The following situations exist:

- The zone pair and policy are configured in the same zone. If no policy is configured for Z1 and Z2, traffic will flow freely between E0 and E1, but not between E0 or E1 to E2. A zone pair and policy may be created to inspect this traffic.
- If no policies are configured, traffic will not flow between any other interfaces (for example, E0 and E2, E1 and E2, E3 and E1, and E3 and E2).
- Traffic can flow between E0 or E1 and E2 only when an explicit policy permitting traffic is configured between zone Z1 and zone Z2.
- Traffic can never flow between E3 and E0/E1/E2 unless default zones are enabled and a zone-pair is created between the default zone and the other zones.

- Virtual Interfaces as Members of Security Zones, page 5

Virtual Interfaces as Members of Security Zones

A virtual template interface is a logical interface configured with generic configuration information for a specific purpose or for a configuration common to specific users, plus router-dependent information. The template contains Cisco IOS software interface commands that are applied to virtual access interfaces. To configure a virtual template interface, use the **interface virtual-template** command.

Zone member information is acquired from a RADIUS server and the dynamically created interface is made a member of that zone.

The **zone-member security** command adds the dynamic interface into the corresponding zone.

Zone Pairs

A zone pair allows you to specify a unidirectional firewall policy between two security zones.

To define a zone pair, use the **zone-pair security** command. The direction of the traffic is specified by a source and destination zone. The source and destination zones of a zone pair must be security zones.

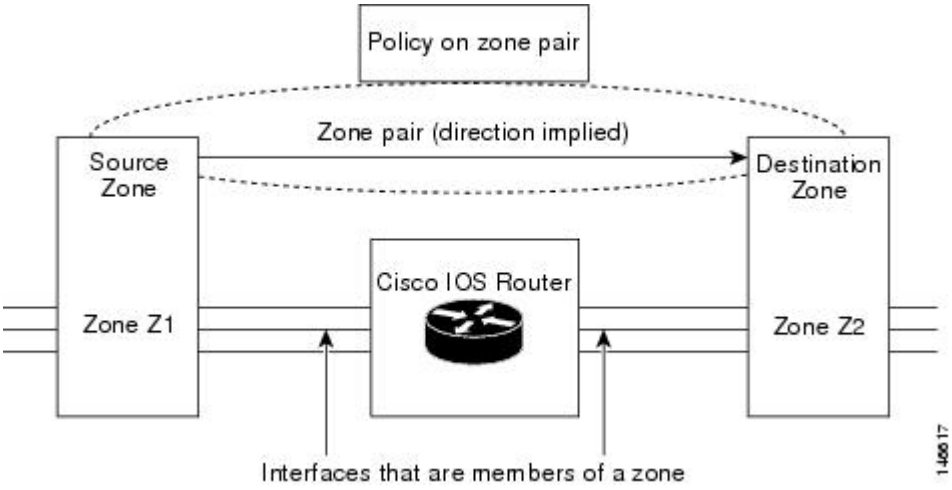
You can select the default or self zone as either the source or the destination zone. The self zone is a system-defined zone. It does not have any interfaces as members. A zone pair that includes the self zone, along with the associated policy, applies to traffic directed to the router or traffic generated by the router. It does not apply to traffic through the router.

The most common usage of firewalls is to apply them to traffic through a router, so you need at least two zones (that is, you cannot use the self zone).

To permit traffic between zone-member interfaces, you must configure a policy permitting (or inspecting) traffic between that zone and another zone. To attach a firewall policy map to the target zone pair, use the **service-policy type inspect** command.

The figure below shows the application of a firewall policy to traffic flowing from zone Z1 to zone Z2, which means that the ingress interface for the traffic is a member of zone Z1 and the egress interface is a member of zone Z2.

Figure 2 Zone Pairs



If there are two zones and you require policies for traffic going in both directions (from Z1 to Z2 and Z2 to Z1), you must configure two zone pairs (one for each direction).

If a policy is not configured between a pair of zones, traffic is dropped. However, it is not necessary to configure a zone pair and a service policy solely for the return traffic. By default, return traffic is not allowed. If a service policy inspects the traffic in the forward direction and there is no zone pair and service policy for the return traffic, the return traffic is inspected. If a service policy passes the traffic in the forward direction and there is no zone pair and service policy for the return traffic, the return traffic is dropped. In both these cases, you need to configure a zone pair and a service policy to allow the return traffic. In the above figure, it is not mandatory that you configure a zone pair source and destination solely for allowing return traffic from Z2 to Z1. The service policy on the Z1 to Z2 zone pair takes care of it.

Zones and Inspection

Zone-based policy firewalls examine the source and destination zones from the ingress and egress interfaces for a firewall policy. It is not necessary that all traffic flowing to or from an interface be inspected; you can designate that individual flows in a zone pair be inspected through your policy map that you apply across the zone pair. The policy map will contain class maps that specify the individual flows.

You can also configure **inspect** parameters like TCP thresholds and timeouts on a per-flow basis.

Zones and ACLs

Access Control Lists (ACLs) applied to interfaces that are members of zones are processed before the policy is applied on the zone pair. You must make sure that interface ACLs do not interfere with the policy firewall traffic when there are policies between zones.

Pinholes (are ports opened through a firewall that allows applications controlled access to a protected network) are not punched for return traffic in interface ACLs.

Zones and VRF-Aware Firewalls

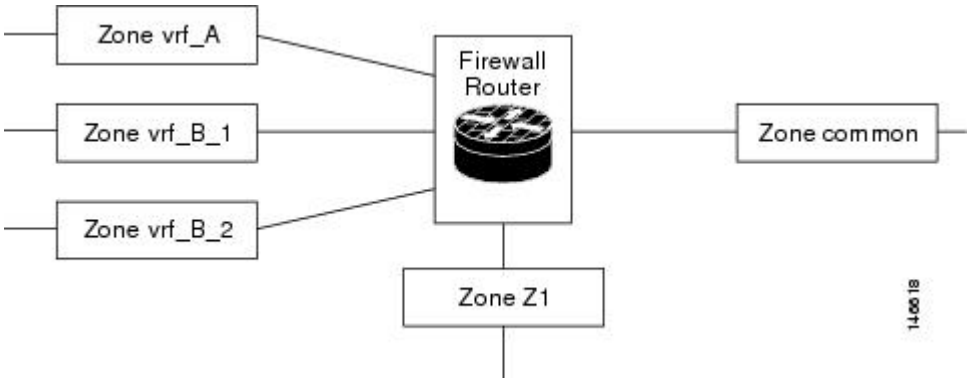
The Cisco IOS firewall is VPN routing and forwarding (VRF)-aware. It handles IP address overlap across different VRFs, separate thresholds, and timeouts for VRFs. All interfaces in a zone must belong to the same VRF.

However, you should not group interfaces from different VRFs in the same zone because VRFs belong to different entities that typically have their own policies.

You can configure a zone pair between two zones that contain different VRFs, as shown in the figure below.

When multiple VRFs are configured on a router and an interface provides common services to all the VRFs (for example, Internet service), you should place that interface in a separate zone. You can then define policies between the common zone and other zones. (There can be one or more zones per VRF.)

Figure 3 Zones and VRF



In the figure above, the interface providing common services is a member of the zone “common.” All of VRF A is in a single zone, vrf_A. VRF B, which has multiple interfaces, is partitioned into multiple zones vrf_B_1 and vrf_B_2. Zone Z1 does not have VRF interfaces. You can specify policies between each of these zones and the common zone. Additionally, you can specify polices between each of the zones vrf_A, vrf_B_n, and Z1 if VRF route export is configured and the traffic patterns make sense. You can configure a policy between zones vrf_A and vrf_B_1, but you have to make sure that traffic can flow between them.

There is no need to specify the global thresholds and timers on a per-VRF basis. Instead, parameters are supplied to the **inspect** action through a parameter map.

Zones and Transparent Firewalls

The Cisco IOS firewall supports transparent firewalls where the interfaces are placed in bridging mode and IP firewalling is performed on the bridged traffic.

To configure a transparent firewall, use the **bridge** command to enable the bridging of a specified protocol in a specified bridge and the **zone-member security** command to attach an interface to a zone. The **bridge** command on the interface indicates that the interface is in bridging mode.

A bridged interface can be a member of a zone. In a typical case, the Layer 2 domain is partitioned into zones and a policy is applied the same way as for Layer 3 interfaces.

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Transparent Firewall Restriction for P2P Inspection

The Cisco IOS firewall uses network-based application recognition (NBAR) for peer-to-peer (P2P) protocol classification and policy enforcement. NBAR is not available for bridged packets; thus, P2P packet inspection is not supported for firewalls with transparent bridging.

Overview of Security Zone Firewall Policies

A class is a way of identifying a set of packets based on its contents. Normally you define a class so that you can apply an action on the identified traffic that reflects a policy. A class is designated through class maps.

An action is a specific functionality that is typically associated with a traffic class. For example, **inspect**, **drop**, and **pass** are actions.

To create firewall policies, you should complete the following tasks:

- Define a match criterion (class map).
- Associate actions to the match criterion (policy map).
- Attach the policy map to a zone pair (service policy).

The **class-map** command creates a class map to be used for matching packets to a specified class. Packets arriving at the targets (such as the input interface, output interface, or zone pair), that are determined by how the **service-policy** command is configured, are checked against match criteria configured for a class map to determine if the packet belongs to that class.

The **policy-map** command creates or modifies a policy map that can be attached to one or more targets to specify a service policy. Use the **policy-map** command to specify the name of the policy map to be created, added to, or modified before you can configure policies for classes whose match criteria are defined in a class map.

Class Maps and Policy Maps for Zone-Based Policy Firewalls

Quality of service (QoS) class maps have numerous match criteria; firewalls have fewer match criteria. Firewall class maps have the type inspect and this information controls what shows up under firewall class maps.

A policy is an association of traffic classes and actions. It specifies what actions should be performed on defined traffic classes. An action is a specific function, and it is typically associated with a traffic class. For example, **inspect** and **drop** are actions.

- Layer 3 and Layer 4 Class Maps and Policy Maps, page 8
- Layer 7 Class Maps and Policy Maps, page 10
- Class-Default Class Map, page 11
- Hierarchical Policy Maps, page 11

Layer 3 and Layer 4 Class Maps and Policy Maps

Layer 3 and Layer 4 class maps are used to identify traffic streams on which different actions should be performed.

A Layer 3 or Layer 4 policy map is sufficient for the basic inspection of traffic.

The following example shows how to configure class map c1 with the match criteria of ACL 101 and the HTTP protocol, and create an inspect policy map named p1 to specify that packets will be dropped on the traffic at c1:

```
Router(config)# class-map type inspect match-all c1

Router(config-cmap)# match access-group 101
Router(config-cmap)# match protocol http

Router(config)# policy-map type inspect p1

Router(config-pmap)# class type inspect c1

Router(config-pmap-c)# drop
```

To create a Layer 3 or Layer 4 policy, see the "Configuring Layer 7 Protocol-Specific Firewall Policies, page 31"section.

- Class-Map Configuration Restriction, page 9
- Rate Limiting (Policing) Traffic Within a Layer 3 and Layer 4 Policy Map, page 9

Class-Map Configuration Restriction

If a traffic meets multiple match criteria, these match criteria must be applied in the order of specific to less specific. For example, consider the following class map example:

```
class-map type inspect match-any my-test-cmap
 match protocol http
 match protocol tcp
```

In this example, HTTP traffic must first encounter the **match protocol http** command to ensure that the traffic is handled by the service-specific capabilities of HTTP inspection. If the "match" lines are reversed, and the traffic encounters the **match protocol tcp** command before it is compared to the **match protocol http** command, the traffic would be classified as TCP traffic and inspected according to the capabilities of the firewall's TCP inspection component. This configuration would be a problem for services such as FTP and TFTP, and for multimedia and voice signaling services such as H.323, Real Time Streaming Protocol (RTSP), Session Initiation Protocol (SIP), and Skinny. These services require additional inspection capabilities to recognize the more complex activities.

Rate Limiting (Policing) Traffic Within a Layer 3 and Layer 4 Policy Map

In Cisco IOS Release 12.4(9)T and later releases, you can use the **police** command within an inspect policy to limit the number of concurrent connections allowed for applications such as Instant Messenger and P2P.

To effectively use the **police** command, you must enable Cisco IOS stateful packet inspection within the inspect policy map. If you configure the **police** command without configuring the **inspect** command, you will receive an error message and the **police** command will be rejected.

Compatibility with Existing Police Actions

Police actions provisioned in a modular QoS CLI (MQC) policy map are applied as input and output policies on an interface. An inspect policy map can be applied only to a zone pair, not to an interface. The police action will be enforced on traffic that traverses the zone pair. (The direction of the traffic is inherent to the specification of the zone pair.) Thus, a QoS policy containing a police action can be present on interfaces that make up a zone pair and a police action can be present in an inspect policy map applied across the zone pair. If both police actions are configured, the zone pair police action is executed after the input interface police action, but before the output interface police action. There is no interaction between QoS and the inspect police actions.

Police Restrictions

- The police action is not allowed in policies that are attached to zone pairs involving a “self” zone. Use Control Plane Policing if you want to perform this task.
- Policing can be specified only in Layer 3 and Layer 4 policy maps; it cannot be specified in Layer 7 policy maps.

Layer 7 Class Maps and Policy Maps

Layer 7 class maps can be used in inspect policy maps only for deep packet inspection (DPI). The DPI functionality is delivered through Layer 7 class maps and policy maps.

To create a Layer 7 class map, use the **class-map type inspect** command for the desired protocol. For example, for the HTTP protocol, enter the **class-map type inspect http** command.

The type of class map (for example, HTTP) determines the match criteria that you can use. For example, if you want to specify HTTP traffic that contains Java applets, you must specify a “match response body java” statement in the context of an “inspect HTTP” class map.

A Layer 7 policy map provides application-level inspection of traffic. The policy map can include class maps only of the same type.

To create a Layer 7 policy map, specify the protocol in the **policy-map type inspect** command. For example, to create a Layer 7 HTTP policy map, use the **policy-map type inspect http** *policy-map-name* command. Enter the name of the HTTP policy-map for the *policy-map-name* argument.

If you do not specify a protocol name (for example, if you use the **policy-map type inspect** command), you will be creating a Layer 3 or Layer 4 policy map, which can only be an inspect type policy map.

A Layer 7 policy map must be contained in a Layer 3 or Layer 4 policy map; it cannot be attached directly to a target. To attach a Layer 7 policy map to a top-level policy map, use the **service-policy** command and specify the application name (that is, HTTP, Internet Message Access Protocol [IMAP], Post Office Protocol 3 [POP3], Simple Mail Transfer Protocol [SMTP], or SUN Remote Procedure Call [SUNRPC]). The parent class for a Layer 7 policy should have an explicit match criterion that match only one Layer 7 protocol before the policy is attached.

If the Layer 7 policy map is in a lower level, you must specify the **inspect** action at the parent level for a Layer 7 policy map.

- Layer 7 Supported Protocols, page 10

Layer 7 Supported Protocols

You can create Layer 7 class maps and policy maps for the following protocols:

- America Online (AOL) Instant Messenger (IM) protocol
- eDonkey P2P protocol
- FastTrack traffic P2P protocol
- Gnutella Version 2 traffic P2P protocol
- H.323 VoIP Protocol Version 4
- HTTP—The protocol used by web browsers and web servers to transfer files, such as text and graphic files
- Internet Message Access Protocol (IMAP)—Method of accessing e-mail or bulletin board messages kept on a mail server that can be shared
- I Seek You (ICQ) IM protocol
- Kazaa Version 2 P2P protocol

- MSN Messenger IM protocol
- Post Office Protocol, Version 3 (POP3)—Protocol that client e-mail applications use to retrieve mail from a mail server
- SIP—Session Initiation Protocol (SIP)
- SMTP—Simple Network Management Protocol
- SUNRPC—Sun RPC (Remote Procedure Call)
- Windows Messenger IM Protocol
- Yahoo IM protocol

For information on configuring a Layer 7 class map and policy map (policies), see the "Configuring Layer 7 Protocol-Specific Firewall Policies, page 31" section.

Class-Default Class Map

In addition to user-defined classes, a system-defined class map named class-default represents all packets that do not match any of the user-defined classes in a policy. The class-default class is always the last class in a policy map.

You can define explicit actions for the group of packets that do not match any of the user-defined classes. If you do not configure any actions for the class-default class in an inspect policy, the default action is **drop**.

Note For a class-default in an inspect policy, you can configure only **drop** action or **pass** action.

The following example shows how to use class-default in a policy map. In this example, HTTP traffic is dropped and the remaining traffic is inspected. Class map c1 is defined for HTTP traffic, and class-default is used for a policy map p1.

```
Router(config)# class-map type inspect match-all c1
Router(config-cmap)# match protocol http
Router(config)# policy-map type inspect p1
Router(config-pmap)# class type inspect c1
Router(config-pmap-c)# drop
Router(config-pmap)# class class-default
Router(config-pmap-c)# drop
```

Hierarchical Policy Maps

A policy can be nested within a policy. A policy that contains a nested policy is called a hierarchical policy.

To create a hierarchical policy, attach a policy directly to a class of traffic. A hierarchical policy contains a child and a parent policy. The child policy is the previously defined policy that is associated with the new policy through the use of the **service-policy** command. The new policy using the preexisting policy is the parent policy.

Note There can be a maximum of two levels in a hierarchical inspect service policy.

Parameter Maps

A parameter map allows you to specify parameters that control the behavior of actions and match criteria specified under a policy map and a class map, respectively.

There are three types of parameter maps:

- Inspect parameter map

An inspect parameter map is optional. If you do not configure a parameter map, the software uses default parameters. Parameters associated with the inspect action apply to all nested actions (if any). If parameters are specified in both the top and lower levels, the parameters in the lower levels override those in the top levels.

- URL Filter parameter map

A parameter map is required for URL filtering (through the URL filter action in a Layer 3 or Layer 4 policy map and the URL filter parameter map).

- Protocol-specific parameter map

A parameter map that is required for an Instant Messenger application (Layer 7) policy map.

Firewall and Network Address Translation

Network Address Translation (NAT) enables private IP internetworks that use nonregistered IP addresses to connect to the Internet. NAT operates on a router, usually connecting two networks, and translates the private (not globally unique) addresses in the internal network into legal addresses before packets are forwarded onto another network. NAT can be configured to advertise only one address for the entire network to the outside world. A router configured with NAT will have at least one interface to the inside network and one to the outside network.

In a typical environment, NAT is configured at the exit router between a stub domain and the backbone. When a packet leaves the domain, NAT translates the locally significant source address into a globally unique address. When a packet enters the domain, NAT translates the globally unique destination address into a local address. If more than one exit point exists, each NAT must have the same translation table. If the software cannot allocate an address because it has run out of addresses, it drops the packet and sends an ICMP host unreachable packet.

With reference to NAT, the term “inside” refers to those networks that are owned by an organization and that must be translated. Inside this domain, hosts will have addresses in one address space. When NAT is configured and when the hosts are outside, hosts will appear to have addresses in another address space. The inside address space is referred to as the local address space and the outside address space is referred to as the global address space.

Consider a scenario where NAT translates both the source and the destination IP addresses. A packet is sent to a router from inside NAT with the source address 192.168.1.1 and the destination address 10.1.1.1. NAT translates these addresses and sends the packet to the external network with the source address 209.165.200.225 and the destination address 209.165.200.224.

Similarly, when the response comes back from outside NAT, the source address will be 209.165.200.225 and the destination address will be 209.165.200.224. Therefore, inside NAT, the packets will have a source address of 10.1.1.1 and a destination address of 192.168.1.1.

In this scenario, if you want to create an Application Control Engine (ACE) to be used in a firewall policy, the pre-NAT IP addresses (also known as inside local and outside global addresses) 192.168.1.1 and 209.165.200.224 must be used.

WAAS Support for the Cisco IOS Firewall

The WAAS firewall software, which was introduced in Cisco IOS Release 12.4(15)T, provides an integrated firewall that optimizes security-compliant WANs and application acceleration solutions with the following benefits:

- Optimizes a WAN through full stateful inspection capabilities.
- Simplifies Payment Card Industry (PCI) compliance.
- Protects transparent WAN accelerated traffic.
- Integrates WAAS networks transparently.
- Supports the Network Management Equipment (NME) WAE modules or standalone WAAS device deployment.

WAAS has an automatic discovery mechanism that uses TCP options during the initial three-way handshake used to identify WAE devices transparently. After automatic discovery, optimized traffic flows (paths) experience a change in the TCP sequence number to allow endpoints to distinguish between optimized and nonoptimized traffic flows.

Note Paths are synonymous with connections.

WAAS allows the Cisco IOS firewall to automatically discover optimized traffic by enabling the sequence number to change without compromising the stateful Layer 4 inspection of TCP traffic flows that contain internal firewall TCP state variables. These variables are adjusted for the presence of WAE devices.

If the Cisco IOS firewall notices that a traffic flow has successfully completed WAAS automatic discovery, it permits the initial sequence number shift for the traffic flow and maintains the Layer 4 state on the optimized traffic flow.

Note Stateful Layer 7 inspection on the client side can also be performed on nonoptimized traffic.

- WAAS Traffic Flow Optimization Deployment Scenarios, page 13

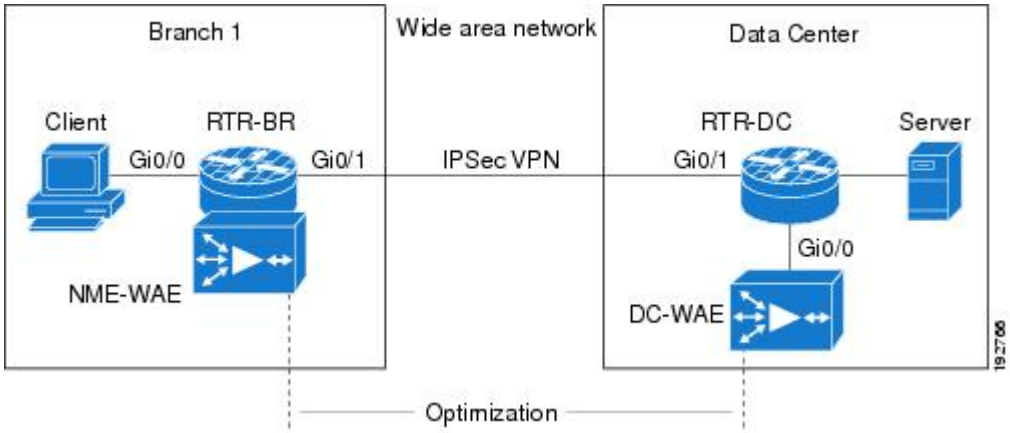
WAAS Traffic Flow Optimization Deployment Scenarios

The following sections describe two different WAAS traffic flow optimization scenarios for branch office deployments. WAAS traffic flow optimization works with the Cisco IOS firewall feature on a Cisco Integrated Services Router (ISR).

The figure below shows an example of an end-to-end WAAS traffic flow optimization with the Cisco IOS firewall. In this particular deployment, an Network Modules (NME)-WAE device is on the same router as

the Cisco IOS firewall. Web Cache Communication Protocol (WCCP) is used to redirect traffic for interception.

Figure 4 End-to-End WAAS Optimization Path



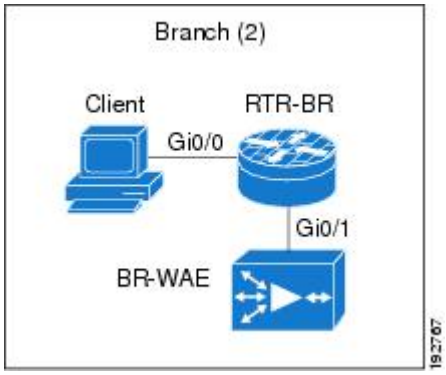
- WAAS Branch Deployment with an Off-Path Device, page 14
- WAAS Branch Deployment with an Inline Device, page 14

WAAS Branch Deployment with an Off-Path Device

A WAE device can be either an NME-WAE that is installed on an ISR as an integrated service engine (as shown in WAAS Branch Deployment with an Off-Path Device) or a standalone WAE device.

The figure below shows a WAAS branch deployment that uses WCCP to redirect traffic to an off-path, standalone WAE device for traffic interception. The configuration for this option is the same as the WAAS branch deployment with an NME-WAE.

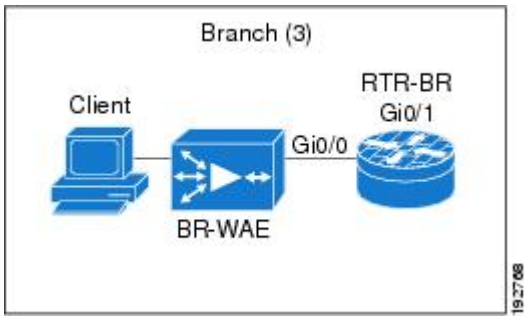
Figure 5 WAAS Off-Path Branch Deployment



WAAS Branch Deployment with an Inline Device

The figure below shows a WAAS branch deployment that has an inline WAE device that is physically in front of the ISR router. Because the WAE device is in front of the router, the Cisco IOS firewall receives WAAS optimized packets and hence, Layer 7 inspection on the client side is not supported.

Figure 6 WAAS Inline Path Branch Deployment



An edge WAAS device with the Cisco IOS firewall is applied at branch office sites that must inspect the traffic moving to and from a WAN connection. The Cisco IOS firewall monitors traffic for optimization indicators (TCP options and subsequent TCP sequence number changes) and allows optimized traffic to pass, while still applying Layer 4 stateful inspection and deep packet inspection to all traffic and maintaining security while accommodating WAAS optimization advantages.

Note If the WAE device is in the inline location, the device enters its bypass mode after the automatic discovery process. Although the router is not directly involved in WAAS optimization, the router must be aware that WAAS optimization is applied to the traffic in order to apply the Cisco IOS firewall inspection to network traffic and make allowances for optimization activity if optimization indicators are present.

Out-of-Order Packet Processing Support in the Zone-Based Firewall Application

Out-of-Order (OoO) packet processing support for Common Classification Engine (CCE) firewall application and CCE adoptions of the Intrusion Prevention System (IPS) allows for packets that arrive out of order to be copied and reassembled in the correct order. The OoO packet processing reduces the need to retransmit dropped packets and reduces the bandwidth needed for transmission on a network. To configure OoO support, use the **parameter-map type ooo global** command.

Note IPS sessions use OoO parameters that are configured using the **parameter-map type ooo global** command.

Note OoO processing is not supported in SMTP because SMTP supports masking actions that require packet modification.

OoO packet processing support is enabled by default when a Layer 7 policy is configured for DPI for the following protocols:

- AOL IM protocol
- eDonkey P2P protocol

- FastTrack traffic P2P protocol
- Gnutella Version 2 traffic P2P protocol
- H.323 VoIP Protocol Version 4
- HTTP—The protocol used by web browsers and web servers to transfer files, such as text and graphic files
- IMAP—Method of accessing e-mail or bulletin board messages kept on a mail server that can be shared
- ICQ IM Protocol
- Kazaa Version 2 P2P protocol
- Match Protocol SIP—Match Protocol SIP
- MSN Messenger IM protocol
- POP3—Protocol that client e-mail applications use to retrieve mail from a mail server
- SUNRPC—Sun RPC
- Windows Messenger IM Protocol
- Yahoo IM protocol

For information on configuring a Layer 7 class map and policy map (policies), see the "Configuring Layer 7 Protocol-Specific Firewall Policies, page 31" section.

Note OoO packets are dropped when IPS and zone-based policy firewall with L4 inspection are enabled.

Intrazone Support in the Zone-Based Firewall Application

Intrazone support allows a zone configuration to include users both inside and outside a network. Intrazone support allows traffic inspection between users belonging to the same zone but different networks. Before Cisco IOS Release 15.0(1)M, traffic within a zone was allowed to pass uninspected by default. To configure a zone pair definition with the same zone for source and destination, use the **zone-pair security** command. This allows the functionality of attaching a policy map and inspecting the traffic within the same zone.

How to Configure Zone-Based Policy Firewall

Configuring Layer 3 and Layer 4 Firewall Policies

Layer 3 and Layer 4 policies are "top level" policies that are attached to the target (zone pair). Use the following tasks to configure Layer 3 and Layer 4 firewall policies:

Configuring a Class Map for a Layer 3 and Layer 4 Firewall Policy

Use this task to configure a class map for classifying network traffic.

Note You must perform at least one match step from Step 4, 5, or 6.

When packets are matched to an access group, protocol, or class map, a traffic rate is generated for these packets. In a zone-based firewall policy, only the first packet that creates a session matches the policy. Subsequent packets in this flow do not match the filters in the configured policy, but instead match the session directly. The statistics related to subsequent packets are shown as part of the inspect action.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect** [**match-any** | **match-all**] *class-map-name*
4. **match access-group** {*access-group* | **name** *access-group-name*}
5. **match protocol** *protocol-name* [**signature**]
6. **match class-map** *class-map-name*
7. **exit**
8. **show policy-map type inspect zone-pair session**

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 type inspect** [**match-any** | **match-all**] *class-map-name* **Example:** `Router(config)# class-map type inspect match-all c1`	Creates a Layer 3 or Layer 4 inspect type class map and enters QoS class-map configuration mode.

	Command or Action	Purpose
Step 4	**match access-group** {*access-group* | **name** *access-group-name*} **Example:** `Router(config-cmap)# match access-group 101`	Configures the match criterion for a class map based on the ACL name or number.
Step 5	**match protocol** *protocol-name* [**signature**] **Example:** `Router(config-cmap)# match protocol http`	Configures the match criterion for a class map on the basis of a specified protocol. • Only Cisco IOS stateful packet inspection-supported protocols can be used as match criteria in inspect type class maps. • **signature**—Signature-based classification for P2P packets is enabled.
Step 6	**match class-map** *class-map-name* **Example:** `Router(config-cmap)# match class-map c1`	Specifies a previously defined class as the match criteria for a class map.
Step 7	**exit** **Example:** `Router(config-cmap)# end`	Exits QoS class-map configuration mode and enters privileged EXEC mode.
Step 8	**show policy-map type inspect zone-pair session** **Example:** `Router(config-cmap)# show policy-map type inspect zone-pair session`	(Optional) Displays the Cisco IOS stateful packet inspection sessions created because of the policy-map application on the specified zone pair. **Note** The information displayed under the class-map field is the traffic rate (bits per second) of the traffic that belongs to the connection-initiating traffic only. Unless the connection setup rate is significantly high and is sustained for multiple intervals over which the rate is computed, no significant data is shown for the connection.

Creating a Policy Map for a Layer 3 and Layer 4 Firewall Policy

Use this task to create a policy map for a Layer 3 and Layer 4 firewall policy that will be attached to zone pairs.

Note If you are creating an inspect type policy map, note that only the following actions are allowed: drop, inspect, police, pass, service-policy, and urlfilter.

Note You must perform at least one step from Step 5, 8, 9, or 10.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map type inspect** *policy-map-name*
4. **class type inspect** *class-name*
5. **inspect** [*parameter-map-name*]
6. **police rate bps burst** *size*
7. **drop** [**log**]
8. **pass**
9. **service-policy type inspect** *policy-map-name*
10. **urlfilter** *parameter-map-name*
11. **exit**

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 type inspect** *policy-map-name* **Example:** `Router(config)# policy-map type inspect p1`	Creates a Layer 3 and Layer 4 inspect type policy map and enters QoS policy-map configuration mode.
Step 4	**class type inspect** *class-name* **Example:** `Router(config-pmap)# class type inspect c1`	Specifies the traffic (class) on which an action is to be performed.

	Command or Action	Purpose
Step 5	**inspect** [*parameter-map-name*] **Example:** `Router(config-pmap-c)# inspect inspect-params`	Enables Cisco IOS stateful packet inspection.
Step 6	**police rate bps burst** *size* **Example:** `Router(config-pmap-c)# police rate 2000 burst 3000`	(Optional) Limits traffic matching within a firewall (inspect) policy.
Step 7	**drop** [**log**] **Example:** `Router(config-pmap-c)# drop`	(Optional) Drops packets that are matched with the defined class. **Note** The actions **drop** and **pass** are exclusive, and the actions **inspect** and **drop** are exclusive; that is, you cannot specify both of them.
Step 8	**pass** **Example:** `Router(config-pmap-c)# pass`	(Optional) Allows packets that are matched with the defined class.
Step 9	**service-policy type inspect** *policy-map-name* **Example:** `Router(config-pmap-c)# service-policy type inspect p1`	Attaches a firewall policy map to a zone pair.
Step 10	**urlfilter** *parameter-map-name* **Example:** `Router(config-pmap-c)# urlfilter param1`	(Optional) Enables Cisco IOS firewall URL filtering.
Step 11	**exit** **Example:** `Router(config-pmap-c)# exit`	Returns to QoS policy-map configuration mode.

Configuring a Parameter Map

Depending on your policy, you can configure either an inspect, URL filter, or protocol-specific type parameter map. If you are configuring a URL filter type or protocol-specific type policy, you must configure a parameter map, as appropriate. However, a parameter map is optional if you are using an inspect type policy.

Note Changes to the parameter map are not reflected on connections already established through the firewall. Changes are applicable only to new connections permitted to the firewall. To ensure that your firewall enforces policies strictly, clear all the connections allowed in the firewall after you change the parameter map. To clear existing connections, use the **clear zone-pair inspect sessions** command.

Use one of the following tasks to configure a parameter map:

- Creating an Inspect Parameter Map, page 21
- Creating a URL Filter Parameter Map, page 24
- Configuring a Layer 7 Protocol-Specific Parameter Map, page 27
- Configuring OoO Packet Processing Support in the Zone-Based Firewall Applications, page 28
- Configuring Intrazone Support in the Zone-Based Firewall Applications, page 30

Creating an Inspect Parameter Map

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **parameter-map type inspect** {*parameter-map-name* | **global** | **default**}
4. **log** {**dropped-packets** {**disable** | **enable**} | **summary** [**flows** *number*] [**time-interval** *seconds*]}
5. **alert** {**on** | **off**}
6. **audit-trail** {**on** | **off**}
7. **dns-timeout** *seconds*
8. **icmp idle-timeout** *seconds*
9. **max-incomplete** {**low** | **high**} {*number-of-connections*}
10. **one-minute** {**low** | **high**} *number-of-connections*
11. **sessions maximum** *sessions*
12. **tcp finwait-time** *seconds*
13. **tcp idle-time** *seconds*
14. **tcp max-incomplete host** *threshold* [**block-time** *minutes*]
15. **tcp synwait-time** *seconds*
16. **tcp window-scale-enforcement loose**
17. **udp idle-time** *seconds*
18. **exit**

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	**parameter-map type inspect** {*parameter-map-name* | **global** | **default**} **Example:** `Router(config)# parameter-map type inspect eng-network-profile`	Configures an inspect parameter map for connecting thresholds, timeouts, and other parameters pertaining to the **inspect** action, and enters parameter map type inspect configuration mode.
Step 4	**log** {**dropped-packets** {**disable** | **enable**} | **summary** [**flows** *number*] [**time-interval** *seconds*]} **Example:** `Router(config-profile)# log summary flows 15 time-interval 30`	(Optional) Configures packet logging during the firewall activity. **Note** This command is visible in the parameter map type inspect configuration mode only.
Step 5	**alert** {**on** | **off**} **Example:** `Router(config-profile)# alert on`	(Optional) Turns on Cisco IOS stateful packet inspection alert messages that are displayed on the console.
Step 6	**audit-trail** {**on** | **off**} **Example:** `Router(config-profile)# audit-trail on`	(Optional) Turns on audit trail messages.
Step 7	**dns-timeout** *seconds* **Example:** `Router(config-profile)# dns-timeout 60`	(Optional) Specifies the domain name system (DNS) idle timeout (the length of time for which a DNS lookup session will continue to be managed while there is no activity).

	Command or Action	Purpose
Step 8	**icmp idle-timeout** *seconds* **Example:** `Router(config-profile)# icmp idle-timeout 90`	(Optional) Configures the timeout for ICMP sessions.
Step 9	**max-incomplete** {**low** | **high**} {*number-of-connections*} **Example:** `Router(config-profile)# max-incomplete low 800`	(Optional) Defines the number of existing half-open sessions that will cause the Cisco IOS firewall to start and stop deleting half-open sessions.
Step 10	**one-minute** {**low** | **high**} *number-of-connections* **Example:** `Router(config-profile)# one-minute low 300`	(Optional) Defines the number of new unestablished sessions that will cause the system to start deleting half-open sessions and stop deleting half-open sessions.
Step 11	**sessions maximum** *sessions* **Example:** `Router(config-profile)# sessions maximum 200`	(Optional) Sets the maximum number of allowed sessions that can exist on a zone pair. • Use this command to limit the bandwidth used by the sessions. • *sessions*—Maximum number of allowed sessions. Range: 1 to 2147483647.
Step 12	**tcp finwait-time** *seconds* **Example:** `Router(config-profile)# tcp finwait-time 5`	(Optional) Specifies how long a TCP session will be managed after the Cisco IOS firewall detects a FIN-exchange.
Step 13	**tcp idle-time** *seconds* **Example:** `Router(config-profile)# tcp idle-time 90`	(Optional) Configures the timeout for TCP sessions.
Step 14	**tcp max-incomplete host** *threshold* [**block-time** *minutes*] **Example:** `Router(config-profile)# tcp max-incomplete host 500 block-time 10`	(Optional) Specifies threshold and blocking time values for TCP host-specific Denial-of-Service (DoS) detection and prevention.

	Command or Action	Purpose
Step 15	**tcp synwait-time** *seconds* **Example:** `Router(config-profile)# tcp synwait-time 3`	(Optional) Specifies how long the software will wait for a TCP session to reach the established state before dropping the session.
Step 16	**tcp window-scale-enforcement loose** **Example:** `Router(config-profile)# tcp window-scale-enforcement loose`	(Optional) Disables the window scale option check in the parameter map for a TCP packet that has an invalid window scale option under the Zone-based policy firewall.
Step 17	**udp idle-time** *seconds* **Example:** `Router(config-profile)# udp idle-time 75`	(Optional) Configures the idle timeout of UDP sessions that are going through the firewall.
Step 18	**exit** **Example:** `Router(config-profile)# exit`	Exits parameter map type inspect configuration mode and enters global configuration mode.

Creating a URL Filter Parameter Map

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **parameter-map type urlfilter** *parameter-map-name*
4. **alert** {**on** | **off**}
5. **allow-mode** {**on** | **off**}
6. **audit-trail** {**on** | **off**}
7. **cache** *number*
8. **exclusive-domain** {**deny** | **permit**} *domain-name*
9. **max-request** *number-of-requests*
10. **max-resp-pak** *number-of-requests*
11. **server vendor** {**n2h2** | **websense**} {*ip-address* | *hostname* [**port** *port-number*]} [**outside**] [**log**] [**retrans** *retransmission-count*] [**timeout** *seconds*]
12. **source-interface** *interface-name*
13. **exit**

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	**parameter-map type urlfilter** *parameter-map-name* **Example:** `Router(config)# parameter-map type urlfilter eng-network-profile`	Creates or modifies a parameter map for URL filtering parameters and enters parameter map type inspect configuration mode. **Note** This command is hidden in releases later than Cisco IOS Release 12.4(20)T, but it continues to work. The **parameter-map type urlfpolicy** command can also be used. This command is used to create URL filtering parameters for local, trend, Websense Internet filtering, and the N2H2 Internet blocking program. We recommend the use of the URL filter policy rather than the URL filter action for Cisco IOS Release 12.4(20)T and later releases. All the use cases supported by the URL filter as an action are also supported by the URL filter policy. See the "Configuring a URL Filter Policy, page 39" section for more information.
Step 4	**alert** {**on** | **off**} **Example:** `Router(config-profile)# alert on`	(Optional) Turns on Cisco IOS stateful packet inspection alert messages that are displayed on the console.
Step 5	**allow-mode** {**on** | **off**} **Example:** `Router(config-profile)# allow-mode on`	(Optional) Turns on the default mode of the filtering algorithm.
Step 6	**audit-trail** {**on** | **off**} **Example:** `Router(config-profile)# audit-trail on`	(Optional) Turns on audit trail messages.

	Command or Action	Purpose
Step 7	**cache** *number* **Example:** `Router(config-profile)# cache 5`	(Optional) Controls how the URL filter handles the cache it maintains of HTTP servers.
Step 8	**exclusive-domain** {**deny** | **permit**} *domain-name* **Example:** `Router(config-profile)# exclusive-domain permit cisco.com`	(Optional) Adds a domain name to or from the exclusive domain list so that the Cisco IOS firewall does not have to send lookup requests to the vendor server.
Step 9	**max-request** *number-of-requests* **Example:** `Router(config-profile)# max-request 80`	(Optional) Specifies the maximum number of outstanding requests that can exist at a time.
Step 10	**max-resp-pak** *number-of-requests* **Example:** `Router(config-profile)# max-resp-pak 200`	(Optional) Specifies the maximum number of HTTP responses that the Cisco IOS firewall can keep in its packet buffer.
Step 11	**server vendor** {**n2h2** | **websense**} {*ip-address* | *hostname* [**port** *port-number*]} [**outside**] [**log**] [**retrans** *retransmission-count*] [**timeout** *seconds*] **Example:** `Router(config-profile)# server vendor n2h2 10.193.64.22 port 3128 outside retrans 9 timeout 8`	Specifies the URL filtering server.
Step 12	**source-interface** *interface-name* **Example:** `Router(config-profile)# source-interface ethernet0`	(Optional) Specifies the interface whose IP address is used as the source IP address while making a TCP connection to the URL filter server (Websense or N2H2).
Step 13	**exit** **Example:** `Router(config-profile)# exit`	Exits parameter map type inspect configuration mode and enters global configuration mode.

Configuring a Layer 7 Protocol-Specific Parameter Map

Note Protocol-specific parameter maps can be created only for instant messenger applications (AOL, ICQ, MSN Messenger, Yahoo Messenger, and Windows Messenger).

To enable name resolution to occur, you must also enable the **ip domain name** command and the **ip name-serve**r command.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **parameter-map type protocol-info** *parameter-map-name*
4. **server** {**name** *string* [**snoop**] | **ip** {*ip-address* | **range** *ip-address-start ip-address-end*}}
5. **exit**

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	**parameter-map type protocol-info** *parameter-map-name* **Example:** `Router(config)# parameter-map type protocol-info ymsgr`	Defines an application-specific parameter map and enters parameter map type inspect configuration mode.

	Command or Action	Purpose
Step 4	**server** {**name** *string* [**snoop**] | **ip** {*ip-address* | **range** *ip-address-start ip-address-end*}} **Example:** `Router(config-profile)# server name example1.example.com`	Configures a set of DNS servers for which a given instant messenger application will be interacting. **Note** If at least one server instance is not configured, the parameter map will not have any definitions to enforce; that is, the configured instant messenger policy cannot be enforced. **Note** To configure more than one set of servers, you can issue the **server** command multiple times within an instant messenger's parameter map. Multiple entries are treated cumulatively.
Step 5	**exit** **Example:** `Router(config-profile)# exit`	Exits parameter map type inspect configuration mode and enters global configuration mode.

- Troubleshooting Tips, page 28

Troubleshooting Tips

To display details of an IM protocol-specific parameter map, use the **show parameter-map type protocol-info** command.

Configuring OoO Packet Processing Support in the Zone-Based Firewall Applications

Note When you configure a TCP-based Layer 7 policy for DPI, OoO is enabled by default. Use the **parameter-map type ooo global** command to configure the OoO packet support parameters or to turn off OoO processing.

Note In Cisco IOS Release 12.4(15)T, OoO processing was enabled for zone-based firewall and for IPS shared sessions with Layer 4 match (match protocol TCP, match protocol http), and for any TCP-based Layer 7 packet ordering.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **parameter-map type ooo global**
4. **tcp reassembly alarm** {**on** | **off**}
5. **tcp reassembly memory limit** *memory-limit*
6. **tcp reassembly queue length** *queue-length*
7. **tcp reassembly timeout** *time-limit*
8. **exit**

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	**parameter-map type ooo global** **Example:** `Router(config)# parameter-map type ooo global`	Configures OoO processing and enters parameter map type inspect configuration mode.
Step 4	**tcp reassembly alarm** {**on**	**off**} **Example:** `Router(config-profile)# tcp reassembly alarm on`	Specifies the alert message configuration.
Step 5	**tcp reassembly memory limit** *memory-limit* **Example:** `Router(config-profile)# tcp reassembly memory limit 2048`	Specifies the OoO box-wide buffer size.

	Command or Action	Purpose
Step 6	**tcp reassembly queue length** *queue-length* **Example:** `Router(config-profile)# tcp reassembly queue length 45`	Specifies the OoO queue length per TCP flow.
Step 7	**tcp reassembly timeout** *time-limit* **Example:** `Router(config-profile)# tcp reassembly timeout 34`	Specifies the OoO queue reassembly timeout value.
Step 8	**exit** **Example:** `Router(config-profile)# exit`	Exits parameter map type inspect configuration mode and enters global configuration mode.

Configuring Intrazone Support in the Zone-Based Firewall Applications

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **zone-pair security** *zone-pair-name* [**source** *source-zone-name* **destination** *destination-zone-name*]
4. **policy-map type inspect** *policy-map-name*
5. **class type inspect protocol-name** *class-map-name*
6. **exit**

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	**zone-pair security** *zone-pair-name* [**source** *source-zone-name* **destination** *destination-zone-name*] **Example:** `Router(config)# zone-pair security zonepair17 source zone8 destination zone8`	Specifies the name of the zone pair that is attached to an interface, the source zone for information, and the destination zone for information passing through this zone pair. **Note** To configure intrazone support, the source zone and the destination zone must be the same.
Step 4	**policy-map type inspect** *policy-map-name* **Example:** `Router(config)# policy-map type inspect my-pmap`	Specifies a policy map name and enters QoS policy-map configuration mode.
Step 5	**class type inspect protocol-name** *class-map-name* **Example:** `Router(config-pmap)# class type inspect aol cmap1`	Specifies the firewall class map protocol and name.
Step 6	**exit** **Example:** `Router(config-pmap)# exit`	Exits QoS policy-map configuration mode and enters global configuration mode.

Configuring Layer 7 Protocol-Specific Firewall Policies

Configure Layer 7 policy maps if you are need extra provisioning for Layer 7 inspection modules. It is not necessary that you configure all of the Layer 7 policy maps specified in this section.

Use one of the following tasks to configure a Layer 7, protocol-specific firewall policy:

Layer 7 Class Map and Policy Map Restrictions

- DPI class maps for Layer 7 can be used in inspect policy maps of the respective type. For example, **class-map type inspect http** can only be used only in **policy-map type inspect http**.
- DPI policies require an **inspect** action at the parent level.
- A Layer 7 (DPI) policy map must be nested at the second level in a Layer 3 or Layer 4 inspect policy map, whereas a Layer 3 or Layer 4 inspect policy can be attached at the first level. Therefore, a Layer 7 policy map cannot be attached directly to a zone pair.
- If no action is specified in the hierarchical path of an inspect service policy, the packet is dropped. Traffic matching class-default in the top-level policy is dropped if there are no explicit actions configured in class-default. If the traffic does not match any class in a Layer 7 policy, the traffic is not dropped; control returns to the parent policy and subsequent actions (if any) in the parent policy are executed on the packet.
- Layer 7 policy maps include class maps only of the same type.
- You can specify the **reset** action only for TCP traffic; it resets the TCP connection.
- In Cisco IOS Release 15.1(4)M and later releases, removing a class that has a header with a regular expression from a Layer 7 policy map causes active HTTP sessions to reset. Prior to this change, when a class was removed from a Layer 7 policy map, the router reloaded.

Configuring an HTTP Firewall Policy

To configure match criteria on the basis of an element within a parameter map, you must configure a parameter map as shown in the task "Creating an Inspect Parameter Map, page 21."

You must specify at least one match criterion; otherwise, the firewall policy will not be effective.

- Configuring an HTTP Firewall Class Map, page 32
- Configuring an HTTP Firewall Policy Map, page 38

Configuring an HTTP Firewall Class Map

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect http** [**match-any** | **match-all**] *class-map-name*
4. **match response body java-applet**
5. **match req-resp protocol violation**
6. **match req-resp body length** {**lt** | **gt**} *bytes*
7. **match req-resp header content-type** {**violation** | **mismatch** | **unknown**}
8. **match** {**request** | **response** | **req-resp**} **header** [*header-name*] **count gt** *number*
9. **match** {**request** | **response** | **req-resp**} **header** [*header-name*] **length gt** *bytes*
10. **match request** {**uri** | **arg**} **length gt** *bytes*
11. **match request method** {**connect** | **copy** | **delete** | **edit** | **get** | **getattribute** | **getattributenames** | **getproperties**| **head** | **index** | **lock** | **mkdir** | **move** | **options** | **post** | **put** | **revadd** | **revlabel** | **revlog** | **revnum** | **save** | **setattribute** | **startrev** | **stoprev** | **trace** | **unedit** | **unlock**}
12. **match request port-misuse** {**im** | **p2p** | **tunneling**| **any**}
13. **match req-resp header transfer-encoding** {**chunked**| **compress**| **deflate**| **gzip**| **identity**| **all**}
14. **match** {**request** | **response** | **req-resp**} **header** [*header-name*] **regex** *parameter-map-name*
15. **match request uri regex** *parameter-map-name*
16. **match** {**request** | **response** | **req-resp**} **body regex***parameter-map-name*
17. **match response status-line regex** *parameter-map-name*
18. **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	**class-map type inspect http** [**match-any** | **match-all**] *class-map-name* **Example:** `Router(config)# class-map type inspect http http-class`	Creates a class map for the HTTP protocol so that you can enter match criteria and enters QoS class- map configuration mode.
Step 4	**match response body java-applet** **Example:** `Router(config-cmap)# match response body java-applet`	(Optional) Identifies Java applets in an HTTP connection.
Step 5	**match req-resp protocol violation** **Example:** `Router(config-cmap)# match req-resp protocol violation`	(Optional) Configures an HTTP class map to allow HTTP messages to pass through the firewall or to reset the TCP connection when HTTP noncompliant traffic is detected.
Step 6	**match req-resp body length** {**lt** | **gt**} *bytes* **Example:** `Router(config-cmap)# match req-resp body length gt 35000`	(Optional) Configures an HTTP class map to use the minimum or maximum message size, in bytes, as a match criterion for permitting or denying HTTP traffic through the firewall. • The number of bytes can be from 0 to 65535.
Step 7	**match req-resp header content-type** {**violation** | **mismatch** | **unknown**} **Example:** `Router(config-cmap)# match req-resp header content-type mismatch`	(Optional) This command configures an HTTP class map based on the content type of the HTTP traffic.
Step 8	**match** {**request** | **response** | **req-resp**} **header** [*header-name*] **count gt** *number* **Example:** `Router(config-cmap)# match req-resp header count gt 16`	(Optional) Configure an HTTP firewall policy to permit or deny HTTP traffic on the basis of both request and response messages whose header count does not exceed a maximum number of fields.

	Command or Action	Purpose
Step 9	**match** {**request** | **response** | **req-resp**} **header** [*header-name*] **length gt** *bytes* **Example:** `Router(config-cmap)# match response header length gt 50000`	(Optional) Permits or denies HTTP traffic based on the length of the HTTP request header. • *header-name*—Specific line in the header field. If a specific line is defined, only that specific field length will be used as a match criterion. • **gt** *bytes*—Maximum number of bytes that can be in the header of the HTTP request. Range: 0 to 65535.
Step 10	**match request** {**uri** | **arg**} **length gt** *bytes* **Example:** `Router(config-cmap)# match request uri length gt 500`	(Optional) Configures an HTTP firewall policy to use the URI or argument length in the request message as a match criterion for permitting or denying HTTP traffic.
Step 11	**match request method** {**connect** | **copy** | **delete** | **edit** | **get** | **getattribute** | **getattributenames** | **getproperties**| **head** | **index** | **lock** | **mkdir** | **move** | **options** | **post** | **put** | **revadd** | **revlabel** | **revlog** | **revnum** | **save** | **setattribute** | **startrev** | **stoprev** | **trace** | **unedit** | **unlock**} **Example:** `Router(config-cmap)# match request method connect`	(Optional) Configures an HTTP firewall policy to use the request methods or the extension methods as a match criterion for permitting or denying HTTP traffic.
Step 12	**match request port-misuse** {**im** | **p2p** | **tunneling**| **any**} **Example:** `Router(config-cmap)# match request port-misuse any`	(Optional) Identifies applications misusing the HTTP port.

Command or Action	Purpose
Step 13 **match req-resp header transfer-encoding** {**chunked**| **compress**| **deflate**| **gzip**| **identity**| **all**} **Example:** `Router(config-cmap)# match req-resp header transfer-encoding compress`	(Optional) Permits or denies HTTP traffic according to the specified transfer encoding of the message. • **chunked**—Encoding format (specified in RFC 2616, *Hypertext Transfer Protocol--HTTP/1*) in which the body of the message is transferred in a series of chunks; each chunk contains its own size indicator. • **compress**—Encoding format produced by the UNIX compress utility. • **deflate**—ZLIB format defined in RFC 1950, *ZLIB Compressed Data Format Specification Version 3.3* , combined with the deflate compression mechanism described in RFC 1951, *DEFLATE Compressed Data Format Specification Version 1.3* . • **gzip**—Encoding format produced by the gzip (GNU zip) program. • **identity**—Default encoding, which indicates that no encoding has been performed. • **all**—All of the transfer encoding types.

Command or Action	Purpose
Step 14 **match** {**request** | **response** | **req-resp**} **header** [*header-name*] **regex** *parameter-map-name* **Example:** `Router(config-cmap)# match req-resp header regex non_ascii_regex`	(Optional) Configures HTTP firewall policy match criteria on the basis of headers that match the regular expression defined in a parameter map. • HTTP has two regular expression (regex) options. One combines the **header** keyword, **content-type** header name, and **regex** keyword and *parameter-map-name* argument. The other combines the **header** keyword, **regex** keyword, and *parameter-map-name* argument. • If the **header** and **regex** keywords are used with the *parameter-map-name* argument, the parameter map does not require a period and asterisk in front of the *parameter-map-name* argument. For example, either "html" or ".*html" *parameter-map-name* argument can be configured. • If the **header** keyword is used with the content-type header name and **regex** keyword, then the parameter map name requires a period and asterisk (.*) in front of the *parameter-map-name* argument. For example, the *parameter-map-name* argument "html" is expressed as: .*html. **Note** If the period and asterisk are added in front of "html" (.*html), the *parameter-map-name* argument works for both HTTP regex options. • The **mismatch** keyword is valid only for the **match response header content-type regex** command syntax for messages that need to be matched and that have a content-type header name mismatch. **Tip** It is a good practice to add ".*" to the **regex** *parameter-map-name* arguments that are not present at the beginning of a text string.
Step 15 **match request uri regex** *parameter-map-name* **Example:** `Router(config-cmap)# match request uri regex uri_regex_cm`	(Optional) Configures an HTTP firewall policy to permit or deny HTTP traffic on the basis of request messages whose URI or arguments (parameters) match a defined regular expression.
Step 16 **match** {**request** | **response** | **req-resp**} **body regex***parameter-map-name* **Example:** `Router(config-cmap)# match response body regex body_regex`	(Optional) Configures a list of regular expressions that are to be matched against the body of the request, response, or both the request and response message.

	Command or Action	Purpose
Step 17	**match response status-line regex** *parameter-map-name* **Example:** `Router(config-cmap)# match response status-line regex status_line_regex`	(Optional) Specifies a list of regular expressions that are to be matched against the status line of a response message.
Step 18	**end** **Example:** `Router(config-cmap)# end`	(Optional) Exits QoS class- map configuration mode and enters privileged EXEC mode .

Configuring an HTTP Firewall Policy Map

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map type inspect http** *policy-map-name*
4. **class-type inspect http** *http-class-name*
5. **allow**
6. **log**
7. **reset**
8. **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	**policy-map type inspect http** *policy-map-name* **Example:** `Router(config)# policy-map type inspect http myhttp-policy`	Creates a Layer 7 HTTP policy map and enters QoS policy-map configuration mode.
Step 4	**class-type inspect http** *http-class-name* **Example:** `Router(config-pmap)# class-type inspect http http-class`	Creates a class map for the HTTP protocol.
Step 5	**allow** **Example:** `Router(config-pmap)# allow`	(Optional) Allows a traffic class matching the class.
Step 6	**log** **Example:** `Router(config-pmap)# log`	Generates a log (messages).
Step 7	**reset** **Example:** `Router(config-pmap)# reset`	(Optional) Resets a TCP connection if the data length of the SMTP body exceeds the value configured in the **class-map type inspect smtp** command.
Step 8	**end** **Example:** `Router(config-pmap)# end`	Exits QoS policy-map configuration mode and enters privileged EXEC mode.

Configuring a URL Filter Policy

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **parameter-map type urlfpolicy** {**local** | **n2h2** | **websense**} *parameter-map-name*
4. **exit**
5. **class-map type urlfilter** {*class-map-name* | **match-any** *class-map-name* | **n2h2** {*class-map-name* | **match-any** *class-map-name*} | **websense** {*class-map-name* | **match-any** *class-map-name*}}
6. **exit**
7. **policy-map type inspect urlfilter** *policy-map-name*
8. **service-policy urlfilter** *policy-map-name*
9. **exit**

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	**parameter-map type urlfpolicy** {**local** | **n2h2** | **websense**} *parameter-map-name* **Example:** `Router(config)# parameter-map type urlfpolicy websense websense-param-map`	Configures the URL filter name related to the parameter map, which can include local, Websense, or N2H2 parameters and enters parameter map type inspect configuration mode.
Step 4	**exit** **Example:** `Router(config-profile)# exit`	Exits parameter map type inspect configuration mode.

	Command or Action	Purpose
Step 5	**class-map type urlfilter** {*class-map-name* | **match-any** *class-map-name* | **n2h2** {*class-map-name* | **match-any** *class-map-name*} | **websense** {*class-map-name* | **match-any** *class-map-name*}} **Example:** `Router(config)# class-map type urlfilter websense websense-param-map`	Configures the class map for the URL filter and enters Qos class-map configuration mode.
Step 6	**exit** **Example:** `Router(config-cmap)# exit`	Exits QoS class-map configuration mode and enters global configuration mode.
Step 7	**policy-map type inspect urlfilter** *policy-map-name* **Example:** `Router(config)# policy-map type inspect urlfilter websense-policy`	Configures the URL filter policy.
Step 8	**service-policy urlfilter** *policy-map-name* **Example:** `Router(config)# service-policy urlfilter websense-policy`	Applies the URL filter policy under the inspect class as the service policy.
Step 9	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode and enters privileged EXEC mode.

Configuring an IMAP Firewall Policy

Configuring an IMAP Class Map

Perform this task to configure an IMAP class map.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip inspect name** *inspection-name protocol* [**alert** {**on** | **off**}] [**audit-trail** {**on** | **off**}] [**reset**] [**secure-login**] [**timeout** *seconds*]
4. **class-map type inspect imap** [**match-any**] *class-map-name*
5. **log**
6. **match invalid-command**
7. **match login clear-text**
8. **exit**

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 inspect name** *inspection-name protocol* [**alert** {**on** | **off**}] [**audit-trail** {**on** | **off**}] [**reset**] [**secure-login**] [**timeout** *seconds*] **Example:** `Router(config)# ip inspect name mail-guard imap`	Defines a set of inspection rules.
Step 4	**class-map type inspect imap** [**match-any**] *class-map-name* **Example:** `Router(config)# class-map type inspect imap imap-class`	Creates a class map for IMAP to enter the match criterion, and enters QoS class-map configuration mode.
Step 5	**log** **Example:** `Router(config-cmap)# log`	Generates a log of messages.

	Command or Action	Purpose
Step 6	**match invalid-command** **Example:** `Router(config-cmap)# match invalid-command`	(Optional) Locates invalid commands on an IMAP connection.
Step 7	**match login clear-text** **Example:** `Router(config-cmap)# match login clear-text`	(Optional) Locates nonsecure login when an IMAP server is used.
Step 8	**exit** **Example:** `Router(config-cmap)# exit`	Exits QoS class-map configuration mode and returns to global configuration mode.

Configuring an IMAP Policy Map

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map type inspect imap** *policy-map-name*
4. **class-type inspect imap** *imap-class-name*
5. **log**
6. **reset**
7. **end**

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**policy-map type inspect imap** *policy-map-name* **Example:** `Router(config)# policy-map type inspect imap myimap-policy`	Creates a Layer 3 IMAP policy map and enters QoS policy-map configuration mode.
Step 4	**class-type inspect imap** *imap-class-name* **Example:** `Router(config-pmap)# class-type inspect imap pimap`	Creates a class map for the IMAP protocol.
Step 5	**log** **Example:** `Router(config-pmap)# log`	Generates a log (messages).
Step 6	**reset** **Example:** `Router(config-pmap)# reset`	(Optional) Resets a TCP connection if the data length of the SMTP body exceeds the value that you configured in the **class-map type inspect smtp** command.
Step 7	**end** **Example:** `Router(config-pmap)# end`	Exits QoS policy-map configuration mode and enters privileged EXEC mode.

Configuring an Instant Messenger Policy

Configuring an IM Class Map

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class map type inspect** {**aol** | **msnmsgr** | **ymsgr** | **icg** | **winmsgr**} [**match-any**] *class-map-name*
4. **match service** {**any** | **text-chat**}
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 type inspect** {**aol** | **msnmsgr** | **ymsgr** | **icg** | **winmsgr**} [**match-any**] *class-map-name* **Example:** `Router(config)# class map type inspect aol myaolclassmap`	Creates an IM type class map so you can begin adding match criteria and enters QoS class-map configuration mode.
Step 4	**match service** {**any** | **text-chat**} **Example:** `Router(config-cmap)# match service text-chat`	(Optional) Creates a match criterion on the basis of text chat messages.
Step 5	**end** **Example:** `Router(config-cmap)# end`	Exits QoS class-map configuration mode and enters privileged EXEC mode.

Configuring an IM Policy Map

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy map type inspect** *protocol-name policy-map-name*
4. **class type inspect** {**aol** | **msnmsgr** | **ymsgr** | **icq** | **winmsgr**} *class-map-name*
5. **reset**
6. **log**
7. **allow**
8. **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 type inspect** *protocol-name policy-map-name* **Example:** `Router(config)# policy map type inspect aol myaolpolicymap`	Creates an IM policy map and enters QoS policy-map configuration mode.
Step 4	**class type inspect** {**aol**	**msnmsgr**	**ymsgr**	**icq**	**winmsgr**} *class-map-name* **Example:** `Router(config-pmap)# class type inspect aol myaolclassmap`	Specifies a traffic class on which an action is to be performed. • *class-map-name*—This class map name should match the class map specified by using the **class-map type inspect** command.
Step 5	**reset** **Example:** `Router(config-pmap)# reset`	(Optional) Resets the connection.

	Command or Action	Purpose
Step 6	**log** **Example:** `Router(config-pmap)# log`	(Optional) Generates a log message for the matched parameters.
Step 7	**allow** **Example:** `Router(config-pmap)# allow`	(Optional) Allows the connection.
Step 8	**end** **Example:** `Router(config-pmap)# end`	Exits QoS policy-map configuration mode and enters privileged EXEC mode.

Configuring a Peer-to-Peer Policy

You can create a P2P policy for the following P2P applications: eDonkey, FastTrack, Gnutella, and Kazaa Version 2.

- Configuring a P2P Class Map, page 47
- Configuring a P2P Policy Map, page 48

Configuring a P2P Class Map

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class map type inspect** {**edonkey** | **fasttrack** | **gnutella** | **kazaa2**} [**match-any**] *class-map-name*
4. **match file-transfer** [*regular-expression*]
5. **match search-file-name** [*regular-expression*]
6. **match text-chat** [*regular-expression*]
7. **end**

DETAILED STEPS

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

Command or Action	Purpose
Step 2 **configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3 **class map type inspect** {**edonkey** | **fasttrack** | **gnutella** | **kazaa2**} [**match-any**] *class-map-name* **Example:** `Router(config)# class map type inspect edonkey myclassmap`	Creates a P2P type class map so that you can begin adding match criteria and enters QoS class-map configuration mode.
Step 4 **match file-transfer** [*regular-expression*] **Example:** `Router(config-cmap)# match file-transfer *`	(Optional) Matches file transfer connections within any supported P2P protocol. **Note** To specify that all file transfer connections should be identified by the traffic class, use "*" as the regular expression.
Step 5 **match search-file-name** [*regular-expression*] **Example:** `Router(config-cmap)# match search-file-name`	(Optional) Blocks filenames within a search request for clients using the eDonkey P2P application. **Note** This command is applicable only for the eDonkey P2P application.
Step 6 **match text-chat** [*regular-expression*] **Example:** `Router(config-cmap)# match text-chat`	(Optional) Blocks text chat messages between clients using the eDonkey P2P application. **Note** This command is applicable only for the eDonkey P2P application.
Step 7 **end** **Example:** `Router(config-cmap)# end`	Exits QoS class-map configuration mode and enters privileged EXEC mode.

Configuring a P2P Policy Map

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy map type inspect p2p** *policy-map-name*
4. **class type inspect** {**edonkey** | **fasttrack** | **gnutella** | **kazaa2**} *class-map-name*
5. **reset**
6. **log**
7. **allow**
8. **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 type inspect p2p** *policy-map-name* **Example:** `Router(config)# policy map type inspect p2p mypolicymap`	Creates a P2P policy map and enters QoS policy-map configuration mode.
Step 4	**class type inspect** {**edonkey** | **fasttrack** | **gnutella** | **kazaa2**} *class-map-name* **Example:** `Router(config-pmap)# class type inspect edonkey myclassmap`	Specifies a traffic class on which an action is to be performed and enters policy map configuration mode. • *class-map-name*—This class map name should match the class map specified through the **class-map type inspect** command.
Step 5	**reset** **Example:** `Router(config-pmap)# reset`	(Optional) Resets the connection.

	Command or Action	Purpose
Step 6	**log** **Example:** `Router(config-pmap)# log`	(Optional) Generates a log message for the matched parameters.
Step 7	**allow** **Example:** `Router(config-pmap)# allow`	(Optional) Allows the connection.
Step 8	**end** **Example:** `Router(config-pmap)# end`	Exits QoS policy-map configuration mode and enters privileged EXEC mode.

Configuring a POP3 Firewall Policy

Configuring a POP3 Firewall Class Map

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip inspect name** *inspection-name protocol* [**alert** {**on** | **off**}] [**audit-trail** {**on** | **off**}] [**reset**] [**secure-login**] [**timeout** *seconds*]
4. **class-map type inspect pop3** [**match-any**] *class-map-name*
5. **match invalid-command**
6. **match login clear-text**
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.
Step 3	**ip inspect name** *inspection-name protocol* [**alert** {**on** | **off**}] [**audit-trail** {**on** | **off**}] [**reset**] [**secure-login**] [**timeout** *seconds*] **Example:** `Router(config)# ip inspect name mail-guard pop3`	Defines a set of inspection rules.
Step 4	**class-map type inspect pop3** [**match-any**] *class-map-name* **Example:** `Router(config)# class-map type inspect pop3 pop3-class`	Creates a class map for the POP3 protocol to enter match criteria and enters QoS class-map configuration mode.
Step 5	**match invalid-command** **Example:** `Router(config-cmap)# match invalid-command`	(Optional) Locates invalid commands on a POP3 server.
Step 6	**match login clear-text** **Example:** `Router(config-cmap)# match login clear-text`	(Optional) Finds a nonsecure login when using a POP3 server.
Step 7	**end** **Example:** `Router(config-cmap)# end`	Exits QoS class-map configuration mode and enters privileged EXEC mode.

Configuring a POP3 Firewall Policy Map

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map type inspect pop3** *policy-map-name*
4. **class-type inspect pop3** *pop3-class-name*
5. **log**
6. **reset**
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.
Step 3	**policy-map type inspect pop3** *policy-map-name* **Example:** `Router(config)# policy-map type inspect pop3 mypop3-policy`	Creates a Layer 7 POP3 policy map and enters QoS policy-map configuration mode.
Step 4	**class-type inspect pop3** *pop3-class-name* **Example:** `Router(config-pmap)# class-type inspect pop3 pcl`	Creates a class map for the POP3 protocol.
Step 5	**log** **Example:** `Router(config-pmap)# log`	Generates a log (messages).
Step 6	**reset** **Example:** `Router(config-pmap)# reset`	(Optional) Resets a TCP connection if the data length of the SMTP body exceeds the value that you configured in the **class-map type inspect smtp** command.

	Command or Action	Purpose
Step 7	**end** **Example:** `Router(config-pmap)# end`	Exits QoS policy-map configuration mode and enters privileged EXEC mode.

Configuring an SMTP Firewall Policy

Configuring an SMTP Firewall Class Map

Note To enable inspection for extended SMTP (ESMTP) in a class map, use the **match protocol smtp extended** command. See the "Restrictions for Zone-Based Policy Firewall, page 2" section for more information on using this command in Cisco IOS Release 12.4(15)T.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect smtp** [**match-all** | **match-any**] *class-map-name*
4. **match data-length gt** *max-data-value*
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.

	Command or Action	Purpose
Step 3	**class-map type inspect smtp** [**match-all** | **match-any**] *class-map-name* **Example:** `Router(config)# class-map type inspect smtp smtp-class`	Creates a class map for the SMTP protocol to enter match criteria and enters QoS class- map configuration mode.
Step 4	**match data-length gt** *max-data-value* **Example:** `Router(config-cmap)# match data-length gt 200000`	Determines if the amount of data transferred in an SMTP connection is above the configured limit.
Step 5	**end** **Example:** `Router(config-cmap)# end`	Exits QoS class-map configuration mode and enters privileged EXEC mode.

Configuring an SMTP Firewall Policy Map

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map type inspect smtp** *policy-map-name*
4. **class-type inspect smtp** *smtp-class-name*
5. **reset**
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.

	Command or Action	Purpose
Step 3	**policy-map type inspect smtp** *policy-map-name* **Example:** `Router(config)# policy-map type inspect smtp mysymtp-policy`	Creates a Layer 7 SMTP policy map and enters QoS policy-map configuration mode.
Step 4	**class-type inspect smtp** *smtp-class-name* **Example:** `Router(config-pmap)# class-type inspect smtp sc`	Configures inspection parameters for the SMTP protocol.
Step 5	**reset** **Example:** `Router(config-pmap)# reset`	(Optional) Resets the TCP connection if the data length of the SMTP body exceeds the value that you configured in the **class-map type inspect smtp** command.
Step 6	**end** **Example:** `Router(config-pmap)# end`	Exits QoS policy-map configuration mode and enters privileged EXEC mode.

Configuring a SUNRPC Firewall Policy

Note If you are inspecting an RPC protocol (that is, you have specified the **match protocol sunrpc** command in the Layer 4 class map), the Layer 7 SUNRPC policy map is required.

- Configuring a SUNRPC Firewall Class Map, page 55
- Configuring a SUNRPC Firewall Policy Map, page 56

Configuring a SUNRPC Firewall Class Map

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect sunrpc** [**match-any**] *class-map-name*
4. **match program-number** *program-number*
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 type inspect sunrpc** [**match-any**] *class-map-name* **Example:** `Router(config)# class-map type inspect sunrpc long-urls`	Creates a class map for the SUNRPC protocol to enter match criteria and enters QoS class-map configuration mode.
Step 4	**match program-number** *program-number* **Example:** `Router(config-cmap)# match program-number 2345`	(Optional) Specifies the allowed Remote Procedure Call (RPC) protocol program number as a match criterion.
Step 5	**end** **Example:** `Router(config-cmap)# end`	Exits QoS policy-map configuration mode and enters privileged EXEC mode.

Configuring a SUNRPC Firewall Policy Map

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map type inspect sunrpc** *policy-map-name*
4. **class-type inspect sunrpc** *sunrpc-class-name*
5. **allow** [**wait-time** *minutes*]
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 type inspect sunrpc** *policy-map-name* **Example:** `Router(config)# policy-map type inspect sunrpc my-rpc-policy`	Creates a Layer 7 SUNRPC policy map and enters policy-map configuration mode.
Step 4	**class-type inspect sunrpc** *sunrpc-class-name* **Example:** `Router(config-pmap)# class-type inspect sunrpc cs1`	Configures inspection parameters for the SUNRPC protocol.
Step 5	**allow** [**wait-time** *minutes*] **Example:** `Router(config-pmap)# allow wait-time 10`	(Optional) Allows the configured program number. • Specifies the number of minutes to keep a small hole in the firewall to allow subsequent connections from the same source address and to the same destination address and port. The default wait time is zero minutes. This keyword is available only for the RPC protocol.
Step 6	**end** **Example:** `Router(config-pmap)# end`	Exits QoS policy-map configuration mode and enters privileged EXEC mode.

Configuring an MSRPC Firewall Policy

Note If you are inspecting an RPC protocol (that is, you have specified the **match protocol msrpc** command in the Layer 4 class map), the Layer 7 Microsoft Remote Procedure Call (MSRPC) policy map is required.

Perform this task to configure an MSRPC firewall policy.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **parameter-map type protocol-info msrpc** *parameter-map-name*
4. **timeout** *seconds*
5. **exit**
6. **class-map type inspect match-any** *class-map-name*
7. **match protocol msrpc**
8. **match protocol msrpc-smb-netbios**
9. **exit**
10. **policy-map type inspect** *policy-map-name*
11. **class type inspect** *class-map-name*
12. **inspect**
13. **exit**
14. **class class-default**
15. **drop**
16. **exit**
17. **exit**
18. **zone security** *security-zone-name*
19. **exit**
20. **zone security** *security-zone-name*
21. **exit**
22. **zone-pair security** *zone-pair-name* **source** *source-zone* **destination** *destination-zone*
23. **service-policy type inspect** *policy-map-name*
24. **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	**parameter-map type protocol-info msrpc** *parameter-map-name* **Example:** `Router(config)# parameter-map type protocol-info msrpc para-map`	Defines an application-specific parameter map and enters parameter map type inspect configuration mode.
Step 4	**timeout** *seconds* **Example:** `Router(config-profile)# timeout 60`	Configures the MSRPC endpoint mapper (EPM) timeout.
Step 5	**exit** **Example:** `Router(config-profile)# exit`	Exits parameter map type inspect configuration mode and enters global configuration mode.
Step 6	**class-map type inspect match-any** *class-map-name* **Example:** `Router(config)# class-map type inspect match-any c-map`	Creates an inspect type class map for the traffic class and enters QoS class-map configuration mode.
Step 7	**match protocol msrpc** **Example:** `Router(config-cmap)# match protocol msrpc`	Configures match criteria for a class map on the basis of a specified protocol. • Only Cisco IOS stateful packet inspection-supported protocols can be used as match criteria in inspect type class maps.
Step 8	**match protocol msrpc-smb-netbios** **Example:** `Router(config-cmap)# match protocol msrpc-smb-netbios`	Configures match criteria for a class map on the basis of a specified protocol. • Only Cisco IOS stateful packet inspection-supported protocols can be used as match criteria in inspect type class maps.
Step 9	**exit** **Example:** `Router(config-cmap)# exit`	Exits QoS class-map configuration mode and enters global configuration mode.
Step 10	**policy-map type inspect** *policy-map-name* **Example:** `Router(config)# policy-map type inspect p-map`	Creates a Layer 3 and Layer 4 inspect type policy map and enters QoS policy-map configuration mode.

	Command or Action	Purpose
Step 11	**class type inspect** *class-map-name* **Example:** `Router(config-pmap)# class type inspect c-map`	Specifies the traffic (class) on which an action is to be performed and enters QoS policy-map class configuration mode.
Step 12	**inspect** **Example:** `Router(config-pmap-c)# inspect`	Enables Cisco IOS stateful packet inspection.
Step 13	**exit** **Example:** `Router(config-pmap-c)# exit`	Exits QoS policy-map class configuration mode and enters QoS policy-map configuration mode.
Step 14	**class class-default** **Example:** `Router(config-pmap)# class class-default`	Specifies the matching of the system default class and enters QoS policy-map class configuration mode. • If the system default class is not specified, then unclassified packets are matched.
Step 15	**drop** **Example:** `Router(config-pmap-c)# drop`	Drops packets that matches a defined class.
Step 16	**exit** **Example:** `Router(config-pmap-c)# exit`	Exits QoS policy-map class configuration mode and enters QoS policy-map configuration mode.
Step 17	**exit** **Example:** `Router(config-pmap)# exit`	Exits QoS policy-map configuration mode and enters global configuration mode.
Step 18	**zone security** *security-zone-name* **Example:** `Router(config)# zone security in-zone`	Creates a security zone to which interfaces can be assigned and enters security zone configuration mode.

	Command or Action	Purpose
Step 19	**exit** **Example:** `Router(config-sec-zone)# exit`	Exits security zone configuration mode and enters global configuration mode.
Step 20	**zone security** *security-zone-name* **Example:** `Router(config)# zone security out-zone`	Creates a security zone to which interfaces can be assigned and enters security zone configuration mode.
Step 21	**exit** **Example:** `Router(config-sec-zone)# exit`	Exits security zone configuration mode and enters global configuration mode.
Step 22	**zone-pair security** *zone-pair-name* **source** *source-zone* **destination** *destination-zone* **Example:** `Router(config)# zone-pair security in-out source in-zone destination out-zone`	Creates a zone pair and enters security zone configuration mode. **Note** To apply a policy, you must configure a zone pair.
Step 23	**service-policy type inspect** *policy-map-name* **Example:** `Router(config-sec-zone)# service-policy type inspect p-map`	Attaches a firewall policy map to the destination zone pair. **Note** If a policy is not configured between a pair of zones, traffic is dropped by default.
Step 24	**end** **Example:** `Router(config-sec-zone)# end`	Exits security zone configuration mode and enters privileged EXEC mode.

Creating Security Zones and Zone Pairs and Attaching a Policy Map to a Zone Pair

You need two security zones to create a zone pair. However, you can create only one security zone and use a system-defined security zone called “self.” Note that if you select a self zone, you cannot configure inspect policing.

Use this process to complete the following tasks:

- Create at least one security zone.
- Define zone pairs.
- Assign interfaces to security zones.

- Attach a policy map to a zone pair.

Tip Before you create zones, think about what should constitute the zones. The general guideline is that you should group interfaces that are similar when they are viewed from a security perspective.

Note

- An interface cannot be part of a zone and a legacy inspect policy at the same time.
- An interface can be a member of only one security zone.
- When an interface is a member of a security zone, all traffic to and from that interface is blocked unless you configure an explicit interzone policy on a zone pair involving that zone.
- Traffic cannot flow between an interface that is a member of a security zone and an interface that is not a member of a security zone because a policy can be applied only between two zones.
- For traffic to flow among all the interfaces in a router, all interfaces must be members of one security zone or another. This is particularly important because after you make an interface a member of a security zone, a policy action (such as **inspect** or **pass**) must explicitly allow packets. Otherwise, packets are dropped.
- If an interface on a router cannot be part of a security zone or firewall policy, you may have to add that interface in a security zone and configure a “pass all” policy (that is, a “dummy” policy) between that zone and other zones to which a traffic flow is desired.
- You cannot apply an ACL between security zones or on a zone pair.
- An ACL cannot be applied between security zones and zone pairs. Include the ACL configuration in a class map, and use policy maps to drop traffic.
- An ACL on an interface that is a zone member should not be restrictive (strict).
- All interfaces in a security zone must belong to the same VRF instance.
- You can configure policies between security zones whose member interfaces are in separate VRFs. However, traffic may not flow between these VRFs if the configuration does not allow it.
- If traffic does not flow between VRFs (because route-leaking between VRFs is not configured), the policy across VRFs is not executed. This is a configuration mistake on the routing side, not on the policy side.
- Traffic between interfaces in the same security zone is not subject to any policy; the traffic passes freely.
- The source and the destination zones in a zone pair must be of the type security.
- The same zone cannot be defined as both the source and the destination.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **zone security** *zone-name*
4. **description** *line-of-description*
5. **exit**
6. **zone-pair security** *zone-pair name* [**source** *source-zone-name* | **self**] **destination** [**self** | *destination-zone-name*]
7. **description** *line-of-description*
8. **exit**
9. **interface** *type number*
10. **zone-member security** *zone-name*
11. **exit**
12. **zone-pair security** *zone-pair-name* {**source** *source-zone-name* | **self**]} **destination** [**self** | *destination-zone-name*]
13. **service-policy type inspect** *policy-map-name*
14. **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	**zone security** *zone-name* **Example:** `Router(config)# zone security zone1`	Creates a security zone to which interfaces can be assigned and enters security zone configuration mode.
Step 4	**description** *line-of-description* **Example:** `Router(config-sec-zone)# description Internet Traffic`	(Optional) Describes the zone.

	Command or Action	Purpose
Step 5	**exit** **Example:** `Router(config-sec-zone)# exit`	Exits security zone configuration mode and enters global configuration mode.
Step 6	**zone-pair security** *zone-pair name* [**source** *source-zone-name* | **self**] **destination** [**self** | *destination-zone-name*] **Example:** `Router(config)# zone-pair security zp source z1 destination z2`	Creates a zone pair and enters security zone configuration mode. **Note** To apply a policy, you must configure a zone pair.
Step 7	**description** *line-of-description* **Example:** `Router(config-sec-zone)# description accounting network`	(Optional) Describes the zone pair.
Step 8	**exit** **Example:** `Router(config-sec-zone)# exit`	Exits security zone configuration mode and enters global configuration mode.
Step 9	**interface** *type number* **Example:** `Router(config)# interface ethernet 0`	Configures an interface and enters interface configuration mode.
Step 10	**zone-member security** *zone-name* **Example:** `Router(config-if)# zone-member security zone1`	Assigns an interface to a specified security zone. **Note** When you make an interface a member of a security zone, all traffic in and out of that interface (except traffic bound for the router or initiated by the router) is dropped by default. To let traffic through the interface, you must make the zone part of a zone pair to which you should apply a policy. If the policy permits traffic, traffic can flow through that interface.
Step 11	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and enters global configuration mode.

	Command or Action	Purpose
Step 12	**zone-pair security** *zone-pair-name* {**source** *source-zone-name* | **self**]} **destination** [**self** | *destination-zone-name*] **Example:** `Router(config)# zone-pair security zp source z1 destination z2`	Creates a zone pair and enters security zone pair configuration mode.
Step 13	**service-policy type inspect** *policy-map-name* **Example:** `Router(config-sec-zone-pair)# service-policy type inspect p2`	Attaches a firewall policy map to the destination zone pair. **Note** If a policy is not configured between a pair of zones, traffic is dropped by default.
Step 14	**end** **Example:** `Router(config-sec-zone-pair)# end`	Exits security zone pair configuration mode and enters privileged EXEC mode.

Configuring the Cisco IOS Firewall with WAAS

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip wccp** *service-id*
4. **ip inspect waas enable**
5. **class-map type inspect** *class-name*
6. **match protocol** *protocol-name* [**signature**]
7. **exit**
8. **policy-map type inspect** *policy-map-name*
9. **class class-default**
10. **class-map type inspect** *class-name*
11. **inspect**
12. **exit**
13. **exit**
14. **zone security** *zone-name*
15. **description** *line-of-description*
16. **exit**
17. **zone-pair security** *zone-pair name* [**source** *source-zone-name* | **self**] **destination** [**self** | *destination-zone-name*]
18. **description** *line-of-description*
19. **exit**
20. **interface** *type number*
21. **description** *line-of-description*
22. **zone-member security** *zone-name*
23. **ip address** *ip-address*
24. **ip wccp** {*service-id* {**group-listen** | **redirect** {**in** | **out**}} | **redirect exclude in** | **web-cache** {**group-listen** | **redirect** {**in** | **out**}}
25. **exit**
26. **zone-pair security** *zone-pair-name* {**source** *source-zone-name* | **self**]} **destination** [**self** | *destination-zone-name*]
27. **service-policy type inspect** *policy-map-name*
28. **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 wccp** *service-id* **Example:** `Router(config)# ip wccp 61`	Enters the WCCP dynamically defined service identifier number.
Step 4	**ip inspect waas enable** **Example:** `Router(config)# ip inspect waas enable`	Enables the Cisco IOS firewall inspection so that WAAS optimization can be discovered. **Note** If an ISR router along with Cisco IOS Firewall is deployed as an intermediary router inside the WAAS optimization path, the **ip inspect waas enable** command should be used to enable WAAS awareness and interoperability. If the router is not configured for optimization awareness, the optimized traffic would violate the TCP activity expectations, and the firewall would drop the traffic.
Step 5	**class-map type inspect** *class-name* **Example:** `Router(config)# class-map type inspect most-traffic`	Creates an inspect type class map for the traffic class and enters QoS class-map configuration mode. **Note** The **class-map type inspect most-traffic**command is hidden.
Step 6	**match protocol** *protocol-name* [**signature**] **Example:** `Router(config-cmap)# match protocol http`	Configures match criteria for a class map on the basis of a specified protocol and enters security zone configuration mode. • Only Cisco IOS stateful packet inspection-supported protocols can be used as match criteria in inspect type class maps. • **signature**—Signature-based classification for peer-to-peer (P2P) packets is enabled.
Step 7	**exit** **Example:** `Router(config-sec-zone)# exit`	Returns to global configuration mode.

	Command or Action	Purpose
Step 8	**policy-map type inspect** *policy-map-name* **Example:** `Router(config)# policy-map type inspect p1`	Creates a Layer 3 and Layer 4 inspect type policy map and enters QoS policy-map configuration mode.
Step 9	**class class-default** **Example:** `Router(config-pmap)# class class-default`	Specifies the matching of the system default class. • If the system default class is not specified, unclassified packets are matched.
Step 10	**class-map type inspect** *class-name* **Example:** `Router(config-pmap)# class-map type inspect most-traffic`	Specifies the firewall traffic (class) map on which an action is to be performed and enters QoS policy-map class configuration mode.
Step 11	**inspect** **Example:** `Router(config-pmap-c)# inspect`	Enables Cisco IOS stateful packet inspection.
Step 12	**exit** **Example:** `Router(config-pmap-c)# exit`	Exits QoS policy-map class configuration mode and enters policy map configuration mode.
Step 13	**exit** **Example:** `Router(config-pmap)# exit`	Exits policy map configuration mode and enters global configuration mode.
Step 14	**zone security** *zone-name* **Example:** `Router(config)# zone security zone1`	Creates a security zone to which interfaces can be assigned and enters security zone configuration mode.
Step 15	**description** *line-of-description* **Example:** `Router(config-sec-zone)# description Internet Traffic`	(Optional) Describes the zone.

	Command or Action	Purpose
Step 16	**exit** **Example:** `Router(config-sec-zone)# exit`	Exits security zone configuration mode and enters global configuration mode.
Step 17	**zone-pair security** *zone-pair name* [**source** *source-zone-name* | **self**] **destination** [**self** | *destination-zone-name*] **Example:** `Router(config)# zone-pair security zp source z1 destination z2`	Creates a zone pair and enters security zone configuration mode. **Note** To apply a policy, you must configure a zone pair.
Step 18	**description** *line-of-description* **Example:** `Router(config-sec-zone)# description accounting network`	(Optional) Describes the zone pair.
Step 19	**exit** **Example:** `Router(config-sec-zone)# exit`	Exits security zone configuration mode and enters global configuration mode.
Step 20	**interface** *type number* **Example:** `Router(config)# interface ethernet 0`	Specifies an interface and enters interface configuration mode.
Step 21	**description** *line-of-description* **Example:** `Router(config-if)# description zone interface`	(Optional) Describes the interface.
Step 22	**zone-member security** *zone-name* **Example:** `Router(config-if)# zone-member security zone1`	Assigns an interface to a specified security zone. **Note** When you make an interface a member of a security zone, all traffic in and out of that interface (except the traffic bound for the router or initiated by the router) is dropped by default. To let traffic through the interface, you must make the zone part of a zone pair to which you apply a policy. If the policy permits traffic, traffic can flow through that interface.

	Command or Action	Purpose
Step 23	**ip address** *ip-address* **Example:** `Router(config-if)# ip address 10.70.0.1 255.255.255.0`	Assigns the interface IP address for the security zone.
Step 24	**ip wccp** {*service-id* {**group-listen** | **redirect** {**in** | **out**}} | **redirect exclude in** | **web-cache** {**group-listen** | **redirect** {**in** | **out**}} **Example:** `Router(config-if)# ip wccp 61 redirect in`	Specifies the following WCCP parameters on the interface: • The *service-id* argument defines a service identifier number from 1 to 254. • The **redirect exclude in** keywords are used to exclude inbound packets from outbound redirection. • The **web-cache** keyword is used to define the standard web caching service. • The **group-listen** keyword is used for discovering multicast WCCP protocol packets. • The **in** keyword is used to redirect to a cache engine the appropriate inbound packets. • The **out** keyword is used to redirect to a cache engine the appropriate outbound packets.
Step 25	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and enters global configuration mode.
Step 26	**zone-pair security** *zone-pair-name* {**source** *source-zone-name* | **self**]} **destination** [**self** | *destination-zone-name*] **Example:** `Router(config)# zone-pair security zp source z1 destination z2`	Creates a zone pair and enters security zone pair configuration mode.
Step 27	**service-policy type inspect** *policy-map-name* **Example:** `Router(config-sec-zone-pair)# service-policy type inspect p2`	Attaches a firewall policy map to the destination zone pair. **Note** If a policy is not configured between a pair of zones, traffic is dropped by default.
Step 28	**end** **Example:** `Router(config-sec-zone-pair)# end`	Exits security zone pair configuration mode and enters privileged EXEC mode.

Configuration Examples for Zone-Based Policy Firewall

Example: Configuring Layer 3 and Layer 4 Firewall Policies

The following example shows a Layer 3 or Layer 4 top-level policy. The traffic is matched to the ACL,199 and deep-packet HTTP inspection is configured. Configuring the **match access-group** 101 enables Layer 4 inspection. As a result, Layer 7 inspection is omitted unless the class-map is of type **mach-all**.

```
class-map type inspect match-all http-traffic
 match protocol http
 match access-group 101
policy-map type inspect mypolicy
 class type inspect http-traffic
  inspect
  service-policy http http-policy
```

Example: Configuring Layer 7 Protocol-Specific Firewall Policies

The following example shows how to match HTTP sessions that have a URL length greater than 500. The Layer 7 policy action **reset** is configured.

```
class-map type inspect http long-urls
 match request uri length gt 500
policy-map type inspect http http-policy
 class type inspect http long-urls
  reset
```

The following example shows how to enable inspection for ESMTP by including the **extended** keyword:

```
class-map type inspect c1
 match protocol smtp extended
policy-map type inspect p1
 class type inspect c1
  inspect
```

The **service-policy type inspect smtp** command is optional and can be entered after the **inspect** command.

Example Configuring an URL Filter Policy

```
parameter-map type urlfpolicy websense-param-map
class-map type urlfilter websense websense-param-map
policy-map type inspect urlfilter websense-policy
service-policy urlfilter websense-policy
```

Example: Configuring a URL Filter Policy Websense

The following example shows how to configure a URL filter policy for Websense:

- Example Websense Server Configuration, page 72
- Example Configuring the Websense Class Map, page 72
- Example Configuring the Websense URL Filter Policy, page 72

Example Websense Server Configuration

The following example shows how to configure the Websense server:

```
parameter-map type urlfpolicy websense websense-param-map
 server fw21-ss1-bldr.example.com timeout 30
 source-interface Loopback0
 truncate script-parameters
 cache-size maximum-entries 100
 cache-entry-lifetime 1
 block-page redirect-url http://abc.example.com
```

Example Configuring the Websense Class Map

The following example shows how to configure the Websense class map:

```
class-map type urlfilter websense match-any websense-class
 match server-response any
```

Example Configuring the Websense URL Filter Policy

The following example shows how to configure the Websense URL filter policy:

```
policy-map type inspect urlfilter websense-policy
 parameter type urlfpolicy websense websense-param-map
 class type urlfilter websense websense-class
  server-specified-action
  log
```

Example: Creating Security Zones and Zone Pairs and Attaching a Policy Map to a Zone Pair

Example: Creating a Security Zone

The following example shows how to create security zone z1, which is called Internet Traffic:

```
zone security z1
 description Internet Traffic
```

Example: Creating Zone Pairs

A zone-based firewall drops a packet if it is not explicitly allowed by a rule or policy in contrast to a legacy firewall, which permits a packet if it is not explicitly denied by a rule or policy by default.

A zone-based firewall behaves differently in handling intermittent ICMP responses generated within a zone as a result of the traffic flowing between in-zones and out-zones.

In a configuration where an explicit policy is configured for the self zone to go out of its zone and for the traffic moving between the in-zone and out-zone, if any intermittent ICMP responses are generated, then the zone-based firewall looks for a explicit permit rule for the ICMP protocol in the self zone to go out of its zone. An explicit inspect rule for the ICMP protocol for the self zone to go out-zone may not help because there is not a session associated with the intermittent ICMP responses.

The following example shows how to create zones z1 and z2, describes the zones, and specifies that the firewall policy map is applied in zone z2 for traffic flowing between the zones:

```
zone security z1
 description finance department networks
zone security z2
 description engineering services network
zone-pair security zp source z1 destination z2
```

Example: Assigning an Interface to a Security Zone

The following example shows how to attach Ethernet interface 0 to zone z1:

```
interface ethernet0
 zone-member security z1
```

Example Attaching a Policy Map to a Zone Pair

The following example shows how to attach a firewall policy map to the target zone pair p1:

```
zone-pair security zp source z1 destination z2
 service-policy type inspect p1
```

Example: Cisco IOS Firewall Configuration with WAAS

The following is a sample of an end-to-end WAAS traffic flow optimization configuration for the Cisco IOS firewall that uses WCCP to redirect traffic to a WAE device for traffic interception.

The following configuration example prevents traffic from being dropped between security zone members because the integrated-service-engine interface is configured on a different zone and each security zone member is assigned an interface. This change was made to the Cisco IOS firewall configuration in Cisco IOS Release 12.4(20)T and 12.4(22)T to address the different input interfaces.

```
ip wccp 61
ip wccp 62
ip inspect waas enable
class-map type inspect most-traffic
match protocol icmp
match protocol ftp
match protocol tcp
match protocol udp
policy--map type inspect p1
class type inspect most--traffic
inspect
class class--default
zone security zone-hr
zone security zone-outside
zone security z-waas
zone--pair security hr--out source zone-hr destination zone-outside
service--policy type inspect p1
zone--pair security out--hr source zone-outside destination zone-hr
service--policy type inspect p1
zone--pair security eng--out source zone-eng destination zone-outside
service--policy type inspect p1
interface GigabitEthernet0/0
description Trusted interface
ipaddress 10.70.0.1 255.255.255.0
ip wccp 61 redirect in
zone--member security zone-hr
```

```
interface GigabitEthernet0/0
description Trusted interface
ipaddress 10.71.0.2 255.255.255.0
ip wccp 61 redirect in
zone--member security zone-eng
interface GigabitEthernet0/1
description Untrusted interface
ipaddress 10.72.2.3 255.255.255.0
ip wccp 62 redirect in
zone--member security zone-outside
```

Note The new configuration in Cisco IOS Release 12.4(20)T and 12.4(22)T places the integrated service engine in its own zone and need not be part of any zone pair. The zone pairs are configured between zone-hr (zone-out) and zone-eng (zone-output).

```
interface Integrated--Service--Enginel/0
ipaddress 10.70.100.1 255.255.255.252
ip wccp redirect exclude in
zone--member security z-waas
```

Example: Protocol Match Data Not Incrementing for a Class Map

The following configuration example causes the match counter problem in the **show policy-map type inspect zone-pair** command output:

```
class-map type inspect match-any y
 match protocol tcp
 match protocol icmp
class-map type inspect match-all x
 match class y
```

However, cumulative counters for the configuration is displayed in the **show policy-map type inspect zone-pair command** output if the class map matches any class map:

```
show policy-map type inspect zone session
policy exists on zp zp
 Zone-pair: zp
  Service-policy inspect : fw
    Class-map: x (match-any)
      Match: class-map match-any y
        2 packets, 48 bytes   <======= Cumulative class map counters are incrementing.
        30 second rate 0 bps
        Match: protocol tcp
          0 packets, 0 bytes     <==== The match for the protocol is not incrementing.
          30 second rate 0 bps
        Match: protocol icmp
          0 packets, 0 bytes
          30 second rate 0 bps
   Inspect
      Number of Established Sessions = 1
      Established Sessions
        Session 53105C0 (10.1.1.2:19180)=>(172.1.1.2:23) telnet:tcp SIS_OPEN
          Created 00:00:02, Last heard 00:00:02
          Bytes sent (initiator:responder) [30:69]
    Class-map: class-default (match-any)
      Match: any
      Drop
        0 packets, 0 bytes
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	*Cisco IOS Master Commands List, All Releases*
Security commands	• *Cisco IOS Security Command Reference: Commands A to C* • *Cisco IOS Security Command Reference: Commands D to L* • *Cisco IOS Security Command Reference: Commands M to R* • Cisco IOS Security Command Reference: Commands S to Z
Quality of service commands	*Cisco IOS Quality of Service Solutions Command Reference*

Standards and RFCs

Standard & RFC	Title
RFC 1950	*ZLIB Compressed Data Format Specification version 3.3*
RFC 1951	*DEFLATE Compressed Data Format Specification version 1.3*
RFC 2616	*Hypertext Transfer Protocol—HTTP/1.1*

MIBs

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

Technical Assistance

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

Feature Information for Zone-Based Policy Firewall

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 1 Feature Information for Zone-Based Policy Firewall

Feature Name	Releases	Feature Information
Application Inspection and Control for HTTP—Phase 2	12.4(9)T	The Application Inspection and Control for HTTP—Phase 2 feature extends support for HTTP application firewall policies. The following commands were introduced or modified by this feature: **regexmatch body regex**, **match header count**, **match header length**, **match header regex**, **match request length**, **match request** , **match response status-line regex**.
E-mail Inspection Engine	15.1(1)S	The E-mail Inspection Engine feature allows the users to inspect POP3, IMAP, and E/SMTP e-mail traffic contained in SSL VPN tunneled connections that traverse the Cisco IOS router.

Feature Name	Releases	Feature Information
P2P Application Inspection and Control—Phase 1	12.4(9)T 12.4(20)T	The P2P Application Inspection and Control—Phase 1 feature introduces support for identifying and enforcing a configured policy for the following peer-to-peer applications: eDonkey, FastTrack, Gnutella Version 2, and Kazaa Version 2. Support for identifying and enforcing a configured policy for the following Instant Messenger applications is also introduced: AOL, MSN Messenger and Yahoo Messenger. In Release 12.4(20)T, support was added for the following applications: H.323 VoIP and SIP. In Release 12.4(20)T, support for the following IM applications was also added: ICQ and Windows Messenger. The following commands were introduced or modified by this feature: **class-map type inspect**, **class type inspect**, **clear parameter-map type protocol-info**, **debug policy-firewall, match file-transfer**, **match protocol (**zone**)**, **match search-file-name**, **match service**, **match text-chat**, **parameter-map type**, **policy-map type inspect, server (**parameter-map**)**, **show parameter-map type protocol-info**.
Rate-Limiting Inspected Traffic	12.4(9)T	The Rate-Limiting Inspected Traffic feature allows users to rate limit traffic within a Cisco IOS firewall (inspect) policy. Also, users can limit the absolute number of sessions that can exist on a zone pair. The following commands were introduced by this feature: **police (**zone policy**)**, **sessions maximum**.

Feature Name	Releases	Feature Information
Zone-Based Policy Firewall	12.4(6)T	The Zone-Based Policy Firewall feature provides a Cisco IOS unidirectional firewall policy between groups of interfaces known as zones. The following commands were introduced or modified by this feature: **class-map type inspect** , **class type inspect**, **clear parameter-map type protocol-info**, **debug policy-firewall**, **match body regex**, **match file-transfer**, **match header count**, **match header length**, **match header regex**, **match protocol** (**zone**), **match request length**, **match request regex**, **match response status-line regex**, **match search-file-name**, **match service**, **match text-chat**, **parameter-map type**, **policy-map type inspect**, **server** (parameter-map), **service-policy** (policy-map), **service-policy type inspect**, **show parameter-map type protocol-info**.
Zone-Based Firewall Support for MSRPC	15.1(4)M	The Zone-Based Firewall Support for MSRPC feature introduces zone-based policy firewall support for Microsoft Remote Procedure Calls. The following section provides information about this feature:

Feature Name	Releases	Feature Information
Zone-Based Firewall (ZBFW) Usability and Manageability	15.0(1)M 15.1(1)T	The Zone-Based Firewall Usability and Manageability features covered in this document are OoO packet processing support in zone-based firewalls, intrazone support in zone-based firewalls and enhanced debug capabilities. The following commands were introduced or modified by this feature: **clear ip ips statistics**, **debug cce dp named-db inspect**, **debug policy-firewall**, **debug ip virtual-reassembly list**, **parameter-map type ooo global**, **show parameter-map type ooo global**, **zone-pair security**. In Cisco IOS Release 15.1(1)T, the following commands were introduced or modified: **class-map type inspect**, **clear policy-firewall**, **log (**parameter-map type**)**, **match request regex**, **parameter-map type inspect**, **show parameter-map type inspect**, **show policy-firewall config**, **show policy-firewall mib**, **show policy-firewall sessions**, **show policy-firewall stats**, **show policy-firewall summary-log**.

VRF Aware Cisco IOS Firewall

VRF Aware Cisco IOS Firewall applies Cisco IOS Firewall functionality to VRF (Virtual Routing and Forwarding) interfaces when the firewall is configured on a service provider (SP) or large enterprise edge router. SPs can provide managed services to small and medium business markets.

The VRF Aware Cisco IOS Firewall supports VRF-aware URL filtering and VRF-lite (also known as Multi-VRF CE).

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

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 VRF Aware Cisco IOS Firewall

- Understand Cisco IOS firewalls.
- Configure VRFs.
- Verify that the VRFs are operational.

Restrictions for VRF Aware Cisco IOS Firewall

- VRF Aware Cisco IOS Firewall is not supported on Multiprotocol Label Switching (MPLS) interfaces.

- If two VPN networks have overlapping addresses, VRF-aware network address translation (NAT) is required for them to support VRF-aware Firewalls.
- When crypto tunnels belonging to multiple VPNs terminate on a single interface, you cannot apply per-VRF firewall policies.

Information About VRF Aware Cisco IOS Firewall

Cisco IOS Firewall

The Cisco IOS Firewall provides robust, integrated firewall and intrusion detection functionality for every perimeter of the network. Available for a wide range of Cisco IOS software-based routers, the Cisco IOS Firewall offers sophisticated security and policy enforcement for connections within an organization (intranet) and between partner networks (extranets), as well as for securing Internet connectivity for remote and branch offices.

The Cisco IOS Firewall enhances existing Cisco IOS security capabilities such as authentication, encryption, and failover, with state-of-the-art security features such as stateful, application-based filtering (context-based access control), defense against network attacks, per-user authentication and authorization, and real-time alerts.

The Cisco IOS Firewall is configurable via Cisco ConfigMaker software, an easy-to-use Microsoft Windows 95, Windows 98, NT 4.0 based software tool.

The Cisco IOS Firewall provides great value in addition to these benefits:

- Flexibility--Provides multiprotocol routing, perimeter security, intrusion detection, VPN functionality, and dynamic per-user authentication and authorization.
- Scalable deployment--Scales to meet any network's bandwidth and performance requirements.
- Investment protection--Leverages existing multiprotocol router investment.
- VPN support--Provides a complete VPN solution based on Cisco IOS IPSec and other CISCO IOS software-based technologies, including L2TP tunneling and quality of service (QoS).

The VRF Aware Cisco IOS Firewall is different from the non-VRF Aware Firewall because it does the following:

- Allows users to configure a per-VRF Firewall. The firewall inspects IP packets that are sent and received within a VRF.
- Allows SPs to deploy the firewall on the provider edge (PE) router.
- Supports overlapping IP address space, thereby allowing traffic from nonintersecting VRFs to have the same IP address.

- Supports per-VRF (not global) firewall command parameters and Denial-of-Service (DoS) parameters so that the VRF-aware Firewall can run as multiple instances (with VRF instances) allocated to various Virtual Private Network (VPN) customers.
- Performs per-VRF URL filtering.
- Generates VRF-specific syslog messages that can be seen only by a particular VPN. These alert and audit-trail messages allow network administrators to manage the firewall; that is, they can adjust firewall parameters, detect malicious sources and attacks, add security policies, and so forth. The vrf name is tagged to syslog messages being logged to the syslog server.

Both VFR Aware and non-VFR Aware Firewalls now allow you to limit the number of firewall sessions. Otherwise, it would be difficult for VRFs to share router resources because one VRF may consume a maximum amount of resources, leaving few resources for other VRFs. That would cause the denial of service to other VRFs. To limit the number of sessions, enter the **ipinspectname** command.

VRF

VPN Routing and Forwarding (VRF) is an IOS route table instance for connecting a set of sites to a VPN service. A VRF contains a template of a VPN Routing/Forwarding table in a PE router.

The overlapping addresses, usually resulting from the use of private IP addresses in customer networks, are one of the major obstacles to successful deployment of peer-to-peer VPN implementation. The MPLS VPN technology provides a solution to this dilemma.

Each VPN has its own routing and forwarding table in the router, so any customer or site that belongs to a VPN is provided access only to the set of routes contained within that table. Any PE router in the MPLS VPN network therefore contains a number of per-VPN routing tables and a global routing table that is used to reach other routers in the service provider network. Effectively, a number of virtual routers are created in a single physical router.

VRF-lite

VRF-lite is a feature that enables a service provider to support two or more VPNs, where IP addresses can be overlapped among the VPNs. VRF-lite uses input interfaces to distinguish routes for different VPNs and forms virtual packet-forwarding tables by associating one or more Layer 3 interfaces with each VRF. Interfaces in a VRF can be physical, such as Ethernet ports, or logical, such as VLAN switched virtual interfaces (SVIs). However, a Layer 3 interface cannot belong to more than one VRF at a time.

Note VRF-lite interfaces must be Layer 3 interfaces.

VRF-lite includes these devices:

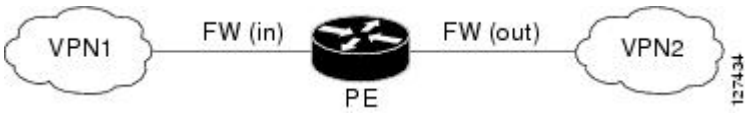
- Customer edge (CE) devices provide customer access to the service provider network over a data link to one or more provider edge (PE) routers. The CE device advertises the site's local routes to the PE router and learns the remote VPN routes from it. A Catalyst 4500 switch can be a CE.
- Provider edge (PE) routers exchange routing information with CE devices by using static routing or a routing protocol such as BGP, RIPv1, or RIPv2.
- Provider routers (or core routers) are any routers in the service provider network that do not attach to CE devices.
- The PE is only required to maintain VPN routes for those VPNs to which it is directly attached, eliminating the need for the PE to maintain all of the service provider VPN routes. Each PE router maintains a VRF for each of its directly connected sites. Multiple interfaces on a PE router can be associated with a single VRF if all of these sites participate in the same VPN. Each VPN is mapped to

a specified VRF. After learning local VPN routes from CEs, a PE router exchanges VPN routing information with other PE routers by using internal BGP (IBPG).

With VRF-lite, multiple customers can share one CE, and only one physical link is used between the CE and the PE. The shared CE maintains separate VRF tables for each customer, and switches or routes packets for each customer based on its own routing table. VRF-lite extends limited PE functionality to a CE device, giving it the ability to maintain separate VRF tables to extend the privacy and security of a VPN to the branch office.

In a VRF-to-VRF situation, if firewall policies are applied on both inbound and outbound interfaces as shown in the figure below, the firewall on the inbound interface takes precedence over the firewall on the outbound interface. If the incoming packets do not match against the firewall rules (that is, the inspection protocols) configured on the inbound interface, the firewall rule on the outbound interface is applied to the packet.

Figure 7 Firewall in a VRF-to-VRF Scenario



Per-VRF URL Filtering

The VRF-aware firewall supports per-VRF URL filtering. Each VPN can have its own URL filter server. The URL filter server typically is placed in the shared service segment of the corresponding VPN. (Each VPN has a VLAN segment in the shared service network.) The URL filter server can also be placed at the customer site.

AlertsandAuditTrails

CBAC generates real-time alerts and audit trails based on events tracked by the firewall. Enhanced audit trail features use SYSLOG to track all network transactions; recording time stamps, the source host, the destination host, ports used, and the total number of transmitted bytes, for advanced, session-based reporting. Real-time alerts send SYSLOG error messages to central management consoles upon detecting suspicious activity. Using CBAC inspection rules, you can configure alerts and audit trail information on a per-application protocol basis. For example, if you want to generate audit trail information for HTTP traffic, you can specify that in the CBAC rule covering HTTP inspection.

MPLS VPN

The MPLS VPN feature allows multiple sites to interconnect transparently through a service provider network. One service provider network can support several IP VPNs. Each VPN appears to its users as a private network, separate from all other networks. Within a VPN, each site can send IP packets to any other site in the same VPN.

Each VPN is associated with one or more VPN VRF instances. A VRF consists of an IP routing table, a derived Cisco Express Forwarding table, and a set of interfaces that use the forwarding table.

The router maintains a separate routing and Cisco Express Forwarding tables for each VRF. This prevents information from being sent outside the VPN and allows the same subnet to be used in several VPNs without causing duplicate IP address problems.

The router using Multiprotocol BGP (MP-BGP) distributes the VPN routing information using the MP-BGP extended communities.

VRF-aware NAT

Network Address Translation (NAT) allows a single device, such as a router, to act as an agent between the Internet (or public network) and a local (or private) network. Although NAT systems can provide broad levels of security advantages, their main objective is to economize on address space.

NAT allows organizations to resolve the problem of IP address depletion when they have existing networks and need to access the Internet. Sites that do not yet possess NIC-registered IP addresses must acquire them. Cisco IOS NAT eliminates concern and bureaucratic delay by dynamically mapping thousands of hidden internal addresses to a range of easy-to-get addresses.

In general, a NAT system makes it more difficult for an attacker to determine the following:

- Number of systems running on a network
- Type of machines and operating systems they are running
- Network topology and arrangement

NAT integration with MPLS VPNs allows multiple MPLS VPNs to be configured on a single device to work together. NAT can differentiate which MPLS VPN it receives IP traffic from even if the MPLS VPNS are all using the same IP addressing scheme. This enables multiple MPLS VPN customers to share services while ensuring that each MPLS VPN is completely separate from the other.

MPLS service providers would like to provide value-added services such as Internet connectivity, domain name servers (DNS), and VoIP service to their customers. This requires that their customers IP addresses be different when reaching the services. Because MPLS VPN allows customers to use overlapped IP addresses in their networks, NAT must be implemented to make the services possible.

There are two approaches to implementing NAT in the MPLS VPN network. NAT can be implemented on the CE router, which is already supported by NAT, or it can be implemented on a PE router. The NAT Integration with MPLS VPNs feature enables the implementation of NAT on a PE router in an MPLS cloud.

VRF-aware IPSec

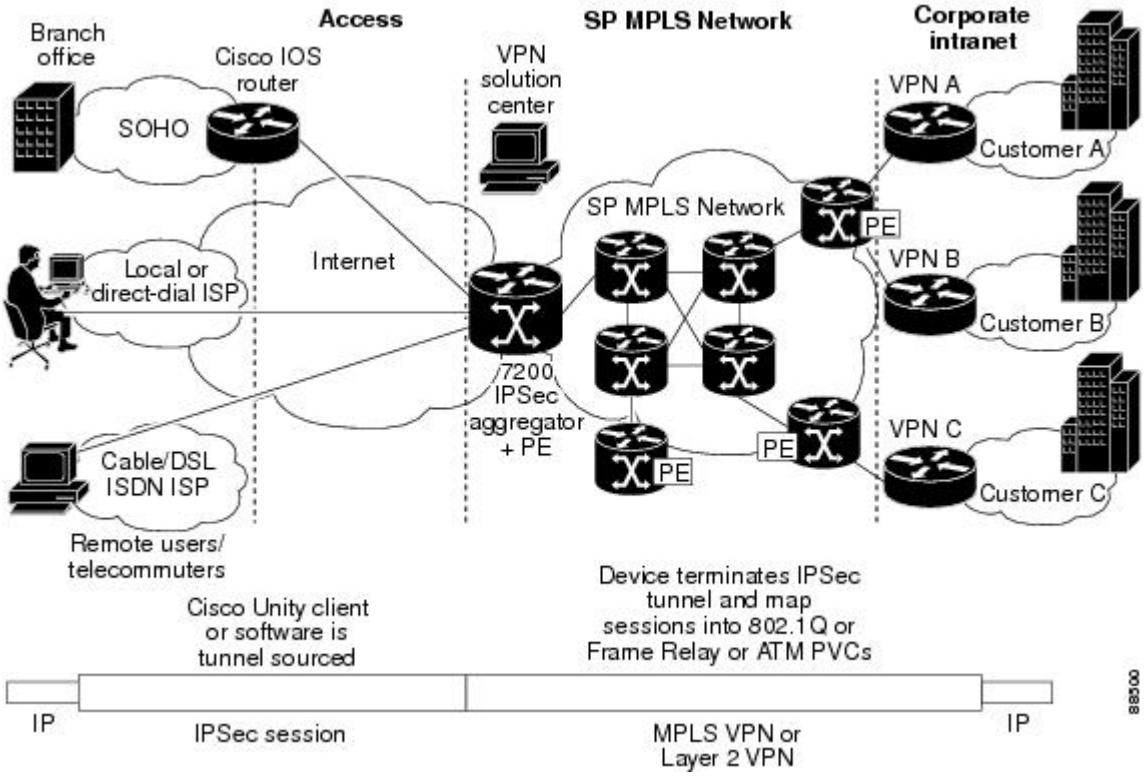
The VRF-aware IPSec feature maps an IP Security (IPSec) tunnel to an MPLS VPN. Using the VRF-aware IPSec feature, you can map IPSec tunnels to VRF instances using a single public-facing address.

Each IPSec tunnel is associated with two VRF domains. The outer encapsulated packet belongs to a VRF domain called the Front Door VRF (FVRF). The inner, protected IP packet belongs to a domain called the Inside VRF (IVRF). In other words, the local endpoint of the IPSec tunnel belongs to the FVRF, whereas the source and destination addresses of the inside packet belong to the IVRF.

One or more IPSec tunnels can terminate on a single interface. The FVRF of all these tunnels is the same and is set to the VRF that is configured on that interface. The IVRF of these tunnels can be different and depends on the VRF that is defined in the Internet Security Association and Key Management Protocol (ISAKMP) profile that is attached to a crypto map entry.

The figure below illustrates a scenario showing IPSec to MPLS and Layer 2 VPNs.

Figure 8 IPSec-to-MPLS and Layer 2 VPNs



VRF Aware Cisco IOS Firewall Deployment

A firewall can be deployed at many points within the network to protect VPN sites from Shared Service (or the Internet) and vice versa. The following firewall deployments are described:

- Distributed Network Inclusion of VRF Aware Cisco IOS Firewall, page 86
- Hub-and-Spoke Network Inclusion of VRF Aware Cisco IOS Firewall, page 88

Distributed Network Inclusion of VRF Aware Cisco IOS Firewall

A VRF Aware Cisco IOS Firewall in a distributed network has the following advantages:

- The firewall is distributed across the MPLS core, so the firewall processing load is distributed to all ingress PE routers.
- VPN Firewall features can be deployed in the inbound direction.
- Shared Service is protected from the VPN site at the ingress PE router; therefore, malicious packets from VPN sites are filtered at the ingress PE router before they enter the MPLS core.

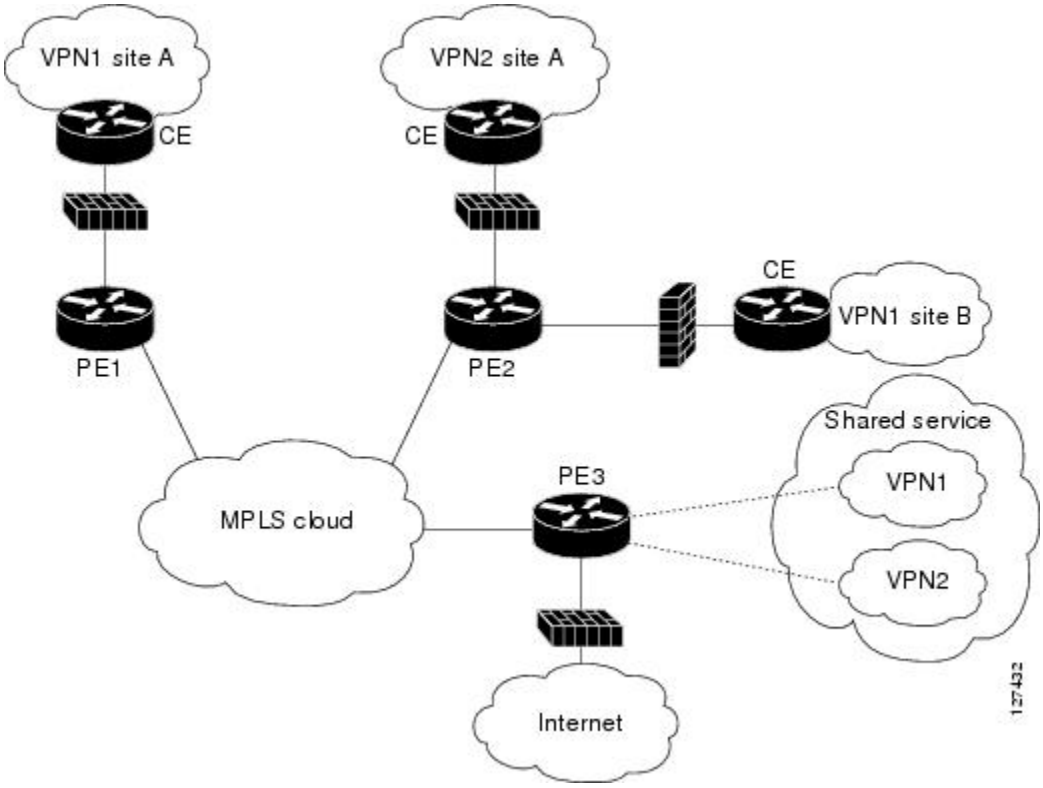
However, the following disadvantages exist:

- There is no centralized firewall deployment, which complicates the deployment and management of the firewall.
- Shared Service firewall features cannot be deployed in the inbound direction.

- The MPLS core is open to the Shared Service. Therefore, malicious packets from Shared Service are filtered only at the ingress PE router after traveling through all core routers.

The figure below illustrates a typical situation in which an SP offers firewall services to VPN customers VPN1 and VPN2, thereby protecting VPN sites from the external network (for example, Shared Services and the Internet) and vice versa.

Figure 9 Distributed Network



In this example, VPN1 has two sites, Site A and Site B, that span across the MPLS core. Site A is connected to PE1, and Site B is connected to PE2. VPN2 has only one site that is connected to PE2.

Each VPN (VPN1 and VPN2) has the following:

- A VLAN segment in the Shared Service that is connected to the corresponding VLAN subinterface on PE3.
- Internet access through the PE3 router that is connected to the Internet

A distributed network requires the following firewall policies:

- VPN Firewall (VPN1-FW and VPN2-FW)--Inspects VPN-generated traffic that is destined to Shared Service or the Internet and blocks all non-firewall traffic that is coming from outside (Shared Service or the Internet), thereby protecting the VPN sites from outside traffic. This firewall typically is deployed on the VRF interface of the ingress PE router that is connected to the VPN site being protected. It is deployed in the inbound direction because the VRF interface is inbound to the VPN site being protected.
- Shared Service Firewall (SS-FW)--Inspects Shared Service-originated traffic that is destined to VPN sites and blocks all non-firewall traffic that is coming from outside (the VPN site), thereby protecting

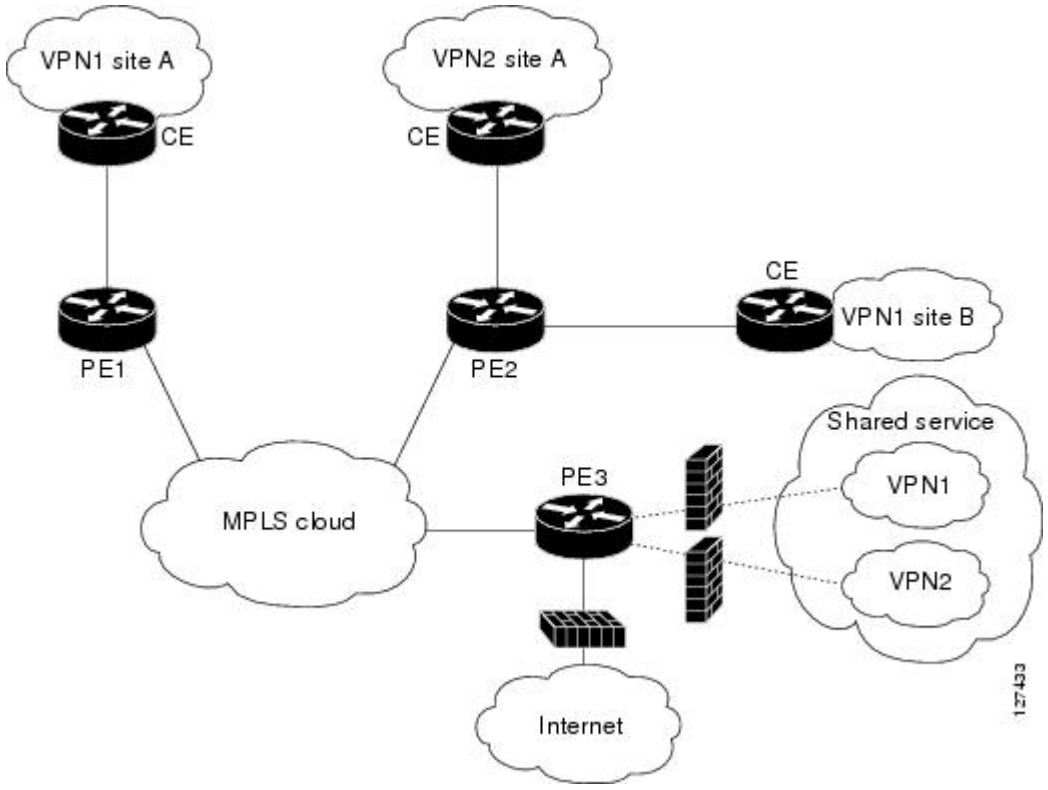
the Shared Service network from VPN sites. This firewall typically is deployed on the VRF interface of the ingress PE router that is connected to the VPN site from where the Shared Service is being protected. It is deployed in the outbound direction because the VRF interface is outbound to the Shared Service that is being protected.

- Generic-VPN Firewall (GEN-VPN-FW)--Inspects VPN-generated traffic that is destined to the Internet and blocks all non-firewall traffic that is coming from the Internet, thereby protecting all VPNs from the Internet. This firewall typically is deployed on the Internet-facing interface of the PE router that is connected to the Internet. It is deployed in the outbound direction because the Internet-facing interface is outbound to VPNs being protected.
- Internet Firewall (INET-FW)--Inspects Internet-generated traffic that is destined to Shared Service and blocks all non-firewall traffic that is coming from VPNs or Shared Service, thereby protecting the Internet from VPNs. This firewall typically is deployed on the Internet-facing interface of the PE router that is connected to the Internet. It is deployed in the inbound direction because the Internet-facing interface is inbound to the Internet being protected.

Hub-and-Spoke Network Inclusion of VRF Aware Cisco IOS Firewall

The figure below illustrates a hub-and-spoke network where the firewalls for all VPN sites are applied on the egress PE router PE3 that is connected to the Shared Service.

Figure 10 Hub-and-Spoke Network



Typically each VPN has a VLAN and/or VRF subinterface connected to the Shared Service. When a packet arrives from an MPLS interface, the inner tag represents the VPN-ID. MPLS routes the packet to the corresponding subinterface that is connected to Shared Service.

A Hub-and-Spoke network requires the following firewall policies:

- VPN Firewall (VPN1-FW and VPN2-FW)--Inspects VPN-generated traffic that is destined to Shared Service and blocks all non-firewall traffic that is coming from Shared Service, thereby protecting the VPN sites from Shared Service traffic. This firewall typically is deployed on the VLAN subinterface of the egress PE router that is connected to the Shared Service network. It is deployed in the outbound direction because the VLAN interface is outbound to the VPN site being protected.
- Shared Service Firewall (SS-FW)--Inspects Shared Service originated traffic that is destined to the VPN/Internet and blocks all non-firewall traffics that is coming from outside, thereby protecting the Shared Service network from VPN/Internet traffic. This firewall typically is deployed on the VLAN interface of the egress PE router that is connected to the Shared Service being protected. It is deployed in the inbound direction because the VLAN interface is inbound to the Shared Service being protected.
- Generic-VPN firewall (GEN-VPN-FW)--Inspects VPN-generated traffic that is destined to the Internet and blocks all non-firewall traffic that is coming from the Internet, thereby protecting all VPNs from the Internet. This firewall typically is deployed on the Internet-facing interface of the PE router that is connected to the Internet. It is deployed in the outbound direction because the Internet-facing interface is outbound to the VPNs being protected.
- Internet firewall (INET-FW)--Inspects Internet-generated traffic that is destined to Shared Service and blocks all non-firewall traffic that is coming from VPNs or Shared Service, thereby protecting the Internet from VPNs. This firewall typically is deployed on the Internet-facing interface of the PE router that is connected to the Internet. It is deployed in the inbound direction because the Internet-facing interface is inbound to the Internet being protected.

How to Configure VRF Aware Cisco IOS Firewall

Configuring and Checking ACLs to Ensure that Non-Firewall Traffic is Blocked

To configure ACLs and verify that only inspected traffic can pass through the firewall, perform the following steps.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip access-list extended** *access-list-name*
4. **interface** *interface-type*
5. **ip access-group** {*access-list-number* | *access-list-name*} {**in** | **out**}
6. **exit**

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 access-list extended** *access-list-name* **Example:** `Router(config)# ip access-list extended vpn-ac1`	Defines an extended IP ACL to block non-firewall traffic in both inbound and outbound directions.
Step 4	**interface** *interface-type* **Example:** `Router(config)# interface ethernet0/1.10`	Enters interface configuration mode and specifies an interface that is associated with a VRF.
Step 5	**ip access-group** {*access-list-number* | *access-list-name*} {**in** | **out**} **Example:** `Router(config-if)# ip access-group vpn-acl in`	Controls access to an interface. Applies the previously defined IP access list to a VRF interface whose non-firewall traffic is blocked.
Step 6	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode. Returns to global configuration mode.

Creating and Naming Firewall Rules and Applying the Rules to the Interface

To create and name firewall rules and apply the rules to the interface, perform the following steps.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip inspect name** *inspection-name* [**parametermax-sessions***number*] *protocol* [**alert** {**on** | **off**}] [**audit-trail** {**on** | **off**}] [**timeout***seconds*]
4. **interface** *interface-id*
5. **ip inspect** *rule-name* {**in** | **out**}
6. **exit**

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 inspect name** *inspection-name* [**parametermax-sessions***number*] *protocol* [**alert** {**on** | **off**}] [**audit-trail** {**on** | **off**}] [**timeout***seconds*] **Example:** `Router(config)# ip inspect name vpn_fw ftp`	Defines a set of inspection rules.
Step 4	**interface** *interface-id* **Example:** `Router(config)# interface ethernet0/1.10`	Enters interface configuration mode and specifies an interface that is associated with a VRF.
Step 5	**ip inspect** *rule-name* {**in** | **out**} **Example:** `Router(config-if)# ip inspect vpn_fw in`	Applies the previously defined inspection role to a VRF interface whose traffic needs to be inspected.

	Command or Action	Purpose
Step 6	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.

Identifying and Setting Firewall Attributes

To identify and set firewall attributes, perform the following steps.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip inspect tcp max-incomplete host** *number* **block-time** *minutes* [**vrf***vrf-name*]
4. **exit**

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 inspect tcp max-incomplete host** *number* **block-time** *minutes* [**vrf***vrf-name*] **Example:** `Router(config)# ip inspect tcp max-incomplete host 256 vrf bank-vrf`	Specifies threshold and blocking time values for TCP host-specific denial-of-service detection and prevention.

	Command or Action	Purpose
Step 4	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode.

Verifying the VRF Aware Cisco IOS Firewall Configuration and Functioning

Verify the configuration and functioning of the firewall by entering the commands shown below.

SUMMARY STEPS

1. **show ip inspect** {**name***inspection-name* | **config** | **interfaces** | **session** [**detail**] | **statistics** | **all**}[**vrf***vrf-name*]
2. **show ip urlfilter** {**config** | **cache** | **statistics**} [**vrf***vrf-name*]

DETAILED STEPS

Step 1 **show ip inspect** {**name***inspection-name* | **config** | **interfaces** | **session** [**detail**] | **statistics** | **all**}[**vrf***vrf-name*]
Use this command to view the firewall configurations, sessions, statistics, and so forth, pertaining to a specified VRF. For example, to view the firewall sessions pertaining to the VRF bank, enter the following command:

Example:

```
Router# show ip inspect interfaces vrf bank
```

Step 2 **show ip urlfilter** {**config** | **cache** | **statistics**} [**vrf***vrf-name*]
Use this command to view the configurations, cache entries, statistics, and so forth, pertaining to a specified VRF. For example, to view the URL filtering statistics pertaining to the VRF bank, enter the following command:

Example:

```
Router# show ip urlfilter statistics vrf bank
```

Configuration Examples for VRF Aware Cisco IOS Firewall

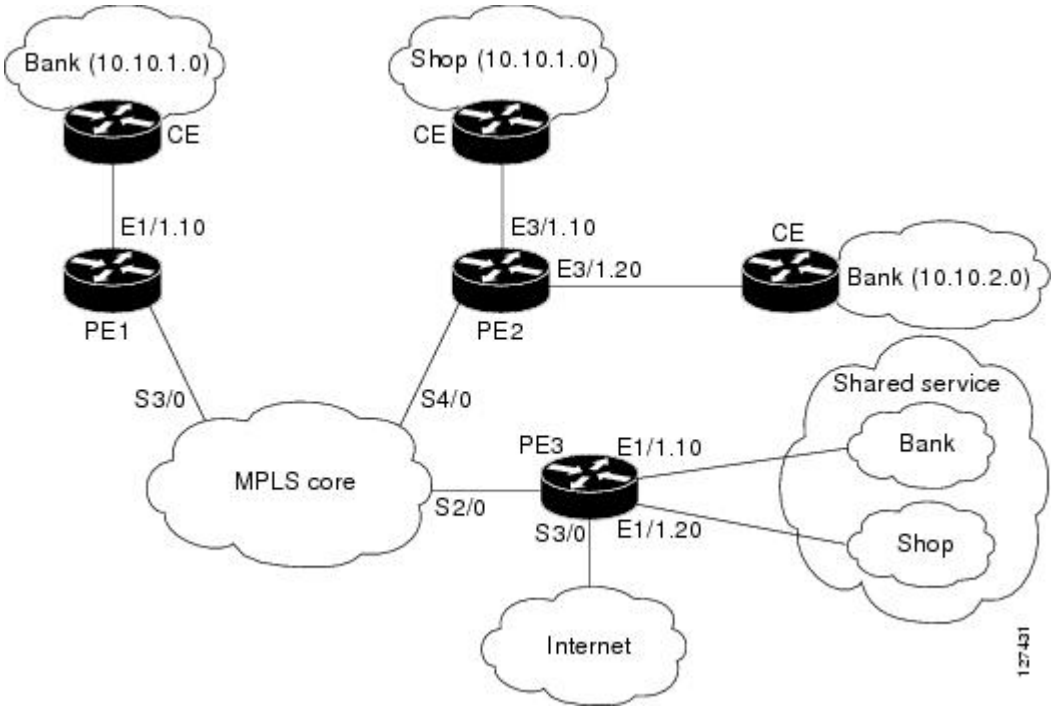
In the example illustrated in the figure below, a service provider offers firewall service to VPN customers Bank and Shop. The Bank VPN has the following two sites in an MPLS network:

- Site connected to PE1, whose network address is 10.10.1.0/24
- Site connected to PE2, whose network address is 10.10.2.0/24

The Bank VPN also has a VLAN network segment in Shared Service that is connected to PE3.

The Shop VPN has only one site, which is connected to PE4. The network address 10.10.1.0/24 is the same network address to which the Bank VPN site is connected.

Figure 11 VPN with Two Sites Across MPLS Network



Each VPN needs the following two firewalls:

- VPN firewall to protect the VPN site from Shared Services
- Shared Service (SS) firewall to protect SS from the VPN site

In addition, the following two firewalls are required:

- Internet firewall to protect VPNs from the Internet
- Generic VPN firewall to protect the Internet from VPNs

In this example, the security policies for Bank and Shop VPNs are as follows:

- Bank VPN Firewall--bank_vpn_fw (Inspects FTP, HTTP, and ESMTP protocols)
- Bank SS Firewall--bank_ss_fw (Inspects ESMTP protocol)
- Shop VPN Firewall--shop_vpn_fw (Inspects HTTP and RTSP protocols)
- Shop SS Firewall--shop_ss_fw (Inspects H323 protocol)

The security policies for the Internet firewall and generic VPN firewall are as follows:

- Internet firewall--inet_fw (Inspects HTTP and ESMTP protocols)
- Generic VPN firewall--gen_vpn_fw (Inspects FTP, HTTP, ESMTP, and RTSP protocols)

DISTRIBUTED NETWORK

PE1:

```
! VRF instance for the Bank VPN
ip vrf bank
rd 100:10
route-target export 100:10
route-target import 100:10

!
! VPN Firewall for Bank VPN protects Bank VPN from Shared Service
ip inspect name bank_vpn_fw ftp
ip inspect name bank_vpn_fw http
ip inspect name bank_vpn_fw esmtp

!
! Shared Service firewall for Bank VPN protects Shared Service from Bank VPN
ip inspect name bank_ss_fw esmtp

!
! VRF interface for the Bank VPN
interface ethernet0/1.10

!
! description of VPN site Bank to PE1
encapsulation dot1Q 10
ip vrf forwarding bank
ip address 10.10.1.2 255.255.255.0
ip access-group bank_ss_acl in
ip access-group bank_vpn_acl out
ip inspect bank_vpn_fw in
ip inspect bank_ss_fw out

!
! MPLS interface
interface Serial3/0
 ip unnumbered Loopback0

 tag-switching ip

 serial restart-delay 0

!
! ACL that protects the VPN site Bank from Shared Service
ip access-list extended bank_vpn_acl

 permit ip 10.10.2.0 0.0.0.255 10.10.1.0 0.0.0.255

 permit tcp any any eq smtp

 deny   ip  any any log
!
! ACL that protects Shared Service from VPN site Bank
ip access-list extended bank_ss_acl

 permit ip 10.10.1.0 0.0.0.255 10.10.2.0 0.0.0.255

 permit tcp any any eq ftp

 permit tcp any any eq http
 permit tcp any any eq smtp

 deny   ip  any any log
```

PE2:

```
! VRF instance for the Bank VPN
ip vrf bank
```

```
rd 100:10
route-target export 100:10
route-target import 100:10

!
! VRF instance for the Shop VPN
ip vrf shop
rd 200:20
route-target export 200:20
route-target import 200:20

!
! VPN firewall for Bank BPN protects Bank VPN from Shared Service
ip inspect name bank_vpn_fw ftp
ip inspect name bank_vpn_fw http
ip inspect name bank_vpn_fw esmtp

!
! Shared Service firewall for Bank VPN protects Shared Service from Bank VPN
ip inspect name bank_ss_fw esmtp

!
! VPN firewall for Shop VPN protects Shop VPN from Shared Service
ip inspect name shop_vpn_fw http
ip inspect name shop_vpn_fw rtsp

!
! Shared Service firewall for Shop VPN protects Shared Service from Shop VPN
ip inspect name shop_ss_fw h323
!
! VRF interface for the Bank VPN
interface Ethernet3/1.10

!
! description of VPN site Bank to PE2
encapsulation dot1Q 10
ip vrf forwarding bank
ip address 10.10.2.2 255.255.255.0
ip access-group bank_ss_acl in
ip access-group bank_vpn_acl out
ip inspect bank_vpn_fw in
ip inspect bank_ss_fw out

!
interface Ethernet3/1.20

!
! description of VPN site Shop to PE2
encapsulation dot1Q 20
ip vrf forwarding shop
ip address 10.10.1.2 255.255.255.0
ip access-group shop_ss_acl in
ip access-group shop_vpn_acl out
ip inspect shop_vpn_fw in
ip inspect shop_ss_fw out
interface Serial4/0

 ip unnumbered Loopback0

 tag-switching ip

 serial restart-delay 0

!
! ACL that protects the VPN site Bank from Shared Service
ip access-list extended bank_vpn_acl

 permit ip 10.10.1.0 0.0.0.255 10.10.2.0 0.0.0.255

 permit tcp any any eq smtp

 deny   ip  any any log
```

```
!
! ACL that protects Shared Service from VPN site Bank
ip access-list extended bank_ss_acl
 permit ip 10.10.2.0 0.0.0.255 10.10.1.0 0.0.0.255

 permit tcp any any eq ftp

 permit tcp any any eq http

 permit tcp any any eq smtp

 deny   ip  any any log

!
! ACL that protects VPN site Shop from Shared Service
ip access-list extended shop_vpn_acl

 permit tcp any any eq h323

 deny   ip any any log

!
ip access-list extended shop_ss_acl

 permit tcp any any eq http

 permit tcp any any eq rtsp
deny   ip  any any log
```

PE3:

```
! VRF instance for the Bank VPN
ip vrf bank
rd 100:10
route-target export 100:10
route-target import 100:10

!
! VRF instance for the Shop VPN
ip vrf shop
rd 200:20
route-target export 200:20
route-target import 200:20

!
! Generic VPN firewall to protect Shop and Bank VPNs from internet
ip inspect name gen_vpn_fw esmtp
ip inspect name gen_vpn_fw ftp
ip inspect name gen_vpn_fw http
ip inspect name gen_vpn_fw rtsp

!
! Internet firewall to prevent malicious traffic from being passed
! to internet from Bank and Shop VPNs
ip inspect name inet_fw esmtp
ip inspect name inet_fw http

!
! VRF interface for the Bank VPN
interface Ethernet1/1.10

!
! Description of Shared Service to PE3
encapsulation dot1Q 10
ip vrf forwarding bank
ip address 10.10.1.50 255.255.255.0

!
! VRF interface for the Shop VPN
interface Ethernet1/1.20
```

```
!
! Description of Shared Service to PE3
encapsulation dot1Q 20
ip vrf forwarding shop
ip address 10.10.1.50 255.255.255.0
interface Serial2/0

 ip unnumbered Loopback0

 tag-switching ip

 serial restart-delay 0

!
! VRF interface for the Bank VPN
interface Serial3/0

!
! Description of Internet-facing interface
ip address 192.168.10.2 255.255.255.0
ip access-group inet_acl out
ip access-group gen_vpn_acl in
ip inspect gen_vpn_fw out
ip inspect inet_fw in

!
! ACL that protects the Bank and Shop VPNs from internet
ip access-list extended gen_vpn_acl

 permit tcp any any eq smtp

 permit tcp any any eq www

 deny   ip  any any log

!
! ACL that protects internet from Bank and Shop VPNs
ip access-list extended inet_acl

 permit tcp any any eq ftp

 permit tcp any any eq http

 permit tcp any any eq smtp

 permit tcp any any eq rtsp

 deny   ip  any any log
```

HUB-AND-SPOKE NETWORK

PE3:

```
! VRF instance for the VPN Bank
ip vrf bank
rd 100:10
route-target export 100:10
route-target import 100:10

!
! VRF instance for the VPN Shop
ip vrf shop
rd 200:20
route-target export 200:20
route-target import 200:20

!
! VPN firewall for Bank BPN protects Bank VPN from Shared Service
ip inspect name bank_vpn_fw ftp
ip inspect name bank_vpn_fw http
```

```
ip inspect name bank_vpn_fw esmtp

!
! Shared Service firewall for Bank VPN protects Shared Service from Bank VPN
ip inspect name bank_ss_fw esmtp

!
! VPN firewall for Shop VPN protects Shop VPN from Shared Service
ip inspect name shop_vpn_fw http
ip inspect name shop_vpn_fw rtsp

!
! Shared Service firewall for Shop VPN protects Shared Service from Shop VPN
ip inspect name shop_ss_fw h323

!
! Generic VPN firewall protects Shop and Bank VPNs from internet
ip inspect name gen_vpn_fw esmtp
ip inspect name gen_vpn_fw ftp
ip inspect name gen_vpn_fw http
ip inspect name gen_vpn_fw rtsp

!
! Internet firewall prevents malicious traffic from being passed
! to internet from Bank and Shop VPNs
ip inspect name inet_fw esmtp
ip inspect name inet_fw http

!
! VRF interface for the Bank VPN
interface Ethernet1/1.10

!
! description of Shared Service to PE3
encapsulation dot1Q 10
ip vrf forwarding bank
ip address 10.10.1.50 255.255.255.0
ip access-group bank_ss_acl out
ip access-group bank_vpn_acl in
ip inspect bank_vpn_fw out
ip inspect bank_ss_fw in

!
! VRF interface for the Shop VPN
interface Ethernet1/1.20
!
! description of Shared Service to PE3
encapsulation dot1Q 20
ip vrf forwarding shop
ip address 10.10.1.50 255.255.255.0
ip access-group shop_ss_acl out
ip access-group shop_vpn_acl in
ip inspect shop_vpn_fw out
ip inspect shop_ss_fw in
interface Serial2/0

 ip unnumbered Loopback0

 tag-switching ip

 serial restart-delay 0
!
! VRF interface for the Bank VPN
interface Serial3/0

!
! description of Internet-facing interface
ip address 192.168.10.2 255.255.255.0
ip access-group inet_acl out
ip access-group gen_vpn_acl in
ip inspect gen_vpn_fw out
ip inspect inet_fw in
```

```
!
! ACL that protects the VPN site Bank from Shared Service
ip access-list extended bank_vpn_acl

 permit tcp any any eq smtp

 deny   ip  any any log
!
! ACL that protects Shared Service from VPN site Bank
ip access-list extended bank_ss_acl

 permit tcp any any eq ftp

 permit tcp any any eq http

 permit tcp any any eq smtp

 deny   ip  any any log

!
! ACL that protects VPN site Shop from Shared Service
ip access-list extended shop_vpn_acl

 permit tcp any any eq h323

 deny   ip any any log

!
ip access-list extended shop_ss_acl

 permit tcp any any eq http
 permit tcp any any eq rtsp
 deny   ip  any any log
!
! ACL that protects the Bank and Shop VPNs from internet
ip access-list extended gen_vpn_acl

 permit tcp any any eq smtp

 permit tcp any any eq www
 deny   ip  any any log
!
! ACL that protects internet from Bank and Shop VPNs
ip access-list extended inet_acl

 permit tcp any any eq ftp
 permit tcp any any eq http

 permit tcp any any eq smtp

 permit tcp any any eq rtsp

 deny   ip  any any log
```

In the example illustrated in the figure below, the Cisco IOS Firewall is configured on PE1 on the VRF interface E3/1. The host on NET1 wants to reach the server on NET2.

Figure 12 Sample VRF Aware Cisco IOS Firewall Network

The configuration steps are followed by a sample configuration and log messages.

1. Configure VRF on PE routers.
2. Ensure that your network supports MPLS traffic engineering.
3. Confirm that the VRF interface can reach NET1 and NET2.
4. Configure the VRF Aware Cisco IOS Firewall.
   a. Configure and apply ACLs.
   b. Create Firewall rules and apply them to the VRF interface.
5. Check for VRF firewall sessions.

VRF Configuration on PE1

```
! configure VRF for host1
ip cef
ip vrf vrf1
rd 100:1
route-target export 100:1
route-target import 100:1
exit
end
!
! apply VRF to the interface facing CE
interface ethernet3/1
ip vrf forwarding vrf1
ip address 190.1.1.2 255.255.0.0
!
! make the interface facing the MPLS network an MPLS interface
interface serial2/0
mpls ip
ip address 191.171.151.1 255.255.0.0
!
! configure BGP protocol for MPLS network
router bgp 100
no synchronization
bgp log-neighbor-changes
neighbor 191.171.151.2 remote-as 100
neighbor 191.171.151.2 update-source serial2/0
no auto-summary
address-family vpnv4
neighbor 191.171.151.2 activate
neighbor 191.171.151.2 send-community both
exit-address-family
address-family ipv4 vrf vrf1
redistribute connected
redistribute static
no auto-summary
no synchronization
exit-address-family
!
! configure VRF static route to reach CE network
ip route vrf vrf1 192.168.4.0 255.255.255.0 190.1.1.1
```

VRF Configuration on PE2

```
! configure VRF for host2
ip cef
ip vrf vrf1
rd 100:1
route-target export 100:1
route-target import 100:1
!
! apply VRF on CE-facing interface
interface fastethernet0/0
ip vrf forwarding vrf1
ip address 193.1.1.2 255.255.255.0
!
! make MPLS network-facing interface an MPLS interface
interface serial1/0
mpls ip
ip address 191.171.151.2 255.255.0.0
!
! configure BGP protocol for MPLS network
router bgp 100
no synchronization
bgp log-neighbor-changes
neighbor 191.171.151.1 remote-as 100
neighbor 191.171.151.1 update-source serial1/0
no auto-summary
address-family vpnv4
neighbor 191.171.151.1 activate
neighbor 191.171.151.1 send-community both
```

```
exit-address-family
address-family ipv4 vrf vrf1
redistribute connected
redistribute static
no auto-summary
no synchronization
exit-address-family
!configure VRF static route to reach CE network
ip route vrf vrf1 192.168.4.0 255.255.255.0 193.1.1.1
```

Configuration on CE1

```
interface e0/1
ip address 190.1.1.1 255.255.255.0
interface e0/0
ip address 192.168.4.2 255.255.255.0
ip route 192.168.104.0 255.255.255.0 190.1.1.2
```

Configuration on CE2

```
interface e0/1
ip address 190.1.1.1 255.255.255.0
interface e0/0
ip address 192.168.4.2 255.255.255.0
ip route 192.168.4.0 255.255.255.0 193.1.1.2
```

Configure Firewall on PE1 and Apply on the VRF Interface

```
! configure ACL so that NET2 cannot access NET1
ip access-list extended 105
permit tcp any any fragment
permit udp any any fragment
deny tcp any any
deny udp any any
permit ip any any
!
! apply ACL to VRF interface on PE1
interface ethernet3/1
ip access-group 105 out
!
! configure firewall rule
ip inspect name test tcp
!
! apply firewall rule on VRF interface
interface ethernet3/1
 ip inspect test in
```

Check for VRF Firewall Sessions When Host on NET1 Tries to Telnet to Server on NET2

```
show ip inspect session vrf vrf1
Established Sessions
 Session 659CE534 (192.168.4.1:38772)=>(192.168.104.1:23) tcp SIS_OPEN
!
! checking for ACLs
show ip inspect session detail vrf vrf1 | include ACL 105
  Out SID 192.168.104.1[23:23]=>192.168.4.1[38772:38772] on ACL 105
(34 matches)
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
VRF-lite	*Catalyst 4500 Series Switch Cisco IOS Software Configuration Guide , Release 12.2*
MPLS VPN	*Configuring a Basic MPLS VPN , Document ID 13733*
VRF Aware IPSec	• *VRF-Aware IPSec* feature module, Release 12.2(15)T • *Cisco IOS Security Configuration Guide* , Release 12.3 • *Cisco IOS Security Command Reference* , Release 12.3T
VRF management	*Cisco 12000/10720 Router Manager User's Guide , Release 3.2*
NAT	• *NAT and Stateful Inspection of Cisco IOS Firewall* , White Paper • *Configuring Network Address Translation: Getting Started* --Document ID 13772

Standards

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

MIBs

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

RFCs

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

Technical Assistance

Description	Link
The Cisco 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 VRF Aware Cisco IOS Firewall

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 2 Feature Information for VRF Aware Cisco IOS Firewall

Feature Name	Releases	Feature Information
VRF Aware Cisco IOS Firewall	12.3(14)T	VRF Aware Cisco IOS Firewall applies Cisco IOS Firewall functionality to VRF (Virtual Routing and Forwarding) interfaces when the firewall is configured on a service provider (SP) or large enterprise edge router. SPs can provide managed services to small and medium business markets. The VRF Aware Cisco IOS Firewall supports VRF-aware URL filtering and VRF-lite (also known as Multi-VRF CE). The following commands were introduced or modified:**clearipurlfiltercache**, **ipinspectalert-off**, **ipinspectaudittrail**, **ipinspectdns-timeout**, **ipinspectmax-incompletehigh**, **ipinspectmax-incompletelow**, **ipinspectname**, **ipinspectone-minutehigh**, **ipinspectone-minutelow**, **ipinspecttcpfinwait-time**, **ipinspecttcpidle-time**, **ipinspecttcpmax-incompletehost**, **ipinspecttcpsynwait-time**, **ipinspectudpidle-time**, **ipurlfilteralert**, **ipurlfilterallowmode**, **ipurlfilteraudit-trail**, **ipurlfiltercache**, **ipurlfilterexclusive-domain**, **ipurlfilterexclusive-domain**, **ipurlfiltermax-request**, **ipurlfiltermax-resp-pak**, **ipurlfilterservervendor**, **ipurlfilterurlf-server-log**, **showipinspect**, **showipurlfiltercache**, **showipurlfilterconfig**, **showipurlfilterstatistics**.

Glossary

CE router --customer edge router. A router that is part of a customer network and that interfaces to a provider edge (PE) router.

CBAC --Context-Based Access Control. A protocol that provides internal users with secure access control for each application and for all traffic across network perimeters. CBAC enhances security by scrutinizing both source and destination addresses and by tracking each application's connection status.

data authentication --Refers to one or both of the following: data integrity, which verifies that data has not been altered, or data origin authentication, which verifies that the data was actually sent by the claimed sender.

data confidentiality --A security service where the protected data cannot be observed.

edge router --A router that turns unlabeled packets into labeled packets, and vice versa.

firewall --A router or access server, or several routers or access servers, designated as a buffer between any connected public networks and a private network. A firewall router uses access lists and other methods to ensure the security of the private network.

inspection rule --A rule that specifies what IP traffic (which application-layer protocols) will be inspected by CBAC at an interface.

intrusion detection --The Cisco IOS Firewall's Intrusion Detection System (Cisco IOS IDS) identifies the most common attacks, using signatures to detect patterns of misuse in network traffic.

IPSec --IP Security Protocol. A framework of open standards developed by the Internet Engineering Task Force (IETF). IPSec provides security for transmission of sensitive data over unprotected networks such as the Internet.

managed security services --A comprehensive set of programs that enhance service providers’ abilities to meet the growing demands of their enterprise customers. Services based on Cisco solutions include managed firewall, managed VPN (network based and premises based), and managed intrusion detection.

NAT --Network Address Translation. Translates a private IP address used inside the corporation to a public, routable address for use outside of the corporation, such as the Internet. NAT is considered a one-to-one mapping of addresses from private to public.

PE router --provider edge router. A router that is part of a service provider's network and is connected to a customer edge (CE) router.

skinny --Skinny Client Control Protocol (SCCP). A protocol that enables CBAC to inspect Skinny control packets that are exchanged between a Skinny client and the Call Manager (CM); CBAC then configures the router (also known as the Cisco IOS Firewall) to enable the Skinny data channels to traverse through the router.

traffic filtering --A capability that allows you to configure CBAC to permit specified TCP and UDP traffic through a firewall only when the connection is initiated from within the network you want to protect. CBAC can inspect traffic for sessions that originate from either side of the firewall.

traffic inspection --CBAC inspection of traffic that travels through the firewall to discover and manage state information for TCP and UDP sessions. This state information is used to create temporary openings in the firewall’s access lists to allow return traffic and additional data connections for permissible sessions (sessions that originated from within the protected internal network).

UDP -- User Datagram Protocol. 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.

VPN --Virtual Private Network. Enables IP traffic to travel securely over a public TCP/IP network by encrypting all traffic from one network to another. A VPN uses “tunneling” to encrypt all information at the IP level.

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

VRF table --A table that stores routing data for each VPN. The VRF table defines the VPN membership of a customer site attached to the network access server (NAS). Each VRF table comprises an IP routing table, a derived Cisco Express Forwarding (CEF) table, and guidelines and routing protocol parameters that control the information that is included in the routing table.

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

Cisco IOS Firewall-H.323 V3 V4 Support

The H.323 V3/V4 Support feature provides the Cisco IOS firewall with support for the H.323 Voice over IP (VoIP) Version 3 and Version 4 protocols. With Version 3 and Version 4 support, features like call signaling (H.225) over User Datagram Protocol (UDP), multiple call signaling over a single TCP connection, T.38 Fax over TCP, and address resolution using border elements are supported. Support for a rate-limiting mechanism to monitor call attempt rate and call aggregation is also introduced and can be enabled.

H.323 is a multiprotocol and multichannel suite. Channel negotiation parameters are embedded inside encoded H.323 control messages. The Base H.323 Application Layer Gateway (ALG) Support feature provides support in Cisco IOS firewall environments to process the H.323 control messages.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

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 Cisco IOS Firewall-H.323 V3 V4 Support

Restrictions for Cisco IOS Firewall-H.323 V3 V4 Support

General

- Inspection of H.323 signaling over secure (encrypted) channel is not supported.

ASR 1000 Series Routers

- Support is provided for gateway terminals using the H.323v4 with H.225v4 and H.245v7 protocols only.
- Backward compatibility is provided for H.323v2 messages only. H.323v1 messages are ignored.
- Multipoint conferencing, managed by the Multipoint Control Unit (MCU), is not supported.
- The T.120 protocol is not supported.
- Cisco IOS firewall support is limited to H.323 Direct Call Signaling and H.225 RAS Call Signaling only.

Information About Cisco IOS Firewall-H.323 V3 V4 Support

H.323 and H.225 RAS Implementation

H.225 Registration, Admission, and Status (RAS) signaling in Cisco IOS firewalls is a signaling protocol that is used between endpoints (such as gateways) and gatekeepers. The H.225 standard is used by H.323 for call setup. H.225 includes RAS control, which is used to communicate with the gatekeeper. A RAS signaling channel enables connections between the gatekeeper and H.323 endpoints.

H.323 and H.245 Protocol

During the call setup between H.323 terminals, the following protocols are used:

- H.225 Call Signaling
- H.245 Call Control

Both protocol messages contain embedded IP addresses and ports. Any message passing through a router running Cisco IOS firewall must be decoded, inspected, and encoded back to the packet.

In order for an H.323 call to take place, an H.225 connection on TCP port 1720 needs to be opened. When the H.225 connection is opened, the H.245 session is initiated and established. This connection can take place on a separate channel from the H.225 or it can be done using H.245 tunneling on the same H.225 channel whereby the H.245 messages are embedded in the H.225 messages and set on the previously established H.225 channel.

If the H.245 tunneled message is not understood the Cisco IOS firewall cannot translate the message, which causes a failure in media traffic. H.245 FastConnect procedures will not help because FastConnect is terminated as soon as an H.245 tunneled message is sent.

H.323 Version 3 and Version 4 Features Supported

The table below lists the H.323 Version 3 and Version 4 features supported by Cisco IOS firewall. For information on the H.323 standard, see the Standards section.

Note On the ASR 1000 series routers Cisco IOS firewall support is limited to H.323 Direct Call Signaling and H.225 RAS Call Signaling only.

Table 3 H.323 Standards Features Supported by Cisco IOS Firewall

Standard	Features Supported by Cisco IOS Firewall
H.323 Version 3	• Caller ID • Annex E--Protocol for Multiplexed Call Signaling Transport • Annex G--Communication Between Administrative Domains • Generic information transport • Maintaining and reusing connections using call signaling channel • Supplementary services (call hold, call park and call pickup, message waiting indication, and call waiting)
H.323 Version 4	• Additive registrations • Alternate gatekeepers • Endpoint capacity • Bandwidth management • Usage information reporting • Generic extensibility framework • Indicating desired protocols • Call status reporting • Enhancements to Annex D (Real-Time Fax) • QoS support for H.323 enhancements • Dual Tone Multifrequency (DTMF) digit transmission using Real-Time Protocol (RTP)

Base H.323 ALG Support

The Base H.323 ALG Support feature provides support for ALGs to perform protocol specific issues such as processing embedded IP address and port numbers and extracting connection and session information from control channels and sessions.

Encoded channel-negotiation parameters are embedded in H.323 control messages. In Cisco IOS firewall environments, the system must intercept these messages and invoke the H.323 ALG to process the messages.

The H.323 ALG performs the following tasks to process the messages:

- Intercepts the H.323 control messages on the H.225.0 TCP port 1720 and on the dynamically negotiated H.245 TCP port.
- Decodes the intercepted control messages.
- Parses the decoded control messages, identifies the embedded IP address and port-number pairs and builds action info tokens based on the IP address and port-number pairs.
- Sends the action info tokens to the Cisco IOS firewall for processing.

The Cisco IOS firewall performs the actions indicated by the action info tokens. The actions performed include session and door entry lookup, creation, and deletion, or address and port translation. When the Cisco IOS firewall completes the action, it fills the action-result field in the action-info token, with the translated IP address and port number, or with an action failure indicator. Cisco IOS firewall then adds a flag to indicate if the packet should be dropped or forwarded. Finally, it returns the action info token to the H.323 ALG.

- Receives the modified action info token from the Cisco IOS firewall and either drops or forwards the packet based on information in the action info token.

The table below lists the H.323 control messages processed by the Base H.323 ALG Support feature. For more information on the H.323 standard, see the Standards section.

Table 4 H.323 Control Messages Processed by Base H.323 ALG Support

Protocol	Messages
H.225.0 Call Signalling	• Setup • Alert • Call proceed • Connect • Facility • Progress • Empty • ReleaseComplete • SetupAcknowlege
H.245 Media Control **Note** If tunnelling mode is enabled H.245 messages may be embedded within H.225.0 messages	• OpenLogicalChannel • OpenLogicalAck • CloseLogicalChannel • CloseLogicalAck

Support of Rate Limiting Mechanism

In addition to supporting Version 3 and Version 4 of the H.323 protocol, support is introduced for a rate-limiting mechanism to monitor call attempt rate and call aggregation. Rate limiting is more important for voice applications where gateways and gatekeepers are set up in less secure arrangements such as a Demilitarized Zone (DMZ). A DMZ can be vulnerable to attack from the Internet.

Rate Limiting of H.323 Traffic Messages

Rate limiting of H.323 traffic control messages is based on actions on H.323 class maps. The messages that are to be rate limited are specified through match message statements within the class map. The rate-limit threshold value is specified by a rate limit command, as an action on the H.323 class map. The rate limit command limits the message attempt rate; it limits the number of H.323 messages being sent per second to and from an end point. Rate Limiting can be used to control call attempt rate.

Note While configuring the **rate-limit** command, do not configure the **allow** or **reset** commands. An error message is displayed if you try to configure the **allow** or **reset** commands while configuring the **rate-limit** command and vice versa.

How to Configure Cisco IOS Firewall-H.323 V3 V4 Support

Configuring a Firewall Policy for H.323 Traffic

Configuring a Class Map for H.323 Traffic

Perform this task to define the class map that for H.323 traffic that is to be permitted between zones.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect** [**match-any** | **match-all**] **class-map-name**
4. **match protocol protocol-name [parameter-map] [signature]**
5. **match protocol h225ras**
6. match protocol h323-annexe
7. match protocol h323-nxg
8. **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 type inspect** [**match-any** | **match-all**] **class-map-name** **Example:** `Router(config)# class-map type inspect match-any h323-traffic-class`	Creates a Layer 3 and Layer 4 (Top Level) inspect type class map and enters class-map configuration mode.
Step 4	**match protocol protocol-name [parameter-map] [signature]** **Example:** `Router(config-cmap)# match protocol h323`	Configures the match criterion for a class map on the basis of the specified protocol.
Step 5	**match protocol h225ras** **Example:** `Router(config-cmap)# match protocol h225ras`	Configures the match criterion for a class map on the basis of a specified protocol. **Note** You should specify the **h225ras** keyword to create a class map for H.225 RAS protocol classification. For a list of supported protocols, use the command-line interface (CLI) help option (**?**) on your platform.
Step 6	match protocol h323-annexe **Example:** `Router(config-cmap)# match protocol h323-annexe`	Enables the inspection of H.323 Protocol Annex E traffic.

	Command or Action	Purpose
Step 7	match protocol h323-nxg **Example:** `Router(config-cmap)# match protocol h323-nxg`	Enables the inspection of H.323 Protocol Annex G traffic.
Step 8	**end** **Example:** `Router(config-cmap)# end`	Exits class-map configuration mode and enters privileged EXEC mode.

Configuring a Policy Map for H.323 Traffic

Perform this task to create a policy map for H.323 traffic.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map type inspect policy-map-name**
4. **class type inspect** *class-map-name*
5. **inspect [parameter-map-name]**
6. **exit**

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	**policy-map type inspect policy-map-name** **Example:** `Router(config)# policy-map type inspect h323-policy`	Creates a Layer 3 or Layer inspect type policy map.
Step 4	**class type inspect** *class-map-name* **Example:** `Router(config)# class type inspect h323-traffic-class`	Specifies the traffic (class) on which an action is to be performed. **Note** The *class-map-name* value must match the appropriate class map name specified via the **class-map type inspect**command.
Step 5	**inspect [parameter-map-name]** **Example:** `Router(config)# inspect`	Enables Cisco IOS stateful packet inspection. **Note** The actions **drop** or **allow** may also be used instead of the **inspect** command here.
Step 6	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode and enters privileged EXEC mode.

Configuring a Zone-Pair for H.323 Traffic and Applying an H.323 Policy Map

Perform this task to configure a zone-pair for H.323 traffic and to apply an H.323 policy map to the traffic.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **zone security** *zone-pair-name*
4. **exit**
5. **zone security** *zone-pair-name*
6. **exit**
7. **zone security** *zone-pair-name*
8. **exit**
9. **zone-pair security zone-pair-name** {**source source-zone-name**| **self**} **destination** [**self** | **destination-zone-name**]
10. **service-policy type inspect** *policy-map-name*
11. **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	**zone security** *zone-pair-name* **Example:** `Router(config) zone security in-out`	Specifies the name of the zone-pair and enters security zone configuration mode.
Step 4	**exit** **Example:** `Router(config-sec-zone) exit`	Exits security zone configuration mode and enters global configuration mode.
Step 5	**zone security** *zone-pair-name* **Example:** `Router(config) zone security inside`	Creates the source zone from which traffic originates and enters security zone configuration mode.
Step 6	**exit** **Example:** `Router(config-sec-zone) exit`	Exits security zone configuration mode and enters global configuration mode.
Step 7	**zone security** *zone-pair-name* **Example:** `Router(config) zone security outside`	Creates the destination zone to which the traffic is bound and enters security zone configuration mode.

	Command or Action	Purpose
Step 8	**exit** **Example:** `Router(config-sec-zone) exit`	Enters global configuration mode.
Step 9	**zone-pair security zone-pair-name** {**source source-zone-name**| **self**} **destination** [**self** | **destination-zone-name**] **Example:** `Router(config)# zone-pair security in-out source inside destination outside`	Associates a zone-pair and declares the names of the routers from which traffic is originating (source) and to which traffic is bound (destination).
Step 10	**service-policy type inspect** *policy-map-name* **Example:** `Router(config-sec-zone)# service-policy type inspect h323-policy`	Attaches a firewall policy map to a zone-pair and enters security zone configuration mode.
Step 11	**end** **Example:** `Router(config-sec-zone)# end`	Exits security zone configuration mode and enters privileged EXEC mode.

Configuring Rate Limiting of H.323 Traffic Control Messages

Perform this task to configure a rate limit on H.323 traffic control messages.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect protocol-name** [**match-any**| **match-all**] **class-map-name**
4. **match message message-name**
5. **exit**
6. **policy-map type inspect** *protocol-name policy-map-name*
7. **class type inspect** *protocol-name class-map-name*
8. **rate-limit** *limit-number*
9. **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 type inspect protocol-name** [**match-any**| **match-all**] **class-map-name** **Example:** `Router(config)# class-map type inspect h323 match-any h323-ratelimit-class`	Creates a Layer 7 (application-specific) inspect type class map and enters class-map configuration mode.
Step 4	**match message message-name** **Example:** `Router(config-cmap)# match message setup`	Configures the match criterion for a class map on the basis of H.323 protocol messages.
Step 5	**exit** **Example:** `Router(config-cmap)# exit`	Exits class-map configuration mode and returns to global configuration mode.
Step 6	**policy-map type inspect** *protocol-name policy-map-name* **Example:** `Router(config)# policy-map type inspect h323 h323-ratelimit-policy`	Creates a Layer 7 inspect type policy map and enters policy-map configuration mode.

	Command or Action	Purpose
Step 7	**class type inspect** *protocol-name class-map-name* **Example:** `Router(config-pmap)# class type inspect h323 h323-ratelimit-class`	Specifies the Layer 7 traffic (class) on which an action is to be performed and enters policy-map class configuration mode. **Note** The *class-map-name* value must match the appropriate class map name specified via the **class-map type inspect**command.
Step 8	**rate-limit** *limit-number* **Example:** `Router(config-pmap-c)# rate limit 1000`	Limits the number of messages that strike the Cisco IOS firewall every second.
Step 9	**end** **Example:** `Router(config-cmap-c)# end`	Exits policy-map class configuration mode and enters privileged EXEC mode.

Configuring Deep Packet Inspection on a Layer 3 Policy Map

Perform this task to configure deep packet inspection on a Layer 3 policy map.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map type inspect policy-map-name**
4. **class type inspect class-map-name**
5. **service-policy** *protocol-name policy-map-name*
6. **end**

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**policy-map type inspect policy-map-name** **Example:** `Router(config)# policy-map type inspect h323-policy`	Creates a Layer 3 and Layer 4 inspect type policy map.
Step 4	**class type inspect class-map-name** **Example:** `Router(config-pmap)# class type inspect h323-traffic-class`	Specifies the traffic (class) on which an action is to be performed and enters policy-map configuration mode.
Step 5	**service-policy** *protocol-name policy-map-name* **Example:** `Router(config-pmap-c)# service-policy h323 h323-ratelimit-policy`	Attaches a Layer 7 policy map to a top-level policy map.
Step 6	**end** **Example:** `Router(config-cmap-c)# end`	Exits policy-map class configuration mode and enters privileged EXEC mode.

Configuration Examples for Cisco IOS Firewall-H.323 V3 V4 Support

Example Configuring a Voice Policy to Inspect H.323 Annex E Packets

The following example shows how to configure a voice policy to inspect the H.323 protocol Annex E packets for the “my-voice-class” class map:

```
class-map type inspect match-all my-voice-class
 match protocol h323-annexe
```

Example Configuring a H.323 Class-Map to Match Specific Messages

The following example shows how to configure an H.323 specific class map to match H.225 setup or release-complete messages only:

```
class-map type inspect h323 match-any my_h323_rt_msgs
 match message setup
 match message release-complete
```

Example Configuring a Voice Policy to Inspect H.323 Annex G Packets

The following example shows how to configure a voice policy to inspect the H.323 protocol Annex E packets for the “my-voice-class” class map:

```
class-map type inspect match-all my-voice-class
 match protocol h323-nxg
```

Example Configuring a Voice Policy to Limit Call Attempt Rate

The following example shows how to configure a voice policy to limit the call attempt rate to 16 calls per second for the calls terminated at 192.168.2.1.

```
access-list 102 permit ip any host 192.168.2.1
!
class-map type inspect match-all my_voice_class
 match protocol h323
 match access-group 102
!
class-map type inspect h323 match-any my_h323_rt_msgs
 match message setup
 policy-map type inspect h323 my_h323_policy
!
class type inspect h323 my_h323_rt_msgs
 rate-limit 16
!
policy-map type inspect my_voice_policy
 class type inspect my_voice_class
 inspect
 service-policy h323 my_h323_policy
!
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
Cisco IOS security commands	*Cisco IOS Security Command Reference*
Overview of the H.323 Standard	"Information About H.323" section in H.323 Overview module
Description of H.323 and RAS support in Cisco IOS firewall	H.323 RAS Support in Cisco IOS Firewall module
Overview of class maps and policy maps for zone-based policy firewalls	"Class Maps and Policy Maps for Zone-Based Policy Firewalls" section in the Zone-Based Policy Firewall module
Description of how to configure a zone-based policy firewall	"How to Configure Zone-Based Policy Firewall" section in the Zone-Based Policy Firewall module

Standards

Standard	Title
ITU-T H.225.0	Call signalling protocols and media stream packetization for packet-based multimedia communication systems
ITU-T H.245	Control protocol for multimedia communication
ITU-T H.323 (H.323 Version 4 and earlier)	Packet-based multimedia communications systems
ITU-T H.450	Supplementary services for multimedia

MIBs

MIB	MIBs Link
No new or modified MIBs are supported.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

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

Technical Assistance

Description	Link
The Cisco 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 Cisco IOS Firewall-H.323 V3 V4 Support

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

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

Table 5 Feature Information for Cisco IOS Firewall - H.323 V3/V4 Support

Feature Name	Releases	Feature Information
Cisco IOS Firewall--H.323 V3/V4 Support	12.4(20)T	This feature introduces support for a range of H.323 Version 3 and Version 4 features and support for a rate-limiting mechanism to monitor call attempt rate and call aggregation. The following commands were introduced or modified: **class-map type inspect**, **class type inspect**, **match message**, **match protocol h323-annexe**, **match protocol h323-nxg**, **match protocol (zone)**, **policy-map type inspect**, **rate-limit (firewall)**, **service-policy (policy-map)**, **service-policy type inspect**.

H.323 RAS Support in Cisco IOS Firewall

This feature introduces support for H.225 Registration, Admission, and Status (RAS) signaling in Cisco IOS firewalls. RAS is a signaling protocol that is used between endpoints (such as gateways) and gatekeepers.

The H.225 standard is used by H.323 for call setup. H.255 includes RAS control, which is used to communicate with the gatekeeper. A RAS signaling channel enables connections between the gatekeeper and H.323 endpoints.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

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 H.323 RAS Support in Cisco IOS Firewall

H.225 RAS inspection is supported only with zone-based policy firewall inspection.

How to Configure a Firewall Policy for H.323 RAS Protocol Inspection

Configuring a Class Map for H.323 RAS Protocol Inspection

Use this task to configure a class map for classifying network traffic.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect** [**match-any** | **match-all**] *class-map-name*
4. **match access-group** {*access-group* | **name** *access-group-name*}
5. **match protocol** *protocol-name* [**signature**]
6. **match protocol** *protocol-name* [**signature**]
7. **match class-map** *class-map-name*
8. **exit**

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 type inspect** [**match-any** | **match-all**] *class-map-name* **Example:** `Router(config)# class-map type inspect match-all c1`	Creates a Layer 3 or Layer 4 inspect type class map and enters class-map configuration mode.
Step 4	**match access-group** {*access-group* | **name** *access-group-name*} **Example:** `Router(config-cmap)# match access-group 101`	(Optional) Configures the match criterion for a class map based on the access control list (ACL) name or number.

	Command or Action	Purpose
Step 5	**match protocol** *protocol-name* [**signature**] **Example:** `Router(config-cmap)# match protocol h225ras`	Configures the match criterion for a class map on the basis of a specified protocol. **Note** You should specify the **h225ras** keyword to create a class-map for H.225 RAS protocol classification. For a list of supported protocols, use the command-line interface (CLI) help option (**?**) on your platform.
Step 6	**match protocol** *protocol-name* [**signature**] **Example:** `Router(config-cmap)# match protocol h323`	Configures the match criterion for a class map on the basis of a specified protocol. **Note** You should specify the **h323** keyword to create a class-map for H.323 protocol classification.
Step 7	**match class-map** *class-map-name* **Example:** `Router(config-cmap)# match class-map c1`	(Optional) Specifies a previously defined class as the match criterion for a class map.
Step 8	**exit** **Example:** `Router(config-cmap)# exit`	Returns to global configuration mode.

Creating a Policy Map for H.323 RAS Protocol Inspection

Use this task to create a policy map for a firewall policy that will be attached to zone pairs.

Note If you are creating an inspect type policy map, only the following actions are allowed: drop, inspect, police, and pass.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map type inspect** *policy-map-name*
4. **class type inspect** *class-name*
5. **inspect** [*parameter-map-name*]
6. **police rate** bps burst size
7. **drop** [**log**]
8. **pass**
9. **exit**

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 type inspect** *policy-map-name* **Example:** `Router(config)# policy-map type inspect p1`	Creates a Layer 3 and Layer 4 inspect type policy map and enters policy-map configuration mode.
Step 4	**class type inspect** *class-name* **Example:** `Router(config-pmap)# class type inspect c1`	Specifies the traffic (class) on which an action is to be performed and enters policy-map class configuration mode.
Step 5	**inspect** [*parameter-map-name*] **Example:** `Router(config-pmap-c)# inspect inspect-params`	Enables Cisco IOS stateful packet inspection.
Step 6	**police rate** bps burst size **Example:** `Router(config-pmap-c)# police rate 2000 burst 3000`	(Optional) Limits traffic matching within a firewall (inspect) policy.
Step 7	**drop** [**log**] **Example:** `Router(config-pmap-c)# drop`	(Optional) Drops packets that are matched with the defined class. **Note** The actions **drop** and **pass** are exclusive, and the actions **inspect** and **drop** are exclusive; that is, you cannot specify both of them.

	Command or Action	Purpose
Step 8	**pass** **Example:** `Router(config-pmap-c)# pass`	(Optional) Allows packets that are matched with the defined class.
Step 9	**exit** **Example:** `Router(config-pmap-c)# exit`	Returns to policy-map configuration mode.

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What to Do Next

After configuring an H.323 RAS protocol firewall policy, you want to attach the policy to a zone pair. For information on completing this task, see the “Zone-Based Policy Firewall” module.

Configuration Examples for H.225 RAS Protocol Inspection

Example H.323 RAS Protocol Inspection Configuration

The following example shows how to configure an H.323 RAS protocol inspection policy:

```
class-map type inspect match-any c1
 match protocol h323
 match protocol h225ras
class-map type inspect match-all c2
 match protocol icmp
!
policy-map type inspect p1
 class type inspect c1
 inspect
 class class-default
  drop
policy-map type inspect p2
 class type inspect c2
 inspect
 class class-default
  drop
!
zone security z1
 description One-Network zone
zone security z2
 description Two-Network zone
zone-pair security zp source z1 destination z2
 service-policy type inspect p1
zone-pair security zp-rev source z2 destination z1
```

```
 service-policy type inspect p2
!
interface FastEthernet1/0
 ip address 10.0.0.0 255.255.0.0
 zone-member security z1
 duplex auto
 speed auto
!
interface FastEthernet1/1
 ip address 10.0.1.1 255.255.0.0
 zone-member security z2
 duplex auto
 speed auto
```

Example H.225 RAS Firewall Policy Configuration

The following example shows how to configure the firewall policy to inspect H.225 RAS messages:

```
interface GigabitEthernet 0/1/5
 ip address 172.16.0.0 255.255.0.0
 zone-member security private
 no shut
!
interface GigabitEthernet 0/1/6
 ip address 192.168.0.0 255.255.0.0
 zone-member security internet
 no shut
!
zone security private
zone security internet
!
class-map type inspect match-any internet-traffic-class
 match protocol h225ras
 match protocol h323
!
policy-map type inspect private-internet-policy
 class type inspect internet-traffic-class
 inspect
 class class-default
!
zone-pair security private-internet source private destination internet
 service-policy type inspect private-internet-policy
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
Zone-based policy configuration commands	*Cisco IOS Security Command Reference*
Zone-based policy information: configurations, examples, descriptions	Zone-Based Policy Firewall Zone-Based Policy Firewall Design Guide

MIBs

MIB	MIBs Link
No new or modified MIBs are supported.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

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 H.323 RAS Support in Cisco IOS Firewall

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 H.323 RAS Support

Feature Name	Releases	Feature Information
H.323 RAS Support in Cisco IOS Firewall	12.4(11)T	This feature introduces support for H.255 Registration, Admission, and Status (RAS) signaling in Cisco IOS firewalls. The following commands were introduced or modified: **match protocol (zone)**.

Cisco IOS Firewall-SIP Enhancements ALG and AIC

Enhanced Session Initiation Protocol (SIP) inspection in the Cisco IOS firewall provides basic SIP inspect functionality (SIP packet inspection and pinholes opening) as well as protocol conformance and application security. These enhancements give you more control than in previous releases on what policies and security checks to apply to SIP traffic and the capability to filter out unwanted messages or users.

The development of additional SIP functionality in Cisco IOS software provides increased support for Cisco Call Manager (CCM), Cisco Call Manager Express (CCME), and Cisco IP-IP Gateway based voice/video systems. Application Layer Gateway (ALG), and Application Inspection and Control (AIC) SIP enhancements also support RFC 3261 and its extensions.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

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 Cisco IOS Firewall-SIP Enhancements ALG and AIC

The following prerequisites apply to the configuration of Cisco IOS Firewall--SIP Enhancements: ALG and AIC.

Hardware Requirements

- One of the following router platforms:
  - Cisco 861, Cisco 881, or Cisco 881G routers
  - Cisco 1700 routers
  - Cisco 1800 routers
  - Cisco 2600 routers
  - Cisco 2800 routers
  - Cisco 3700 routers
  - Cisco 3800 routers
  - Cisco 7200 routers
  - Cisco 7300 routers

Software Requirements

- Cisco IOS Release 12.4(15)XZ or a later release.

Restrictions for Cisco IOS Firewall-SIP Enhancements ALG and AIC

DNS Name Resolution

Although SIP methods can have Domain Name System (DNS) names instead of raw IP addresses, this feature currently does not support DNS names.

Earlier Releases of Cisco IOS Software

Some Cisco IOS releases earlier than Release 12.4(15)XZ may accept the configuration commands for SIP that are shown in this document; however, those earlier versions will not function properly.

Information About Cisco IOS Firewall-SIP Enhancements ALG and AIC

Firewall and SIP Overviews

This section provides an overview of the Cisco IOS firewall and SIP.

Cisco IOS Firewall

The Cisco IOS firewall extends the concept of static access control lists (ACLs) by introducing dynamic ACL entries that open on the basis of the necessary application ports on a specific application and close

these ports at the end of the application session. The Cisco IOS firewall achieves this functionality by inspecting the application data, checking for conformance of the application protocol, extracting the relevant port information to create the dynamic ACL entries, and closing these ports at the end of the session. The Cisco IOS firewall is designed to easily allow a new application inspection whenever support is needed.

Session Initiation Protocol

SIP is an application-layer control (signaling) protocol for creating, modifying, and terminating sessions with one or more participants. These sessions could include Internet telephone calls, multimedia distribution, and multimedia conferences. SIP is based on an HTTP-like request/response transaction model. Each transaction consists of a request that invokes a particular method or function on the server and at least one response.

SIP invitations used to create sessions carry session descriptions that allow participants to agree on a set of compatible media types. SIP makes use of elements called proxy servers to help route requests to the user's current location, authenticate and authorize users for services, implement provider call-routing policies, and provide features to users. SIP also provides a registration function that allows users to upload their current locations for use by proxy servers. SIP runs on top of several different transport protocols.

Firewall for SIP Functionality Description

The Firewall for SIP Support feature allows SIP signaling requests to traverse directly between gateways or through a series of proxies to the destination gateway or phone. After the initial request, if the Record-Route header field is not used, subsequent requests can traverse directly to the destination gateway address as specified in the Contact header field. Thus, the Cisco IOS firewall is aware of all surrounding proxies and gateways and allows the following functionality:

- SIP signaling responses can travel the same path as SIP signaling requests.
- Subsequent signaling requests can travel directly to the endpoint (destination gateway).
- Media endpoints can exchange data between each other.

SIP UDP and TCP Support

RFC 3261 is the current RFC for SIP, which replaces RFC 2543. This feature supports the SIP User Datagram Protocol (UDP) and the TCP format for signaling.

SIP Inspection

This section describes the deployment scenarios supported by the Cisco IOS Firewall--SIP, ALG, and AIC Enhancements feature.

Cisco IOS Firewall Between SIP Phones and CCM

The Cisco IOS firewall is located between CCM or CCME and SIP phones. SIP phones are registered to CCM or CCME through the firewall, and any SIP calls from or to the SIP phones pass through the firewall.

Cisco IOS Firewall Between SIP Gateways

The Cisco IOS firewall is located between two SIP gateways, which can be CCM, CCME, or a SIP proxy. Phones are registered with SIP gateways directly. The firewall sees the SIP session or traffic only when there is a SIP call between phones registered to different SIP gateways. In some scenarios an IP-IP gateway can also be configured on the same device as the firewall. With this scenario all the calls between the SIP gateways are terminated in the IP-IP gateway.

Cisco IOS Firewall with Local CCME and Remote CCME/CCCM

The Cisco IOS firewall is located between two SIP gateways, which can be CCM, CCME, or a SIP proxy. One of the gateways is configured on the same device as the firewall. All the phones registered to this gateway are locally inspected by the firewall. The firewall also inspects SIP sessions between the two gateways when there is a SIP call between them. With this scenario the firewall locally inspects SIP phones on one side and SIP gateways on the other side.

Cisco IOS Firewall with Local CCME

The Cisco IOS firewall and CCME is configured on the same device. All the phones registered to the CCME are locally inspected by the firewall. Any SIP call between any of the phones registered will also be inspected by the Cisco IOS firewall.

How to Configure Cisco IOS Firewall-SIP Enhancements ALG and AIC

Configuring a Policy to Allow RFC 3261 Methods

Perform this task to configure a policy to allow basic RFC 3261 methods and block extension methods.

Note The Cisco IOS Firewall--SIP Enhancements: ALG and AIC feature provides essential support for the new SIP methods such as UPDATE and PRACK, as CCM 5.x and CCME 4.x also use these methods.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect** *protocol-name* **match-any** *class-map-name*
4. **match request method** *method-name*
5. **exit**
6. **class-map type inspect** *protocol-name* **match-any** *class-map-name*
7. **match request method** *method-name*
8. **exit**
9. **policy-map type inspect** *protocol-name policy-map-name*
10. **class type inspect** *protocol-name class-map-name*
11. **allow**
12. **exit**
13. **class type inspect** *protocol-name class-map-name*
14. **reset**
15. **exit**

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 type inspect** *protocol-name* **match-any** *class-map-name* **Example:** `Router(config)# class-map type inspect sip match-any sip-class1`	Creates an inspect type class map and enters class-map configuration mode.

	Command or Action	Purpose
Step 4	**match request method** *method-name* **Example:** `Router(config-cmap)# match request method invite`	Matches RFC 3261 methods. Methods include the following: • ack, bye, cancel, info, invite, message, notify, options, prack, refer, register, subscribe, update.
Step 5	**exit** **Example:** `Router(config-cmap)# exit`	Exits class-map configuration mode.
Step 6	**class-map type inspect** *protocol-name* **match-any** *class-map-name* **Example:** `Router(config)# class-map type inspect sip match-any sip-class2`	Creates an inspect type class map and enters class-map configuration mode.
Step 7	**match request method** *method-name* **Example:** `Router(config-cmap)# match request method message`	Matches RFC 3261 methods, which include the following: • ack, bye, cancel, info, invite, message, notify, options, prack, refer, register, subscribe, update.
Step 8	**exit** **Example:** `Router(config-cmap)# exit`	Exits class-map configuration mode.
Step 9	**policy-map type inspect** *protocol-name policy-map-name* **Example:** `Router(config)# policy-map type inspect sip sip-policy`	Creates an inspect type policy map and enters policy-map configuration mode.
Step 10	**class type inspect** *protocol-name class-map-name* **Example:** `Router(config-pmap)# class type inspect sip sip_class1`	Specifies the class on which the action is performed and enters policy-map class configuration mode.

	Command or Action	Purpose
Step 11	**allow** **Example:** `Router(config-pmap-c)# allow`	Allows SIP inspection.
Step 12	**exit** **Example:** `Router(config-pmap-c)# exit`	Exits policy-map class configuration mode.
Step 13	**class type inspect** *protocol-name class-map-name* **Example:** `Router(config-pmap)# class type inspect sip sip-class2`	Specifies the class on which the action is performed and enters policy-map class configuration mode.
Step 14	**reset** **Example:** `Router(config-pmap-c)# reset`	Resets the class map.
Step 15	**exit** **Example:** `Router(config-pmap-c)# exit`	Exits policy-map class configuration mode.

Configuring a Policy to Block Messages

Perform this task to configure a policy to block SIP messages coming from a particular proxy device.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **parameter-map type regex** *parameter-map-name*
4. **pattern** *url-pattern*
5. **exit**
6. **class-map type inspect** *protocol-name class-map-name*
7. **match request header** *field* **regex** *regex-param-map*
8. **exit**
9. **policy-map type inspect** *protocol-name policy-map-name*
10. **class type inspect** *protocol-name class-map-name*
11. **reset**
12. **exit**

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	**parameter-map type regex** *parameter-map-name* **Example:** `Router(config)# parameter-map type regex unsecure-proxy`	Configures a parameter-map type to match a specific traffic pattern and enters profile configuration mode.
Step 4	**pattern** *url-pattern* **Example:** `Router(config-profile)# pattern “compromised.server.com”`	Matches a call based on the SIP uniform resource identifier (URI).

	Command or Action	Purpose
Step 5	**exit** **Example:** `Router(config-profile)# exit`	Exits profile configuration mode.
Step 6	**class-map type inspect** *protocol-name class-map-name* **Example:** `Router(config)# class-map type inspect sip sip-class`	Creates an inspect type class map and enters class-map configuration mode.
Step 7	**match request header** *field* **regex** *regex-param-map* **Example:** `Router(config-cmap)# match request header Via regex unsecure-proxy`	Configures a class-map type to match a specific request header pattern.
Step 8	**exit** **Example:** `Router(config-cmap)# exit`	Exits class-map configuration mode.
Step 9	**policy-map type inspect** *protocol-name policy-map-name* **Example:** `Router(config)# policy-map type inspect sip sip-policy`	Creates an inspect type policy map and enters policy-map configuration mode.
Step 10	**class type inspect** *protocol-name class-map-name* **Example:** `Router(config-pmap)# class type inspect sip sip-class`	Specifies the class on which the action is performed and enters policy-map class configuration mode.
Step 11	**reset** **Example:** `Router(config-pmap-c)# reset`	Resets the class map.

	Command or Action	Purpose
Step 12	**exit** **Example:** `Router(config-pmap-c)# exit`	Exits policy-map class configuration mode.

Configuring a 403 Response Alarm

Perform this task to configure a policy to generate an alarm whenever a 403 response is returned.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **parameter-map type regex** *parameter-map-name*
4. **pattern** *url-pattern*
5. **exit**
6. **class-map type inspect** *protocol-name class-map-name*
7. **match response status regex** *regex-parameter-map*
8. **exit**
9. **policy-map type inspect** *protocol-name policy-map-name*
10. **class type inspect** *protocol-name class-map-name*
11. **log**
12. **exit**

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	**parameter-map type regex** *parameter-map-name* **Example:** `Router(config)# parameter-map type regex allowed-im-users`	Configures a parameter-map type to match a specific traffic pattern and enters profile configuration mode.
Step 4	**pattern** *url-pattern* **Example:** `Router(config-profile)# pattern “403”`	Matches a call based on the SIP URI.
Step 5	**exit** **Example:** `Router(config-profile)# exit`	Exits profile configuration mode.
Step 6	**class-map type inspect** *protocol-name class-map-name* **Example:** `Router(config)# class-map type inspect sip sip-class`	Creates an inspect type class map and enters class-map configuration mode.
Step 7	**match response status regex** *regex-parameter-map* **Example:** `Router(config-cmap)# match response status regex allowed-im-users`	Configures a class-map type to match a specific response pattern.
Step 8	**exit** **Example:** `Router(config-cmap)# exit`	Exits class-map configuration mode.
Step 9	**policy-map type inspect** *protocol-name policy-map-name* **Example:** `Router(config)# policy-map type inspect sip sip-policy`	Creates an inspect type policy map and enters policy-map configuration mode.

	Command or Action	Purpose
Step 10	**class type inspect** *protocol-name class-map-name* **Example:** `Router(config-pmap)# class type inspect sip sip-class`	Specifies the class on which the action is performed and enters policy-map class configuration mode.
Step 11	**log** **Example:** `Router(config-pmap-c)# log`	Generates a log of messages.
Step 12	**exit** **Example:** `Router(config)# exit`	Exits policy-map class configuration mode.

Limiting Application Messages

Perform this task to configure a policy to rate-limit INVITE messages.

Note While configuring the **rate-limit** command, do not configure the **allow** or **reset** commands. An error message is displayed if you try to configure the **allow** or **reset** commands while configuring the **rate-limit** command and vice versa.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect** *protocol-name* **match-any** *class-map-name*
4. **match request method** *method-name*
5. **exit**
6. **policy-map type inspect** *protocol-name policy-map-name*
7. **class type inspect** *protocol-name class-map-name*
8. **rate-limit** *limit-number*
9. **exit**
10. **exit**
11. **class-map type inspect match-any** *class-map-name*
12. **match protocol** *protocol-name*
13. **exit**
14. **policy-map type inspect** *policy-map-name*
15. **class type inspect** *class-map-name*
16. **inspect**
17. **service-policy** *protocol-name policy-map-name*
18. **exit**

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 type inspect** *protocol-name* **match-any** *class-map-name* **Example:** `Router(config)# class-map type inspect sip match-any class-2`	Creates an inspect type class map and enters class-map configuration mode.

	Command or Action	Purpose
Step 4	**match request method** *method-name* **Example:** `Router(config-cmap)# match request method invite`	Matches RFC 3261 methods. Methods include the following: • ack, bye, cancel, info, invite, message, notify, options, prack, refer, register, subscribe, update.
Step 5	**exit** **Example:** `Router(config-cmap)# exit`	Exits class-map configuration mode.
Step 6	**policy-map type inspect** *protocol-name policy-map-name* **Example:** `Router(config)# policy-map type inspect sip policy-2`	Creates an inspect type policy map and enters policy-map configuration mode.
Step 7	**class type inspect** *protocol-name class-map-name* **Example:** `Router(config-pmap)# class type inspect sip class-2`	Specifies the class on which the action is performed and enters policy-map class configuration mode.
Step 8	**rate-limit** *limit-number* **Example:** `Router(config-pmap-c)# rate-limit 16`	Limits the number of SIP messages that strike the Cisco IOS firewall every second.
Step 9	**exit** **Example:** `Router(config-pmap-c)# exit`	Exits policy-map class configuration mode.
Step 10	**exit** **Example:** `Router(config-pmap)# exit`	Exits policy-map configuration mode and enters global configuration mode.

	Command or Action	Purpose
Step 11	**class-map type inspect match-any** *class-map-name* **Example:** `Router(config)# class-map type inspect match-any class-1`	Creates an inspect type class map and enters class-map configuration mode.
Step 12	**match protocol** *protocol-name* **Example:** `Router(config-cmap)# match protocol sip`	Configures the match criterion for a class map on the basis of the specified protocol.
Step 13	**exit** **Example:** `Router(config-cmap)# exit`	Exits class-map configuration mode.
Step 14	**policy-map type inspect** *policy-map-name* **Example:** `Router(config)# policy-map type inspect policy-1`	Creates an inspect type policy map and enters policy-map configuration mode.
Step 15	**class type inspect** *class-map-name* **Example:** `Router(config-pmap)# class type inspect class-1`	Specifies the class on which the action is performed and enters policy-map class configuration mode.
Step 16	**inspect** **Example:** `Router(config-pmap-c)# inspect`	Enables stateful packet inspection.
Step 17	**service-policy** *protocol-name policy-map-name* **Example:** `Router(config-pmap-c)# service-policy sip policy_2`	Attaches the policy map to the service policy for the interface or virtual circuit.

	Command or Action	Purpose
Step 18	**exit** **Example:** `Router(config-pmap-c)# exit`	Exits policy-map class configuration mode.

Limiting Application Messages for a Particular Proxy

Perform this task to configure a policy to rate-limit INVITE messages coming for a particular proxy.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **parameter-map type regex** *parameter-map-name*
4. **pattern** *url-pattern*
5. **exit**
6. **class-map type inspect** *protocol-name* **match-any** *class-map-name*
7. **match request method** *method-name*
8. **match request header** *field* **regex** *regex-param-map*
9. **exit**
10. **policy-map type inspect** *protocol-name policy-map-name*
11. **class type inspect** *protocol-name class-map-name*
12. **rate-limit** *limit-number*
13. **exit**
14. **exit**
15. **class-map type inspect match-any** *class-map-name*
16. **match protocol** *protocol-name*
17. **exit**
18. **policy-map type inspect** *policy-map-name*
19. **class type inspect** *class-map-name*
20. **inspect**
21. **service-policy** *protocol-name policy-map-name*
22. **exit**

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	**parameter-map type regex** *parameter-map-name* **Example:** `Router(config)# parameter-map type regex rate-limited-proxy`	Configures a parameter-map type to match a specific traffic pattern and enters profile configuration mode.
Step 4	**pattern** *url-pattern* **Example:** `Router(config-profile)# pattern “compromised.server.com”`	Matches a call based on the SIP URI.
Step 5	**exit** **Example:** `Router(config-cmap)# exit`	Exits profile configuration mode.
Step 6	**class-map type inspect** *protocol-name* **match-any** *class-map-name* **Example:** `Router(config)# class-map type inspect sip match-any class_2`	Creates an inspect type class map and enters class-map configuration mode.
Step 7	**match request method** *method-name* **Example:** `Router(config-cmap)# match request method invite`	Matches RFC 3261 methods. Methods include the following: • ack, bye, cancel, info, invite, message, notify, options, prack, refer, register, subscribe, update.

	Command or Action	Purpose
Step 8	**match request header** *field* **regex** *regex-param-map* **Example:** `Router(config-cmap)# match request header Via regex rate-limited-proxy`	Configures a class-map type to match a specific request header pattern.
Step 9	**exit** **Example:** `Router(config-cmap)# exit`	Exits class-map configuration mode.
Step 10	**policy-map type inspect** *protocol-name policy-map-name* **Example:** `Router(config)# policy-map type inspect sip policy-2`	Creates an inspect type policy map and enters policy-map configuration mode.
Step 11	**class type inspect** *protocol-name class-map-name* **Example:** `Router(config-pmap)# class type inspect sip class-2`	Specifies the class on which the action is performed and enters policy-map class configuration mode.
Step 12	**rate-limit** *limit-number* **Example:** `Router(config-pmap-c)# rate-limit 16`	Limits the number of SIP messages that strike the Cisco IOS firewall every second.
Step 13	**exit** **Example:** `Router(config-pmap-c)# exit`	Exits policy-map class configuration mode.
Step 14	**exit** **Example:** `Router(config-pmap)# exit`	Exits policy-map configuration mode and enters global configuration mode.

	Command or Action	Purpose
Step 15	**class-map type inspect match-any** *class-map-name* **Example:** `Router(config)# class-map type inspect match-any class-1`	Creates an inspect type class map and enters class-map configuration mode.
Step 16	**match protocol** *protocol-name* **Example:** `Router(config-cmap)# match protocol sip`	Configures the match criterion for a class map on the basis of the specified protocol.
Step 17	**exit** **Example:** `Router(config-cmap)# exit`	Exits class-map configuration mode.
Step 18	**policy-map type inspect** *policy-map-name* **Example:** `Router(config)# policy-map type inspect policy-1`	Creates an inspect type policy map and enters policy-map configuration mode.
Step 19	**class type inspect** *class-map-name* **Example:** `Router(config-pmap)# class type inspect class-1`	Specifies the class on which the action is performed and enters policy-map class configuration mode.
Step 20	**inspect** **Example:** `Router(config-pmap-c)# inspect`	Enables stateful packet inspection.
Step 21	**service-policy** *protocol-name policy-map-name* **Example:** `Router(config-pmap-c)# service-policy sip policy-2`	Attaches the policy map to the service policy for the interface or virtual circuit.

	Command or Action	Purpose
Step 22	**exit** **Example:** `Router(config-pmap-c)# exit`	Exits policy-map class configuration mode.

Verifying and Troubleshooting Cisco IOS Firewall-SIP Enhancements ALG and AIC

The following commands can be used to troubleshoot the Cisco IOS Firewall--SIP Enhancements: ALG and AIC feature:

1. **clear zone-pair**
2. **debug cce**
3. **debug ip inspect**
4. **debug policy-map type inspect**
5. **show policy-map type inspect zone-pair**
6. **show zone-pair security**

Note Effective with Cisco IOS Release 12.4(20)T, the **debug ip inspect** command is replaced by the **debug policy-firewall** command. See the *Cisco IOS Debug Command Reference* for more information.

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Examples

The following is sample output of the **show policy-map type inspect zone-pair** command when the **session** keyword is used.

```
Router# show policy-map type inspect zone-pair session
policy exists on zp zp_test_out_self
 Zone-pair: zp_test_out_self
  Service-policy inspect : test
   Class-map: c_sip (match-any)
   ...
    Number of Established Sessions = 2
    Established Sessions
     Session 6717A7A0 (192.168.105.118:62265)=>(192.168.105.2:5060) sip:udp SIS_OPEN
      Created 00:10:27, Last heard 00:00:03
      Bytes sent (initiator:responder) [35579:14964]
     Session 67179EA0 (192.168.105.119:62266)=>(192.168.105.2:5060) sip:udp SIS_OPEN
      Created 00:10:27, Last heard 00:03:17
      Bytes sent (initiator:responder) [10689:4093]
    Number of Pre-generated Sessions = 7
     Pre-generated Sessions
      Pre-gen session 6717A560
192.168.105.2[1024:65535]=>192.168.105.118[62265:62265]       sip:udp
       Created never, Last heard never
       Bytes sent (initiator:responder) [0:0]
      Pre-gen session 67179C60
```

```
192.168.105.2[1024:65535]=>192.168.105.119[62266:62266]       sip:udp
       Created never, Last heard never
       Bytes sent (initiator:responder) [0:0]
      Pre-gen session 67176F60
192.168.105.118[1024:65535]=>192.168.105.2[5060:5060]       sip:udp
       Created never, Last heard never
       Bytes sent (initiator:responder) [0:0]
      Pre-gen session 67176AE0
192.168.105.118[1024:65535]=>192.168.105.2[18318:18318]       sip-RTP-data:udp
       Created never, Last heard never
       Bytes sent (initiator:responder) [0:0]
      Pre-gen session 671768A0
192.168.105.2[1024:65535]=>192.168.105.118[62495:62495]       sip-RTP-data:udp
       Created never, Last heard never
       Bytes sent (initiator:responder) [0:0]
      Pre-gen session 671783A0
192.168.105.118[1024:65535]=>192.168.105.2[18319:18319]       sip-RTCP-data:udp
       Created never, Last heard never
       Bytes sent (initiator:responder) [0:0]
      Pre-gen session 67176420
192.168.105.2[1024:65535]=>192.168.105.118[62496:62496]       sip-RTCP-data:udp
       Created never, Last heard never
       Bytes sent (initiator:responder) [0:0]
```

The following is sample output of the **show zone-pair security** command.

```
Router# show zone-pair security
Zone-pair name zp_in_out
 Source-Zone inside Destination-Zone outside
 service-policy test
Zone-pair name zp_in_self
 Source-Zone inside Destination-Zone self
 service-policy test
Zone-pair name zp_self_out
 Source-Zone self Destination-Zone outside
 service-policy test
```

Configuration Examples for Cisco IOS Firewall-SIP Enhancements ALG and AIC

Example Firewall and SIP Configuration

The following example shows how to configure the Cisco IOS Firewall--SIP Enhancements: ALG and AIC feature when the Cisco IOS firewall is located between two SIP gateways (CCM or CCME), as described in the Cisco IOS Firewall Between SIP Gateways. Some phones are registered to the CCME inside the firewall (inside zone). Other phones are registered to another CCME / CCM outside the firewall (outside zone). Cisco IOS firewall is configured for SIP inspection when there is no IP-IP gateway configured on the firewall device.

```
class-map type inspect sip match-any sip-aic-class
match request method invite
policy-map type inspect sip sip-aic-policy
class type inspect sip sip-aic-class
rate-limit 15
!
policy-map type inspect sip-policy
class type inspect sip-traffic-class
service-policy sip sip-aic-policy
!
class-map type inspect match-any sip-traffic-class
```

```
match protocol sip
!
policy-map type inspect sip-policy
class type inspect sip-traffic-class
inspect my-parameters
!
zone security inside
zone security outside
!
interface fastethernet 0
zone-member security inside
interface fastethernet 1
zone-member security outside
!
zone-pair security in-out source inside destination outside
service-policy type inspect sip-policy
!
zone-pair security in-self source inside destination self
service-policy type inspect sip-policy
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
Cisco IOS firewall commands	*Cisco IOS Security Command Reference*
SIP information and configuration tasks	Configuring Session Initiation Protocol for Voice over IP" module in the *Cisco IOS Voice, Video, and Fax Configuration Guide*
Additional SIP Information	Guide to Cisco Systems VoIP Infrastructure Solution for SIP

MIBs

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

RFCs

RFC	Title
RFC 3261	*SIP: Session Initiation Protocol*

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 Cisco IOS Firewall-SIP Enhancements ALG and AIC

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 7 Feature Information for Cisco IOS Firewall-SIP Enhancements: ALG and AIC

Feature Name	Releases	Feature Information
Cisco IOS Firewall--SIP Enhancements: ALG and AIC	12.4(15)XZ 12.4(20)T	This feature provides voice security enhancements within the firewall feature set in Cisco IOS software for Release 12.4(15)XZ and later releases. In Release 12.4(15)XZ, this feature was introduced on the Cisco 861, Cisco 881, and Cisco 881G routers. In Release 12.4(20)T, this feature was implemented on the Cisco 1700, Cisco 1800, Cisco 2600, Cisco 2800, Cisco 3700, Cisco 3800, Cisco 7200, and Cisco 7300 routers. The following commands were introduced or modified: **class-map type inspect**, **match protocol**, **match protocol-violation**, **match req-resp**, **match request**, **match response**, **policy-map type inspect**, **rate-limit (firewall)**.

Application Inspection and Control for SMTP

The Application Inspection for SMTP feature provides an intense provisioning mechanism that can be configured to inspect packets on a granular level so that malicious network activity, related to the transfer of e-mail at the application level, can be identified and controlled. This feature qualifies the Cisco IOS firewall extended Simple Mail Transfer Protocol (ESMTP) module as an "SMTP application firewall," which protects in a similar way to that of an HTTP application firewall.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

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 Application Inspection and Control for SMTP

Follow the appropriate configuration tasks outlined in the Zone-Based Policy Firewall module before configuring the Application Inspection and Control for SMTP feature. This module contains important information about class-maps and policy-maps and their associated "match" statements necessary for configuring an SMTP policy.

SMTP Policy Requirements

Both SMTP and ESMTP inspection provide a basic method for exchanging e-mail messages between the client and server to negotiate capabilities and use these capabilities in an e-mail transaction. An ESMTP

session is similar to an SMTP session, except for one difference--the Extended HELO (EHLO) command. The EHLO command is sent by a client to initiate the capability dialogue. After the client receives a successful response to the EHLO command, the client works the same way as SMTP, except that the client may issue new extended commands, and it may add a few parameters to the MAIL FROM and REPT TO commands.

Previously, if the Cisco IOS software was configured to inspect SMTP session only, inspection was configured by entering the **match protocol smtp** command. This action would "mask" the EHLO command to prevent capability negotiation and cause the client to go back to the HELO command and basic SMTP.

To have a workable policy for both ESMTP and SMTP inspection, the **match protocol smtp** command must be configured in the top-level policy before the Application Inspection and Control for SMTP features are implemented. See the Configuring a Default Policy for Application Inspection task for more information.

The SMTP policy (which specifies the particular SMTP configuration) is included as a child-policy in the top-level "inspect" policy-map. See the "Top-level Class Maps and Policy Maps" section in the Zone-Based Policy Firewall module for more information.

Restrictions for Application Inspection and Control for SMTP

The Application Inspection and Control for SMTP feature has the following restrictions:

- The **match cmd-line length gt** command filter can co-exist only with a **match cmd verb** command filter in the SMTP match-all class -map (**class-map type inspect smtp**). Any attempt to pair the **match cmd-line length gt** command filter with any other filter is not allowed by the CLI.
- The alternative data transfer SMTP command extension BDAT is not supported. This command is substituted for the DATA command while the SMTP body is transferred. The BDAT command extension is used by the Cisco IOS firewall to mask the CHUNKING keyword in the EHLO response to the Application Inspection and Control for SMTP feature, preventing a client from using it.
- The "mask" action can be configured only with a class having either or both of the **match cmd verb** or **match ehlo reply** commands. This action cannot be configured with a class having any other filter.

Information About Application Inspection and Control for SMTP

The Application Inspection and Control for SMTP feature inspects SMTP in a granular way and is complemented by an intensive provisioning system to help filter e-mail.

- Benefits of Application Inspection and Control for SMTP, page 160
- Cisco Common Classification Policy Language, page 161
- Common Classification Engine SMTP Database and Action Module, page 161

Benefits of Application Inspection and Control for SMTP

The Application Inspection and Control for SMTP feature provides the following benefits:

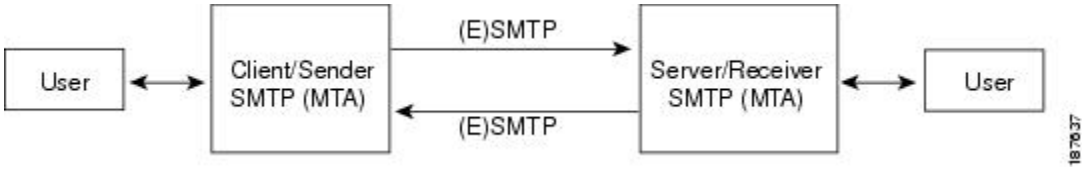
- E-mail senders and user accounts are restricted to filter spam e-mail from suspected domains.

- An action can be specified, which occurs when a number of invalid recipients appears on an SMTP connection. This action helps identify spammers who are looking for valid user accounts.
- The number of invalid SMTP recipients can be restricted by specifying a maximum number for invalid recipients on an SMTP connection.
- A pattern can be specified that identifies e-mail addressed to a particular recipient or domain in cases where a server is functioning as a relay.
- A provisioning mechanism that provides masks specified verbs in an SMTP connection to block potentially dangerous SMTP commands.
- The maximum length value for the SMTP e-mail header can be specified to prevent a Denial of Service (DoS) attack (also called a buffer overflow attack). A DoS attack occurs when the attacker continuously sends a large number of incomplete IP fragments, causing the firewall to lose time and memory while trying to reassemble the fake packets.
- The maximum length of an SMTP command line can be specified to prevent a DoS attack.
- Multipurpose Internet Mail Extension (MIME) content file-types (text, HTML, images, applications, documents,and so on) can be restricted in the body of the e-mail from being transmitted over SMTP.
- Unknown content-encoding types can be restricted from being transmitted over SMTP.
- Specified content-types and content encoding types can be restricted in the SMTP e-mail body.
- Monitor arbitrary patterns (text strings) in the SMTP e-mail message header (subject field) or body.
- A parameter in an EHLO server reply and mask can be specified to prevent a sender (client) from using the service extension in the server reply.
- An SMTP connection can be dropped with an SMTP sender (client) if the SMTP connection violates the specified policy.
- SMTP commands or the parameters returned by the server in response to an EHLO command can be explicitly masked by specifying these SMTP commands.
- An action can be logged for a class type in an SMTP policy-map.

Cisco Common Classification Policy Language

The Cisco Common Classification Policy Language (C3PL) CLI structure is used to provision ESMTP inspection. ESMTP is provisioned by defining a match criterion on an SMTP class-map and associate actions to the match criterion defined in the SMTP policy-map. The Application Inspection and Control for SMTP feature adds new match criteria and actions to the existing SMTP policy maps that are discussed in the Zone-Based Policy Firewall module, which describes the Cisco IOS unidirectional firewall policy between groups of interfaces known as zones.

Figure 13 ESMTP Communication Between a Sender and Receiver



Common Classification Engine SMTP Database and Action Module

The Common Classification Engine (CCE) SMTP database is the site at which manually configured policy information is processed and converted into signatures. The information in these signatures is put into regular expression tables, which are then used to parse packets as they are switched by a router.

The SMTP database has two interfaces. One interface has the control plane, which is used to accept user configured policies, and the other interface has the CCE data-plane engine, which is used to classify a packet.

An action module is used as a part of the Context-Based Access Control (CBAC) SMTP inspection module to organize and trigger SMTP inspection. CBAC is used to detect and block SMTP attacks (illegal SMTP commands) and sends notifications when SMTP attacks occur.

How to Configure Application Inspection and Control for SMTP

Configuring a Default Policy for Application Inspection

If no policy is configured for SMTP, then there is no application inspection for SMTP. The firewall creates a TCP session and only performs “pinholing,” which allows an application to have access to the protected network. Having an open gap in a firewall can expose the protected system to malicious abuse. The steps below are used to provide minimum application inspection protections for SMTP by enforcing the EHLO and HELO SMTP commands.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect smtp** *class-map-name*
4. **match protocol smtp**

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 type inspect smtp** *class-map-name* **Example:** `Router(config)# class-map type inspect smtp c1`	Creates a class map for the SMTP protocol and enters class-map configuration mode.
Step 4	**match protocol smtp** **Example:** `Router(config-cmap)# match protocol smtp`	Enables inspection for ESMTP and SMTP.

Restricting Spam from a Suspicious E-Mail Sender Address or Domain

An e-mail sender and user accounts can be restricted to filter spam e-mail from suspected domains. Spam is restricted by using the **match sender address regex** command to match the parameter-map name of a specific traffic pattern that specifies a sender domain or e-mail address in the SMTP traffic. The specified pattern is scanned in the parameter for the SMTP **MAIL FROM:** command.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **parameter-map type regex** *parameter-map-name*
4. **pattern** *traffic-pattern*
5. exit
6. **class-map type inspect smtp match-any** *class-map-name*
7. **match sender address regex** *parameter-map-name*
8. exit
9. **policy-map type inspect smtp** *policy-map-name*
10. **class type inspect smtp** *class-map-name*
11. **log**
12. **reset**

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	**parameter-map type regex** *parameter-map-name* **Example:** `Router(config)# parameter-map type regex bad-guys`	Enter the parameter-map name of a specific traffic pattern. Once the parameter-map name is specified, parameter-map profile configuration mode is entered.

	Command or Action	Purpose

Step 4	**pattern** *traffic-pattern*
	
	Example:
	`Router(config-profile)# pattern “*deals\.com”`
	
	Example:
	`Router(config-profile)# pattern “*crazyperson*@wrdmail\.com”`
		Specifies the Cisco IOS regular expression (regex) pattern that matches the traffic pattern for the e-mail sender or user accounts from suspected domains that are causing the spam e-mail.

Step 5	exit	Exits parameter-map profile configuration mode.
Step 6	**class-map type inspect smtp match-any** *class-map-name* **Example:** `Router(config)# class-map type inspect smtp match-any c1`	Creates a class map for the SMTP protocol so the match criteria is set to match any criteria for this class map and enters class-map configuration mode.
Step 7	**match sender address regex** *parameter-map-name* **Example:** `Router(config-cmap)# match sender address regex bad-guys`	Enters the parameter-map name class, which was defined in Step 3, to specify the Cisco IOS regular expression (regex) patterns for the class-map.
Step 8	exit	Exits class-map configuration mode.
Step 9	**policy-map type inspect smtp** *policy-map-name* **Example:** `Router(config)# policy-map type inspect smtp p1`	Creates a Layer 7 SMTP policy map and enters policy-map configuration mode.
Step 10	**class type inspect smtp** *class-map-name* **Example:** `Router(config-pmap)# class type inspect smtp c1`	Configures SMTP inspection parameters for this class map.
Step 11	**log** **Example:** `Router(config-pmap)# log`	Logs an action related to this class-type in the SMTP policy map.

	Command or Action	Purpose
Step 12	**reset** **Example:** `Router(config-pmap)# reset`	(Optional) Drops an SMTP connection with an SMTP sender (client) if it violates the specified policy. This action sends an error code to the sender and closes the connection gracefully.

Identifying and Restricting Spammers Searching for User Accounts in a Domain

Spammers who search for a large number of user accounts in a domain typically send the same e-mail to all the user accounts they find in this domain. Spammers can be identified and restricted from searching for user accounts in a domain by using the **match recipient count gt** command to specify an action that occurs when a number of invalid recipients appear on an SMTP connection.

Note The **match recipient count gt** command does not count the number of recipients specified in the To or Cc fields in the e-mail header.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect smtp** *class-map-name*
4. **match recipient count gt** *value*
5. exit
6. **policy-map type inspect smtp** *policy-map-name*
7. **class type inspect smtp** *class-map-name*
8. **reset**

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**class-map type inspect smtp** *class-map-name* **Example:** `Router(config)# class-map type inspect smtp c1`	Creates a class map for the SMTP protocol and enters class-map configuration mode.
Step 4	**match recipient count gt** *value* **Example:** `Router(config-cmap)# match recipient count gt 25`	Sets a limit on the number of RCPT SMTP commands sent by the sender (client) to recipients who are specified in a single SMTP transaction. This command determines the number of RCPT lines and invalid recipients (for which the server has replied “500 No such address”) in the SMTP transaction.
Step 5	exit	Exits class-map configuration mode.
Step 6	**policy-map type inspect smtp** *policy-map-name* **Example:** `Router(config)# policy-map type inspect smtp p1`	Creates a Layer 7 SMTP policy map and enters policy-map configuration mode. • The *policy-map-name* argument is the name of the policy map.
Step 7	**class type inspect smtp** *class-map-name* **Example:** `Router(config-pmap)# class type inspect smtp c1`	Configures SMTP inspection parameters for this class map.
Step 8	**reset** **Example:** `Router(config-pmap)# reset`	(Optional) Drops an SMTP connection with an SMTP sender (client) if it violates the specified policy. This action sends an error code to the sender and closes the connection gracefully.

Restricting the Number of Invalid SMTP Recipients

If a sender specifies in an invalid e-mail recipient and SMTP encounters this invalid recipient on the SMTP connection, then SMTP sends an error code reply to the e-mail sender (client) to specify another recipient. In this case, the event did not violate the SMTP protocol or indicate that this particular SMTP connection is

bad. However, if a pattern of invalid recipients appears, then a reasonable threshold can be set to restrict these nuisance SMTP connections. The **match recipient invalid count gt** command is used to help identify and restrict the number of invalid SMTP recipients that can appear in an e-mail from senders who try common names on a domain in the hope that they discover a valid username to whom they can send spam.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect smtp** *class-map-name*
4. **match recipient invalid count gt** *value*
5. exit
6. **policy-map type inspect smtp** *policy-map-name*
7. **class type inspect smtp** *class-map-name*
8. **reset**

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 type inspect smtp** *class-map-name* **Example:** `Router(config)# class-map type inspect smtp c1`	Creates a class map for the SMTP protocol and enters class-map configuration mode.
Step 4	**match recipient invalid count gt** *value* **Example:** `Router(config-cmap)# match recipient invalid count gt 5`	Specifies a maximum number of invalid e-mail recipients on this SMTP connection.
Step 5	exit	Exits class-map configuration mode.

	Command or Action	Purpose
Step 6	**policy-map type inspect smtp** *policy-map-name* **Example:** `Router(config)# policy-map type inspect smtp p1`	Creates a Layer 7 SMTP policy map and enters policy-map configuration mode.
Step 7	**class type inspect smtp** *class-map-name* **Example:** `Router(config-pmap)# class type inspect smtp c1`	Configures SMTP inspection parameters for this class map.
Step 8	**reset** **Example:** `Router(config-pmap)# reset`	(Optional) Drops an SMTP connection with an SMTP sender (client) if it violates the specified policy. This action sends an error code to the sender and closes the connection gracefully.

Specifying a Recipient Pattern to Learn Spam Senders and Domain Information

A nonexistent e-mail recipient pattern can be specified to learn about spam senders and their domain information by luring them to use this nonexistent e-mail recipient pattern. This pattern is a regular-expression (regex) that can be specified to identify an e-mail addressed to a particular recipient or domain when a server is functioning as a relay. The specified pattern is checked in the SMTP RCPT command (SMTP envelope) parameter to identify if the recipient is either used as an argument or a source-list to forward mail in the route specified in the list.

Note The **match recipient address regex** command does not operate on the To or Cc fields in the e-mail header.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **parameter-map type regex** *parameter-map-name*
4. **pattern** *traffic-pattern*
5. exit
6. **class-map type inspect smtp** *class-map-name*
7. **match recipient address regex** *parameter-map-name*
8. exit
9. **policy-map type inspect smtp** *policy-map-name*
10. **class type inspect smtp** *class-map-name*
11. **log**
12. **reset**

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	**parameter-map type regex** *parameter-map-name* **Example:** `Router(config)# parameter-map type regex known-unknown-users`	Enter the parameter-map name of a specific traffic pattern. Once the parameter-map name is specified, parameter-map profile configuration mode is entered.
Step 4	**pattern** *traffic-pattern* **Example:** `Router(config-profile)# pattern “username@mydomain.com”`	Specifies a Cisco IOS regular expression (regex) pattern that matches the traffic pattern for the e-mail sender or user accounts from suspected domains that are causing the spam e-mail. In the example, “username” is configured as the name for a fake e-mail account used to discover senders (and their domain) when they try to send spam e-mail to this fake account.
Step 5	exit	Exits parameter-map profile configuration mode.

	Command or Action	Purpose
Step 6	**class-map type inspect smtp** *class-map-name* **Example:** `Router(config)# class-map type inspect smtp c1`	Creates a class map for the SMTP protocol and enters class-map configuration mode.
Step 7	**match recipient address regex** *parameter-map-name* **Example:** `Router(config-cmap)# match recipient address regex known-unknown-users`	Specifies the nonexistent e-mail recipient pattern in order to learn spam senders and their domain information by luring them to use this contrived e-mail recipient.
Step 8	exit	Exits class-map configuration mode.
Step 9	**policy-map type inspect smtp** *policy-map-name* **Example:** `Router(config)# policy-map type inspect smtp p1`	Creates a Layer 7 SMTP policy map and enters policy-map configuration mode.
Step 10	**class type inspect smtp** *class-map-name* **Example:** `Router(config-pmap)# class type inspect smtp c1`	Configures SMTP inspection parameters for this class map.
Step 11	**log** **Example:** `Router(config-pmap)# log`	Logs an action related to this class-type in the SMTP policy map.
Step 12	**reset** **Example:** `Router(config-pmap)# reset`	(Optional) Drops an SMTP connection with an SMTP sender (client) if it violates the specified policy. This action sends an error code to the sender and closes the connection gracefully.

Hiding Specified Private SMTP Commands on an SMTP Connection

Use this task to hide or “mask” commonly encountered SMTP verbs (SMTP commands) or specified private SMTP verbs used to provision an SMTP connection.

Specified verbs, such as the ATRN, ETRN, BDAT verbs may be considered vulnerable to exploitation if seen by a sender (client). The most commonly encountered SMTP verbs are listed along with the facility to specify a private verb as a string (using the WORD option).

Note The BDAT verb (used as an alternative to DATA) is not used, so in its place, the CHUNKING keyword is masked in the EHLO response. However, if the sender (client) continues to send the BDAT command, it is masked.

Note Using the **mask** command applies to certain **match** command filters like **match cmd verb**. Validations are performed to make this check and the configuration is not be accepted in case of invalid combinations.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect smtp** *class-map-name*
4. **match cmd verb** {*verb-name* | *WORD*}
5. exit
6. **policy-map type inspect smtp** *policy-map-name*
7. **class type inspect smtp** *class-map-name*
8. **mask**

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 type inspect smtp** *class-map-name* **Example:** `Router(config)# class-map type inspect smtp c1`	Creates a class map for the SMTP protocol and enters class-map configuration mode.

	Command or Action	Purpose
Step 4	**match cmd verb** {*verb-name* | *WORD*} **Example:** `Router(config-cmap)# match cmd verb ATRN`	Specifies either the private verb name to "mask" that is used to provision an SMTP connection. • The *verb-name* argument is the name of an SNMP command verb. • The *WORD* argument is the name of a user-specified SMTP command verb, which is treated as an unknown verb and is masked regardless of whether the 'mask action is configured for the class or not.
Step 5	exit	Exits class-map configuration mode.
Step 6	**policy-map type inspect smtp** *policy-map-name* **Example:** `Router(config)# policy-map type inspect smtp p1`	Creates a Layer 7 SMTP policy map and enters policy-map configuration mode.
Step 7	**class type inspect smtp** *class-map-name* **Example:** `Router(config-pmap)# class type inspect smtp c1`	Configures SMTP inspection parameters for this class map.
Step 8	**mask** **Example:** `Router(config-pmap)# mask`	Explicitly masks the specified SMTP commands or the parameters returned by the server in response to an EHLO command.

Preventing a DoS Attack by Limiting the Length of the SMTP Header

A DoS attack (also called a buffer overflow attack) by a malicious sender (client) can cause the SMTP application firewall to lose time and memory while trying to reassemble the fake packets (large e-mail headers) associated with the e-mail. In an SMTP transaction, the header portion of an e-mail is considered part of the DATA area, which contains fields like Subject, From, To, Cc, Date, and proprietary information, which is used by a recipient's e-mail agent to process the e-mail. A DoS attack can be prevented by using the **match header length gt** command to limit the length of the SMTP header that can be received. If a match is found, possible actions that can be specified within the policy are as follows: allow, reset, or log (the log action triggers a syslog message when a match is found).

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect smtp** *class-map-name*
4. **match header length gt** *bytes*
5. exit
6. **policy-map type inspect smtp** *policy-map-name*
7. **class type inspect smtp** *class-map-name*
8. **reset**

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 type inspect smtp** *class-map-name* **Example:** `Router(config)# class-map type inspect smtp c1`	Creates a class map for the SMTP protocol and enters class-map configuration mode.
Step 4	**match header length gt** *bytes* **Example:** `Router(config-cmap)# match header length gt 16000`	Specifies a value from 1 to 65535 that limits the maximum length of the SMTP header in bytes to thwart DoS attacks.
Step 5	exit	Exits class-map configuration mode.
Step 6	**policy-map type inspect smtp** *policy-map-name* **Example:** `Router(config)# policy-map type inspect smtp p1`	Creates a Layer 7 SMTP policy map and enters policy-map configuration mode.

	Command or Action	Purpose
Step 7	**class type inspect smtp** *class-map-name* **Example:** `Router(config-pmap)# class type inspect smtp c1`	Configures SMTP inspection parameters for this class map.
Step 8	**reset** **Example:** `Router(config-pmap)# reset`	(Optional) Drops an SMTP connection with an SMTP sender (client) if it violates the specified policy. This action sends an error code to the sender and closes the connection gracefully.

Preventing a DoS Attack by Limiting the Length or TYPE of SMTP Command Line

The following task is used to limit the length of an SMTP command line to prevent a DoS attack, which occurs when a malicious sender (client) specifies large command lines in an e-mail to perform DoS attacks on SMTP servers.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect smtp** {*class-map-name* | **match-all** *class-map-name* | **match-any** *class-map-name}*
4. **match cmd** {**line length gt** *length* | **verb** {**AUTH** | **DATA** | **EHLO** | **ETRN** | **EXPN** | **HELO** | **HELP** | **MAIL NOOP** | **QUIT** | **RCPT** | **RSET** | **SAML** | **SEND** | **SOML** | **STARTTLS** | **VERB** | **VRFY** | **WORD**}}
5. exit
6. **policy-map type inspect smtp** *policy-map-name*
7. **class type inspect smtp** *class-map-name*
8. **reset**

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**class-map type inspect smtp** {*class-map-name* | **match-all** *class-map-name* | **match-any** *class-map-name}* **Example:** `Router(config)# class-map type inspect smtp c1`	Enters class-map configuration mode and creates a class map for the SMTP protocol. • The *class-map-name* argument by itself specifies a single class-map. • The **match-all** keyword and *class-map-name* argument places logical and all matching statements under this class map. • The **match-any** keyword and *class-map-name* argument places logical or all matching statements under this class map. **Note** If no **match cmd verb** command statement is specified in a **class-map type inspect smtp match-all** command statement for a class-map, which contains the **match cmd line length gt** command statement, then the class-map applies to all SMTP commands.
Step 4	**match cmd** {**line length gt** *length* | **verb** {**AUTH** | **DATA** | **EHLO** | **ETRN** | **EXPN** | **HELO** | **HELP** | **MAIL NOOP** | **QUIT** | **RCPT** | **RSET** | **SAML** | **SEND** | **SOML** | **STARTTLS** | **VERB** | **VRFY** | **WORD**}} **Example:** `Router(config-cmap)# match header length gt 16000`	Specifies a value that limits the length of the ESMTP command line or ESMTP command line verb used to thwart DoS attacks. • The *length* argument specifies the ESMTP command line greater than the length of a number of characters from 1 to 65535.
Step 5	exit	Exits class-map configuration mode.
Step 6	**policy-map type inspect smtp** *policy-map-name* **Example:** `Router(config)# policy-map type inspect smtp p1`	Creates a Layer 7 SMTP policy map and enters policy-map configuration mode.
Step 7	**class type inspect smtp** *class-map-name* **Example:** `Router(config-pmap)# class type inspect smtp c1`	Configures an SMTP class-map firewall for SMTP inspection parameters.

	Command or Action	Purpose
Step 8	**reset** **Example:** `Router(config-pmap)# reset`	(Optional) Drops an SMTP connection with an SMTP sender (client) if it violates the specified policy. This action sends an error code to the sender and closes the connection gracefully.

Examples

The following configuration has class-map c2 match when the length of the e-mail (MAIL) command exceeds 256 bytes.

When the **class-map type inspect smtp match-all** command statement is configured with the **match cmd verb** command statement, only the **match cmd line length gt** command statement can coexist.

```
class-map type inspect smtp match-all c2
  match cmd line length gt 256
  match cmd verb MAIL
```

There are no match restrictions in case of a **class-map type inspect smtp match-any** command statement for a class map because the class-map applies to all SMTP commands.

Restricting Content File Types in the Body of the E-Mail

The **match mime content-type regex** command is used to specify MIME content file types, which are restricted in attachments in the body of the e-mail being sent over SMTP. See the Example: MIME E-Mail Format section for more information.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **parameter-map type regex** *parameter-map-name*
4. **pattern** *traffic-pattern*
5. exit
6. **class-map type inspect smtp** {*class-map-name* | **match-all** *class-map-name* | **match-any** *class-map-name}*
7. **match mime content-type regex** *content-type-regex*
8. exit
9. **policy-map type inspect smtp** *policy-map-name*
10. **class type inspect smtp** *class-map-name*
11. **log**

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	**parameter-map type regex** *parameter-map-name* **Example:** `Router(config)# parameter-map type regex jpeg`	Enter the parameter-map name of a specific traffic pattern. Once the parameter-map name is specified, parameter-map profile configuration mode is entered.
Step 4	**pattern** *traffic-pattern* **Example:** `Router(config-profile)# pattern "*image//*"`	Specifies a Cisco IOS regular expression (regex) pattern that matches the traffic pattern for the e-mail sender or user accounts from suspected domains that are causing the spam e-mail.
Step 5	exit	Exits parameter-map profile configuration mode.
Step 6	**class-map type inspect smtp** {*class-map-name* | **match-all** *class-map-name* | **match-any** *class-map-name}* **Example:** `Router(config)# class-map type inspect smtp c1`	Enters class-map configuration mode and creates a class map for the SMTP protocol. • The *class-map-name* argument by itself specifies a single class-map. • The **match-all** keyword and *class-map-name* argument places logical and all matching statements under this class map. • The **match-any** keyword and *class-map-name* argument places logical or all matching statements under this class map.

	Command or Action	Purpose
Step 7	**match mime content-type regex** *content-type-regex* **Example:** `Router(config-cmap)# match mime content-type regex jpeg`	Specifies the MIME content file type, which are restricted in attachments in the body of the e-mail being sent over SMTP. • The *content-type-regex* argument is the type of content in the MIME header in regular expression form. This example lets the user specify any form of JPEG image content to be restricted. **Note** The actual content of the MIME part is not checked to see if it matches with the declared content-type in the MIME header.
Step 8	exit	Exits class-map configuration mode.
Step 9	**policy-map type inspect smtp** *policy-map-name* **Example:** `Router(config)# policy-map type inspect smtp p1`	Creates a Layer 7 SMTP policy map and enters policy-map configuration mode.
Step 10	**class type inspect smtp** *class-map-name* **Example:** `Router(config-pmap)# class type inspect smtp c1`	Configures an SMTP class-map firewall for SMTP inspection parameters.
Step 11	**log** **Example:** `Router(config-pmap)# log`	Logs an action related to this class-type in the SMTP policy map.

Restricting Unknown Content Encoding Types from Being Transmitted

Unknown MIME content-encoding types or values can be restricted from being transmitted over SMTP by using one of the following parameters with the **match mime encoding**command.

These preconfigured content-transfer-encoding types act as a filter on the content-transfer-encoding field in the MIME header within the SMTP body. The uuencode encoding type is not recognized as a standard type by the MIME RFCs because many subtle differences exist in its various implementations. However, since it is used by some mail systems, the **x-uuencode** type is included in the preconfigured list.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect smtp** {*class-map-name* | **match-all** *class-map-name* | **match-any** *class-map-name}*
4. **match mime encoding** {**unknown** | *WORD* | *encoding-type*}
5. exit
6. **policy-map type inspect smtp** *policy-map-name*
7. **class type inspect smtp** *class-map-name*
8. **log**

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 type inspect smtp** {*class-map-name* | **match-all** *class-map-name* | **match-any** *class-map-name}* **Example:** `Router(config)# class-map type inspect smtp c1`	Enters class-map configuration mode and creates a class map for the SMTP protocol. • The *class-map-name* argument by itself specifies a single class-map. • The **match-all** keyword and *class-map-name* argument places logical and all matching statements under this class map. • The **match-any** keyword and *class-map-name* argument places logical or all matching statements under this class map.

Command or Action	Purpose
Step 4 **match mime encoding** {**unknown** | *WORD* | *encoding-type*} **Example:** `Router (config-cmap)# match mime encoding quoted-printable`	Restricts unknown MIME content-encoding types or values. • The **unknown** keyword is used if content-transfer-encoding value in the e-mail does not match any of the ones in the list to restrict unknown and potentially dangerous encodings. • The *WORD* argument is a user-defined content-transfer encoding type, which must begin with “X-” (for example, “X-myencoding-scheme”). • The *encoding-type* argument specifies one of the following preconfigured content-transfer-encoding types: ◦ **7-bit**-ASCII characters ◦ **8-bit**-Facilitates the exchange of e-mail messages containing octets outside the 7-bit ASCII range. ◦ **base64**-Any similar encoding scheme that encodes binary data by treating it numerically and translating it into a base 64 representation. ◦ **quoted-printable**-Encoding using printable characters (that is alphanumeric and the equals sign "=") to transmit 8-bit data over a 7-bit data path. It is defined as a MIME content transfer encoding for use in Internet e-mail. ◦ **binary**-Representation for numbers using only two digits (usually, 0 and 1). ◦ **x-uuencode**-Nonstandard encoding. **Note** The **quoted-printable** and **base64** encoding types tell the e-mail client that a binary-to-text encoding scheme was used and that appropriate initial decoding is necessary before the message can be read with its original encoding.
Step 5 exit	Exits class-map configuration mode.
Step 6 **policy-map type inspect smtp** *policy-map-name* **Example:** `Router(config)# policy-map type inspect smtp p1`	Creates a Layer 7 SMTP policy map and enters policy-map configuration mode.
Step 7 **class type inspect smtp** *class-map-name* **Example:** `Router(config-pmap)# class type inspect smtp c1`	Configures an SMTP class-map firewall for SMTP inspection parameters.

	Command or Action	Purpose
Step 8	**log** **Example:** `Router(config-pmap)# log`	Logs an action related to this class-type in the SMTP policy map.

Specifying a Text String to Be Matched and Restricted in the Body of an E-Mail

The **match body regex** command can be used to specify an arbitrary text expression to restrict specified content-types and content encoding types for text and HTML in the body of the e-mail. The text or HTML pattern is scanned only if the encoding is 7-bit or 8-bit and the encoding is checked before attempting to match the pattern. If the pattern is of another encoding type (for example, base64, zip files, and so on), then the pattern cannot be scanned.

Note Using this command can impact performance because the complete SMTP connection has to be scanned.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **parameter-map type regex** *parameter-map-name*
4. **pattern** *traffic-pattern*
5. exit
6. **class-map type inspect smtp** {*class-map-name* | **match-all** *class-map-name* | **match-any** *class-map-name}*
7. **match body regex** *parameter-map-name*
8. exit
9. **policy-map type inspect smtp** *policy-map-name*
10. **class type inspect smtp** *class-map-name*
11. **log**

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**parameter-map type regex** *parameter-map-name* **Example:** `Router(config)# parameter-map type regex doc-data`	Enter the parameter-map name of a specific traffic pattern. Once the parameter-map name is specified, parameter-map profile configuration mode is entered.
Step 4	**pattern** *traffic-pattern* **Example:** `Router(config-profile)# pattern "*UD-421590*"`	Specifies a Cisco IOS regular expression (regex) pattern that matches the traffic pattern for the e-mail sender or user accounts from suspected domains that are causing the spam e-mail.
Step 5	exit	Exits parameter-map profile configuration mode.
Step 6	**class-map type inspect smtp** {*class-map-name* | **match-all** *class-map-name* | **match-any** *class-map-name}* **Example:** `Router(config)# class-map type inspect smtp c1`	Enters class-map configuration mode and creates a class map for the SMTP protocol. • The *class-map-name* argument by itself specifies a single class-map. • The **match-all** keyword and *class-map-name* argument places logical and all matching statements under this class map. • The **match-any** keyword and *class-map-name* argument places logical or all matching statements under this class map.
Step 7	**match body regex** *parameter-map-name* **Example:** `Router(config-cmap)# match body regex doc-data`	Specifies an arbitrary text expression to restrict specified content-types and content encoding types for text and HTML in the "body" of the e-mail.
Step 8	exit	Exits class-map configuration mode.
Step 9	**policy-map type inspect smtp** *policy-map-name* **Example:** `Router(config)# policy-map type inspect smtp p1`	Creates a Layer 7 SMTP policy map and enters policy-map configuration mode.

	Command or Action	Purpose
Step 10	**class type inspect smtp** *class-map-name* **Example:** `Router(config-pmap)# class type inspect smtp c1`	Configures an SMTP class-map firewall for SMTP inspection parameters.
Step 11	**log** **Example:** `Router(config-pmap)# log`	Logs an action related to this class-type in the SMTP policy map.

Configuring the Monitoring of Text Patterns in an SMTP E-Mail Subject Field

The **match header regex** command can be used specify an arbitrary text expression in the SMTP e-mail message header (Subject field) or e-mail body such as Subject, Received, To, or other private header fields to monitor text patterns.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **parameter-map type regex** *parameter-map-name*
4. **pattern** *traffic-pattern*
5. exit
6. **class-map type inspect smtp** {*class-map-name* | **match-all** *class-map-name* | **match-any** *class-map-name}*
7. **match header regex** *parameter-map-name*
8. exit
9. **policy-map type inspect smtp** *policy-map-name*
10. **class type inspect smtp** *class-map-name*
11. **reset**

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	**parameter-map type regex** *parameter-map-name* **Example:** `Router(config)# parameter-map type regex lottery-spam`	Enter the parameter-map name of a specific traffic pattern. Once the parameter-map name is specified, parameter-map profile configuration mode is entered.
Step 4	**pattern** *traffic-pattern* **Example:** `Router(config-profile)# pattern "Subject:*lottery*"`	Specifies a Cisco IOS regular expression (regex) pattern that matches the traffic pattern for the e-mail sender or user accounts from suspected domains that are causing the spam e-mail.
Step 5	exit	Exits parameter-map profile configuration mode.
Step 6	**class-map type inspect smtp** {*class-map-name* | **match-all** *class-map-name* | **match-any** *class-map-name}* **Example:** `Router(config)# class-map type inspect smtp c1`	Enters class-map configuration mode and creates a class map for the SMTP protocol. • The *class-map-name* argument by itself specifies a single class-map. • The **match-all** keyword and *class-map-name* argument places logical and all matching statements under this class map. • The **match-any** keyword and *class-map-name* argument places logical or all matching statements under this class map.
Step 7	**match header regex** *parameter-map-name* **Example:** `Router(config-cmap)# match header regex lottery-spam`	Specifies an arbitrary text expression in the SMTP e-mail message header to monitor text patterns.

	Command or Action	Purpose
Step 8	exit	Exits class-map configuration mode.
Step 9	**policy-map type inspect smtp** *policy-map-name* **Example:** `Router(config)# policy-map type inspect smtp p1`	Creates a Layer 7 SMTP policy map and enters policy-map configuration mode.
Step 10	**class type inspect smtp** *class-map-name* **Example:** `Router(config-pmap)# class type inspect smtp c1`	Configures an SMTP class-map firewall for SMTP inspection parameters.
Step 11	**reset** **Example:** `Router(config-pmap)# reset`	(Optional) Drops an SMTP connection with an SMTP sender (client) if it violates the specified policy. This action sends an error code to the sender and closes the connection gracefully.

Configuring a Parameter to Be Identified and Masked in the EHLO Server Reply

The **match reply ehlo** command is used to identify and mask a service extension parameter in the EHLO server reply (for example, 8BITMIME and ETRN) to prevent a sender (client) from using that particular service extension.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect smtp** {*class-map-name* | **match-all** *class-map-name* | **match-any** *class-map-name}*
4. **match reply ehlo** {*parameter* | *WORD*}
5. exit
6. **policy-map type inspect smtp** *policy-map-name*
7. **class type inspect smtp** *class-map-name*
8. **log**
9. **mask**

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 type inspect smtp** {*class-map-name* | **match-all** *class-map-name* | **match-any** *class-map-name}* **Example:** `Router(config)# class-map type inspect smtp c1`	Enters class-map configuration mode and creates a class map for the SMTP protocol. • The *class-map-name* argument by itself specifies a single class-map. • The **match-all** keyword and *class-map-name* argument places logical and all matching statements under this class map. • The **match-any** keyword and *class-map-name* argument places logical or all matching statements under this class map.
Step 4	**match reply ehlo** {*parameter* | *WORD*} **Example:** `Router(config-cmap)# match reply ehlo ETRN`	Identifies and masks a service extension parameter in the EHLO server reply. • The *parameter* argument specifies a parameter from the well-known EHLO keywords. • The *WORD* argument specifies an extension which is not on the EHLO list.
Step 5	exit	Exits class-map configuration mode.
Step 6	**policy-map type inspect smtp** *policy-map-name* **Example:** `Router(config)# policy-map type inspect smtp p1`	Creates a Layer 7 SMTP policy map and enters policy-map configuration mode.
Step 7	**class type inspect smtp** *class-map-name* **Example:** `Router(config-pmap)# class type inspect smtp c1`	Configures an SMTP class-map firewall for SMTP inspection parameters.

	Command or Action	Purpose
Step 8	**log** **Example:** `Router(config-pmap)# log`	Logs an action related to this class-type in the SMTP policy map.
Step 9	**mask** **Example:** `Router(config-pmap)# mask`	Explicitly masks the specified SMTP commands or the parameters returned by the server in response to an EHLO command.

Configuring a Logging Action for a Class Type in an SMTP Policy-Map

A logging action can be configured for a class type in an SMTP policy-map when conditions specified by the traffic class are met. The logging action results in a LOG_WARNING syslog message followed by the specific log message. The log message format is similar to other application firewall modules (for example, HTTP, IM, Peer-to-Peer (P2P)); session initiator/responder information, and zone-pair and class names.

Note The log action currently exists for other types of policy-maps (http, pop3).

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect smtp** {*class-map-name* | **match-all** *class-map-name* | **match-any** *class-map-name}*
4. **match cmd verb** {*parameter* | *WORD*}
5. exit
6. **policy-map type inspect smtp** *policy-map-name*
7. **class type inspect smtp** *class-map-name*
8. **log**

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**class-map type inspect smtp** {*class-map-name* | **match-all** *class-map-name* | **match-any** *class-map-name}* **Example:** `Router(config)# class-map type inspect smtp c1`	Enters class-map configuration mode and creates a class map for the SMTP protocol. • The *class-map-name* argument by itself specifies a single class-map. • The **match-all** keyword and *class-map-name* argument places logical and all matching statements under this class map. • The **match-any** keyword and *class-map-name* argument places logical or all matching statements under this class map.
Step 4	**match cmd verb** {*parameter* | *WORD*} **Example:** `Router(config-cmap)# match cmd verb ATRN`	Identifies and masks a service extension parameter in the EHLO server reply. • The *parameter* argument specifies a parameter from the well-known EHLO keywords. • The *WORD* argument specifies an extension which is not on the EHLO list.
Step 5	exit	Exits class-map configuration mode.
Step 6	**policy-map type inspect smtp** *policy-map-name* **Example:** `Router(config)# policy-map type inspect smtp p1`	Creates a Layer 7 SMTP policy map and enters policy-map configuration mode.
Step 7	**class type inspect smtp** *class-map-name* **Example:** `Router(config-pmap)# class type inspect smtp c1`	Configures an SMTP class-map firewall for SMTP inspection parameters.
Step 8	**log** **Example:** `Router(config-pmap)# log`	Logs an action related to this class-type in the SMTP policy map.

Configuration Examples for Application Inspection and Control for SMTP

Example Creating a Pinhole for the SMTP Port

The following example shows a configuration without any Layer 7 SMTP policy that creates a pinhole only for the SMTP port. Any command sent to the server, including the EHLO command is accepted.

```
class-map type inspect smtp c1
match protocol smtp
policy-map type inspect smtp c1
    class type inspect smtp c1
        inspect
```

Note No SMTP policy is configured by default. If an SMTP policy is not configured, then no SMTP inspection is done by default.

Example Preventing ESMTP Inspection

If a user decides to create a workable policy that is configured for SMTP inspection only, then it now needs to be explicitly specified in the policy.

The following example can be used to prevent ESMTP inspection:

```
class-map type inspect smtp c1
    match cmd verb EHLO
policy-map type inspect smtp c1
    class type inspect smtp c1
        mask
```

Example MIME E-Mail Format

The format of data being transmitted through SMTP is specified by using the MIME standard, which uses headers to specify the content-type, encoding, and the filenames of data being sent (text, html, images, applications, documents and so on). The following is an example of an e-mail using the MIME format:

```
From: "username2" <username2@example.com>
To: username3 <username3@example.com>
Subject: testmail
Date: Sat, 7 Jan 2006 20:18:47 -0400
Message-ID: <000dadf7453e$bee1bb00$8a22f340@oemcomputer>
MIME-Version: 1.0
Content-Type: image/jpeg;
name='picture.jpg'
Content-Transfer-Encoding: base64
```

<base64 encoded data for the picture.jpg image>

In the above example, the “name=’picture.jpg’” is optional. Even without the definition, the image is sent to the recipient. The e-mail client of the recipient may display the image as “part-1” or “attach-1” or it may render the image in-line. Also, attachments are not ‘stripped’ from the e-mail. If a content-type for which reset action was configured is detected, an 5XX error code is sent and the connection is closed, in order to prevent the whole e-mail from being delivered. However, the remainder of the e-mail message is sent.

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
Firewall commands	*Cisco IOS Security Command Reference*
ESMTP firewall information.	ESMTP Support for Cisco IOS Firewall
Information for configuring an SMTP policy.	Zone-Based Policy Firewall

Standards

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

MIBs

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

RFCs

RFC	Title
RFC 1869 and other SMTP RFC extensions apart from RFC 821.	SMTP Service Extensions

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 Application Inspection and Control for SMTP

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 Application Inspection and Control for SMTP

Feature Name	Releases	Feature Information
Application Inspection and Control for SMTP	12.4(20)T	The Application Inspection and Control for SMTP feature provides an intense provisioning mechanism that can be configured to inspect packets on a granular level so that malicious network activity, related to the transfer of e-mail at the application level, can be identified and controlled. This feature qualifies the Cisco IOS firewall extended SMTP (ESMTP) module as an "SMTP application firewall," which protects in a similar way to that of an HTTP application firewall. The following commands were introduced or modified by this feature: **log (policy-map and class-map) , mask (policy-map)**, **match body regex**, **match cmd**, **match header length gt**, **match header regex**, **match mime content-type regex**, **match mime encoding**, **match sender address regex**, **match recipient address regex**, **match recipient count gt**, **match recipient invalid count gt**, **match reply ehlo**, **reset (policy-map)**.

Glossary

C3PL --Cisco Common Classification Policy Language. Structured, feature-specific configuration commands that use policy maps and class maps to create traffic policies based on events, conditions, and actions.

EHLO --Extended HELO substitute command for starting the capability negotiation. This command identifies the sender (client) connecting to the remote SMTP server by using the ESMTP protocol.

ESMTP --Extended Simple Mail Transfer Protocol. Extended version of the Simple Mail Transfer Protocol (SMTP), which includes additional functionality, such as delivery notification and session delivery. ESMTP is described in RFC 1869, SMTP Service Extensions.

HELO --Command that starts the SMTP capability negotiation. This command identifies the sender (client) connecting to the remote SMTP server by its fully qualified DNS hostname.

MAIL FROM --Start of an e-mail message that identifies the sender e-mail address (and name, if used), which appears in the From: field of the message.

MIME --Multipurpose Internet Mail Extension. Standard for transmitting nontext data (or data that cannot be represented in plain ASCII code) in e-mail, such as binary, foreign language text (such as Russian or Chinese), audio, or video data. MIME is defined in RFC 2045.

RCPT TO --Recipient e-mail address (and name, if used) that can be repeated multiple times for a likely message to deliver a single message to multiple recipients.

SMTP --Simple Mail Transfer Protocol. Internet protocol providing e-mail services.

Subscription-Based Cisco IOS Content Filtering

The Subscription-based Cisco IOS Content Filtering feature interacts with the Trend Micro URL filtering service so that HTTP requests can be allowed or blocked, and logged, based on a content filtering policy. The content filtering policy specifies how to handle items such as web categories, reputations (or security ratings), trusted domains, untrusted domains, and keywords. URLs are cached on the router, so that subsequent requests for the same URL do not require a lookup request, thus improving performance.

Support for third-party URL filtering servers SmartFilter (previously N2H2) and Websense, which was introduced with Cisco IOS Release 12.2(11)YU and integrated into Cisco IOS Release 12.2(15)T, continues to be available.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

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 Subscription-Based Cisco IOS Content Filtering

Cisco IOS Firewalls and Zone-Based Policy Firewall

You should have an understanding of how to configure Cisco IOS firewalls and understand the concepts of traffic filtering, traffic inspection, and zone-based policy.

Trend Micro Requirements

Before you can configure the Subscription-Based Cisco IOS Content Filtering feature on the router, you must:

- Purchase the Cisco IOS Content Filtering Subscription Service from Cisco.
- Receive the Product Authorization Key (PAK) in the mail.
- Activate your license at www.cisco.com/go/license . You will need the serial number for the router and the PAK.
- Download and install the security certificate as described here:

Install Trusted Authority Certificates on Cisco IOS Routers for Trend URL Filtering Support

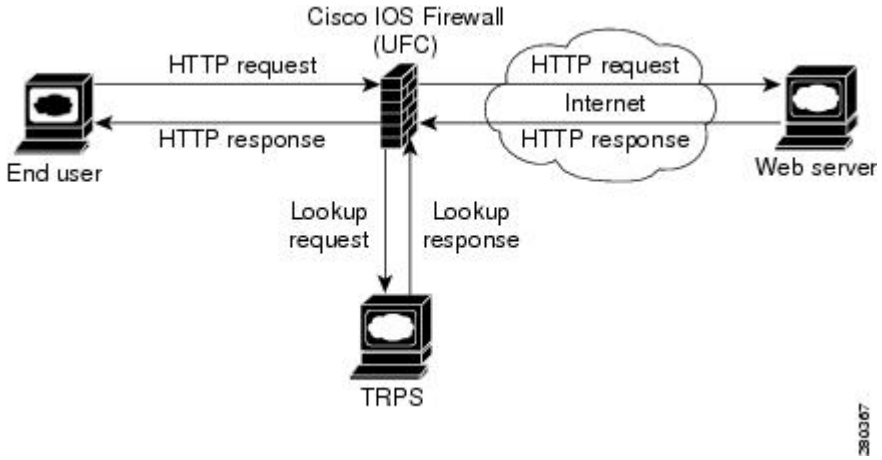
- Use the **trm register** command in privileged EXEC mode to register the router with the Trend Router Provisioning Server (TRPS).

Information About Subscription-Based Cisco IOS Content Filtering

Overview of Subscription-Based Cisco IOS Content Filtering

The Subscription-Based Cisco IOS Content Filtering service interacts with the Trend Micro filtering service URL requests based on URL filtering policy. The figure below and the following steps provide a brief overview of Cisco IOS content filtering.

Figure 14 Subscription-Based Cisco IOS Content Filtering Sample Topology



1 The end user opens a web browser and browses to a web page.

2. The browser sends an HTTP request to the Cisco IOS content filtering service.
3. The Cisco IOS content filtering service receives the request, forwards the request to the web server while simultaneously extracting the URL and sending a lookup request to the TRPS.
4. The TRPS receives the lookup request and retrieves the URL category for the requested URL from its database.
5. The TRPS sends the lookup response to the Cisco IOS content filtering service.
6. The Cisco IOS content filtering service receives the lookup response and permits or denies the URL as specified by a Trend Micro URL filtering policy on the router.
7. The Cisco IOS content filtering service caches the URL and lookup response.

Overview of URL Filtering Policies

A URL filtering policy contains an association of classes and actions and a set of URL filtering parameters that specify how the system handles URL requests.

- A class is a set of match criteria that identifies traffic based on its content. Classes are specified by class maps.
- An action is a specific function associated with a given traffic class. For URL traffic, the actions include **allow**, **log**, and **reset**.
- Classes and actions are associated with one another in a policy map.
- URL filtering parameters specify information about the URL filtering server. URL filtering parameters are specified in a parameter map.
- A URL filtering policy goes into effect when it is attached to a zone pair with the service-policy command.
- You can configure multiple URL filtering policies on the system.

Cisco IOS Content Filtering Modes

Subscription-based Cisco IOS content filtering operates in one of three modes: local filtering mode, URL database filtering mode, and allow mode.

Local Filtering Mode

In this mode, the Cisco IOS content filtering service first tries to match the requested URL with the local lists of trusted domains (white list), untrusted domains (black list), and blocked keywords. If a match is not found, the Cisco IOS content filtering service forwards the lookup request to the URL filtering server as specified in the policy. If the Cisco IOS content filtering service cannot establish communication with the URL filtering server, the system enters allow mode.

The system is in local filtering mode when a URL filtering policy for a URL filtering server has not been specified and when the system cannot establish a connection with the URL filtering server.

URL Database Filtering Mode

In this mode, the Cisco IOS content filtering service has connectivity with the URL filtering server; it can send URL lookup requests to and receive URL lookup responses from the URL filtering server.

In the case of a TRPS, the Cisco IOS content filtering service sends a URL category lookup request to the TRPS and the TRPS responds with the URL category and the URL reputation. Based on the policy set for the URL category and reputation, the HTTP request is allowed, denied, or logged. If a policy has not been configured for the URL category or reputation, the default is to permit the HTTP response.

In the case of SmartFilter and Websense servers, the Cisco IOS content filtering service sends a URL lookup request to the URL database server and the server responds with either a permit or deny message. URL filtering policies for SmartFilter and Websense servers specify a server-based action.

Allow Mode

When the Cisco IOS content filtering service is unable to communicate with the URL filtering server, the system enters allow mode. The default setting for allow mode is off, and all HTTP requests that pass through local filtering mode are blocked. When allow mode is on, all HTTP requests that passed through local filtering mode are allowed.

When both local filtering and URL database filtering modes fail, the system goes into allow mode. If the allow mode action is set to on, all URL requests are allowed. Otherwise, all HTTP requests are blocked.

Benefits of Subscription-Based Cisco IOS Content Filtering

The Subscription-Based Cisco IOS Content Filtering feature allows you to control web traffic based on a particular policy. This following sections describe available with this feature:

- Benefits of Subscription-Based Cisco IOS Content Filtering, page 198
- Benefits of Subscription-Based Cisco IOS Content Filtering, page 198
- Benefits of Subscription-Based Cisco IOS Content Filtering, page 198

White Lists, Black Lists, and Blocked Keyword Lists

This function, which supports the local filtering mode, provides a means of specifying per-policy lists of trusted domain names (white lists), untrusted domain names (black lists), and URL keywords to be blocked (blocked keywords).

When the domain name in a URL request matches an item on the white list, the Cisco IOS content filtering service sends the URL response to the end user's browser directly without sending a lookup request to the TRPS. When the domain name in a URL request matches an item on the black list, the Cisco IOS content filtering service blocks the URL response to the end user's browser. You can specify complete domain names or use the wildcard character * to specify partial domain names.

When a URL contains a keyword, the Cisco IOS content filtering service blocks the URL response directly without sending a lookup request to the URL filtering server. The content filtering service looks at the content of the URL beyond the domain name when making keyword comparisons. For example, if the keyword list contains the word "example," the URL "www.example1.com/example" matches on the keyword example, whereas the URL "www.example.com/example1' does not. You can specify complete words or use the wildcard character * to specify a word pattern.

Caching Recent Requests

This function provides a cache table that contains information about the most recently requested URLs. As a result, a subsequent request for the same URL can be handled by the system without sending a lookup request to the URL filtering server, thus keeping response time to a minimum. In the case of a Trend Micro filtering server, the cache table includes category information for the requested URL. In the case of SmartFilter and Websense filtering servers, the cache table specifies whether the requested URL is allowed or denied.

You can configure the size of the cache table and the length of time an entry remains in the cache table before it expires.

Packet Buffering

This buffering scheme allows the Cisco IOS content filtering service to store HTTP responses while waiting for the URL lookup response from the URL filtering server. The responses remain in the buffer until the response is received from the URL filtering server. If the response indicates that the URL is allowed, the content filtering service releases the HTTP response in the buffer to the end user's browser; if the status indicates that the URL is blocked, the content filtering service discards the HTTP responses in the buffer and closes the connection to both ends. This function prevents numerous HTTP responses from overwhelming your system.

You can specify the number of responses that can be held in the buffer. The default is 200.

Support for SmartFilter and Websense URL Filtering Servers

The Cisco IOS content filtering service provides support for SmartFilter and Websense URL filtering servers. In the case of these third-party URL filtering servers, you configure the URL filtering policy on the router to perform the action specified by the URL filtering server--that is, to allow or deny access to the requested URL.

How to Configure Subscription-Based Cisco IOS Content Filtering

Configuring Class Maps for Local URL Filtering

The Cisco IOS content filtering service filters URL requests on the basis of match criteria in class maps. To enable local URL filtering, you must specify at least one class map each for trusted domains, untrusted domains, and blocked keywords. The match criteria for these class maps are specified in a parameter map, which must be configured before the class map is configured.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **parameter-map type urlf-glob** *parameter-map-name*
4. **pattern** *expression*
5. **exit**
6. Repeat Steps 3 through 5 twice.
7. **class-map type urlfilter match-any** *class-map-name*
8. **match server-domain urlf-glob** *parameter-map-name*
9. **exit**
10. Repeat Step 7 through Step 9.
11. **class-map type urlfilter match-any** *class-map-name*
12. **match url-keyword urlf-glob** *parameter-map-name*
13. **exit**

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	**parameter-map type urlf-glob** *parameter-map-name*
	
	Example:
	`Router(config)#`
	`parameter-map type urlf-glob trusted-domain-param`
		Creates the parameter map for trusted domains and enters profile configuration mode.

Step 4	**pattern** *expression* **Example:** `Router(config-profile)# pattern www.example.com`	Specifies the matching criteria in the parameter map.

	Command or Action	Purpose
Step 5	**exit** **Example:** `Router(config-profile)# exit`	Returns to global configuration mode.
Step 6	Repeat Steps 3 through 5 twice.	Configures the remaining two parameter maps required for local URL filtering: one for untrusted domains and one for URL keywords.
Step 7	**class-map type urlfilter match-any** *class-map-name* **Example:** `Router(config)# class-map type urlfilter match-any trusted-domain-class`	Creates a URL filter class for trusted domains and enters class map configuration mode.
Step 8	**match server-domain urlf-glob** *parameter-map-name* **Example:** `Router(config-cmap)# match server-domain urlf-glob trusted-domain-param`	Configures the matching criteria for the trusted domain class map.
Step 9	**exit** **Example:** `Router(config-cmap)# exit`	Returns to global configuration mode.
Step 10	Repeat Step 7 through Step 9.	Creates and configures the class map for untrusted domains and returns to global configuration mode.
Step 11	**class-map type urlfilter match-any** *class-map-name* **Example:** `Router(config)# class-map type urlfilter match-any keyword-class`	Creates the class map for URL keywords and enters class map configuration mode.
Step 12	**match url-keyword urlf-glob** *parameter-map-name* **Example:** `Router(config-cmap)# match url-keyword urlf-glob keyword-param`	Configures the match criteria for the URL keyword class map based on the previously configured parameter map.

	Command or Action	Purpose
Step 13	**exit** **Example:** `Router(config-cmap)# exit`	Returns to global configuration mode.

Configuring Class Maps for Trend Micro URL Filtering

To enable Trend Micro URL filtering, you must configure one or more class maps that specify the match criteria for URL categories. As an option, you can configure one or more class match that specify match criteria for URL reputations.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type urlfilter trend** [**match-any**] *class-map-name*
4. **match url category** *category-name*
5. Repeat Step 4 until all categories for the class map have been specified.
6. **exit**
7. Repeat Steps 3 through 6 until all classes for Trend Micro URL category filtering have been configured.
8. **class-map type urlfilter trend** [**match-any**] *class-map-name*
9. **match url reputation** *reputation-name*
10. Repeat Step 9 until all reputations for the class map have been specified.
11. **exit**
12. Repeat Steps 8 through 11 until all classes for Trend Micro URL reputation filtering have been configured.

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	**class-map type urlfilter trend** [**match-any**] *class-map-name* **Example:** `Router(config)# class-map type urlfilter trend match-any drop-category`	Creates a class map for Trend Micro URL category filtering and enters class map configuration mode.
Step 4	**match url category** *category-name* **Example:** `Router(config-cmap)# match url category Gambling`	Specifies the matching criteria for the Trend Micro URL filtering class.
Step 5	Repeat Step 4 until all categories for the class map have been specified.	(Optional) Specifies additional matching criteria.
Step 6	**exit** **Example:** `Router(config-cmap)# exit`	Returns to global configuration mode.
Step 7	Repeat Steps 3 through 6 until all classes for Trend Micro URL category filtering have been configured.	(Optional) Configures additional classes for URL filtering.
Step 8	**class-map type urlfilter trend** [**match-any**] *class-map-name* **Example:** `Router(config)# class-map type urlfilter trend match-any drop-reputation`	(Optional) Creates a class map for Trend Micro URL reputation filtering and enters class map configuration mode.
Step 9	**match url reputation** *reputation-name* **Example:** `Router(config-cmap)# match url reputation PHISHING`	(Optional) Specifies the matching criteria for the Trend Micro URL filtering class.
Step 10	Repeat Step 9 until all reputations for the class map have been specified.	(Optional) Specifies additional matching criteria.
Step 11	**exit** **Example:** `Router(config-cmap)# exit`	Returns to global configuration mode.

	Command or Action	Purpose
Step 12	Repeat Steps 8 through 11 until all classes for Trend Micro URL reputation filtering have been configured.	(Optional) Configures additional classes for URL filtering.

Configuring Parameter Maps for Trend Micro URL Filtering

To enable Trend Micro URL filtering, you must configure the global parameters for the TRPS in a parameter map. You can configure only one global Trend Micro parameter map. As an option, you can configure per-policy TRPS parameters in a per-policy parameter map.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **parameter-map type trend-global** *parameter-map-name*
4. **server** {*server-name* | *ip-address*} [**http-port** *port-number*] [**https-port** *port-number*] [**retrans** *retransmission-count*] [**timeout** *seconds*]
5. **alert** {**on** | **off**}
6. **cache-entry-lifetime** *hours*
7. **cache-size maximum-memory** *kilobyte*
8. **exit**
9. **parameter-map type urlfpolicy trend** *parameter-map-name*
10. **allow-mode** {**on** | **off**}
11. **block-page** {**message** *string* | **redirect-url** *url*}
12. **max-request** *number-requests*
13. **max-resp-pak** *number-responses*
14. **truncate hostname**
15. **exit**

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	**parameter-map type trend-global** *parameter-map-name* **Example:** `Router(config)# parameter-map type trend-global global-trend param`	Creates the parameter map for global parameters for the TRPS and enters profile configuration mode.
Step 4	**server** {*server-name* | *ip-address*} [**http-port** *port-number*] [**https-port** *port-number*] [**retrans** *retransmission-count*] [**timeout** *seconds*] **Example:** `Router(config-profile)# server trps1.trendmicro.com retrans 5 timeout 200`	(Optional) Configures basic server parameters for the TRPS.
Step 5	**alert** {**on** | **off**} **Example:** `Router(config-profile)# alert on`	(Optional) Turns on or off URL-filtering server alert messages that are displayed on the console.
Step 6	**cache-entry-lifetime** *hours* **Example:** `Router(config-profile)# cache-entry-lifetime 3`	(Optional) Specifies how long, in hours, an entry remains in the cache table.
Step 7	**cache-size maximum-memory** *kilobyte* **Example:** `Router(config-profile)# cache-size maximum-memory 512`	(Optional) Configures the size of the categorization cache.
Step 8	**exit** **Example:** `Router(config)# exit`	Returns to global configuration mode.

Command or Action	Purpose
Step 9 **parameter-map type urlfpolicy trend** *parameter-map-name* **Example:** `Router(config)# parameter-map type urlfpolicy trend trend-param-map`	(Optional) Creates a parameter map for the per-policy parameters for a Trend Micro URL filtering policy and enters profile configuration mode.
Step 10 **allow-mode** {**on** | **off**} **Example:** `Router(config-profile)# allow-mode on`	(Optional) Specifies whether to allow or block URL requests when the URL filtering process does not have connectivity to the specified URL filtering service. • When allow mode is **on**, all unmatched URL requests are allowed. • When allow mode is **off**, all unmatched URL requests are blocked. • The default is **off**.
Step 11 **block-page** {**message** *string* | **redirect-url** *url*} **Example:** `Router(config-profile)# block-page message "This page is blocked by Trend policy."`	(Optional) Specifies the response to a blocked URL request. • **message** *string* --Specifies the message text to be displayed when a URL request is blocked. • **redirect-url** *url* --Specifies the URL of the web page to be displayed when a URL request is blocked.
Step 12 **max-request** *number-requests* **Example:** `Router(config-profile)# max-request 5000`	(Optional) Specifies the maximum number of pending URL requests. • The range is from 1 to 2147483647. • The default is 1000.
Step 13 **max-resp-pak** *number-responses* **Example:** `Router(config-profile)# max-resp-pak 500`	(Optional) Specifies the number of HTTP responses that can be buffered. • The range is from 0 to 20000. • The default is 200.
Step 14 **truncate hostname** **Example:** `Router(config-profile)# truncate hostname`	(Optional) Specifies that URLs be truncated at the end of the domain name.

	Command or Action	Purpose
Step 15	**exit** **Example:** `Router(config-profile)# exit`	Returns to global configuration mode.

Configuring URL Filtering Policies

URL filtering policies are configured by associating classes with actions and specifying the URL filtering parameters for the URL filtering server. To enable subscription-based Cisco IOS content filtering, you must configure a Trend Micro URL filtering policy. To enable SmartFilter or Websense URL filtering, you must configure a SmartFilter or Websense URL filtering policy.

Before you can configure a URL filter policy, you must have previously configured the URL filter classes to which the policy applies and have specified a parameter map for the filtering server.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map type inspect urlfilter** *policy-map-name*
4. **parameter type urlfpolicy** [**local** | **trend** | **n2h2** | **websense**] *parameter-map-name*
5. **class type urlfilter** [**trend** | **n2h2** | **websense**] *class-map-name*
6. **allow** | **reset** | **server-specified-action**
7. **log**
8. **exit**
9. Repeat Steps 4 through 8 for the remaining classes of traffic to which the policy applies.
10. **exit**

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	**policy-map type inspect urlfilter** *policy-map-name* **Example:** `Router(config)# policy-map type inspect urlfilter trend-policy`	Creates the policy map for the URL filtering policy and enters policy-map configuration mode.
Step 4	**parameter type urlfpolicy** [**local** | **trend** | **n2h2** | **websense**] *parameter-map-name* **Example:** `Router(config-pmap)# parameter type urlfpolicy trend trend-parameters`	Specifies the parameters in a parameter map for the URL filtering server.
Step 5	**class type urlfilter** [**trend** | **n2h2** | **websense**] *class-map-name* **Example:** `Router(config-pmap)# class type urlfilter trusted-domain-class`	Specifies the class to which the policy applies and enters policy-map class configuration mode.
Step 6	**allow** | **reset** | **server-specified-action** **Example:** `Router(config-pmap-c)# allow`	Specify the action to take: • **allow** --Allows traffic matching the pattern specified by the class. • **reset** --Blocks traffic matching the pattern specified by the class by resetting the connection on both ends. • **server-specified-action** --Allows or blocks traffic as specified by the URL filtering server.
Step 7	**log** **Example:** `Router(config-pmap-c)# log`	(Optional) Logs the request for traffic matching the pattern specified by the class.
Step 8	**exit** **Example:** `Router(config-pmap-c)# exit`	Returns to policy map configuration mode.
Step 9	Repeat Steps 4 through 8 for the remaining classes of traffic to which the policy applies.	(Optional) Specifies additional classes and actions for the policy

	Command or Action	Purpose
Step 10	**exit** **Example:** `Router(config-pmap)# exit`	Returns to global configuration mode.

Attaching a URL Filtering Policy

After you have configured a URL filtering policy, you attach the policy to an inspect type policy map that defines the traffic to be inspected and the actions to be taken based on the characteristics of the traffic. Then, you attach the inspect type policy map as a service policy to a particular target (zone-pair). After you attach the policy, you must configure the interfaces that belong to the zone. See the *Cisco IOS Security Configuration Guide* for more information.

If you do not want to use the default parameters for inspecting traffic, use the **parameter-map type inspect** command to configure the parameters related to the inspect action.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect match-all** *class-map-name*
4. **match protocol http**
5. **exit**
6. **policy-map type inspect** *policy-map-name*
7. **class type inspect** *class-map-name*
8. **inspect** *parameter-map-name*
9. **service-policy urlfilter** *policy-map-name*
10. **exit**
11. **class class-default**
12. **drop**
13. **exit**
14. **exit**
15. **zone-pair security** *zone-pair-name* {**source** *source-zone-name* | **self**} **destination** [**self** | *destination-zone-name*]
16. **service-policy type inspect** *policy-map-name*
17. **exit**

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 type inspect match-all** *class-map-name* **Example:** `Router(config)# class-map type inspect match-all http-class`	Creates an inspect type class map and enters class map configuration mode.
Step 4	**match protocol http** **Example:** `Router(config-cmap)# match protocol http`	Specifies the HTTP protocol as the match criteria for the class map.
Step 5	**exit** **Example:** `Router(config-cmap)# exit`	Returns to global configuration mode.
Step 6	**policy-map type inspect** *policy-map-name* **Example:** `Router(config)# policy-map type inspect trend-global-policy`	Creates an inspect type policy map and enters policy-map configuration mode. This policy map defines the traffic to be inspected and the actions to take on that traffic.
Step 7	**class type inspect** *class-map-name* **Example:** `Router(config-pmap)# class type inspect http-class`	Specifies the HTTP traffic class to be inspected by the policy and enters policy-map class configuration mode.

	Command or Action	Purpose
Step 8	**inspect** *parameter-map-name* **Example:** `Router(config-pmap-c)# inspect global`	Specifies the inspect action on HTTP traffic.
Step 9	**service-policy urlfilter** *policy-map-name* **Example:** `Router(config-pmap-c)# service-policy urlfilter trend-policy`	Attaches the URL filter policy to all HTTP traffic.
Step 10	**exit** **Example:** `Router(config-pmap-c)# exit`	Returns to policy-map configuration mode.
Step 11	**class class-default** **Example:** `Router(config-pmap)# class class-default`	Creates the default class--that is, all traffic that does not match the criteria specified by the HTTP class map--and enters policy-map class configuration mode.
Step 12	**drop** **Example:** `Router(config-pmap-c)# drop`	Specifies the action to take on traffic in the default class--that is, to drop all non-HTTP traffic.
Step 13	**exit** **Example:** `Router(config-pmap-c)# exit`	Returns to policy-map configuration mode.
Step 14	**exit** **Example:** `Router(config-pmap)# exit`	Returns to global configuration mode.

	Command or Action	Purpose
Step 15	**zone-pair security** *zone-pair-name* {**source** *source-zone-name* | **self**} **destination** [**self** | *destination-zone-name*] **Example:** `Router(config)# zone-pair security zp source z1 destination z2`	Creates a zone pair and enters security zone-pair configuration mode.
Step 16	**service-policy type inspect** *policy-map-name* **Example:** `Router(config-sec-zone-pair)# service-policy type inspect trend-policy`	Attaches a URL filtering policy to the destination zone pair.
Step 17	**exit** **Example:** `Router(config-sec-zone-pair)# exit`	Returns to global configuration mode.

Configuration Examples for Cisco IOS Content Filtering

Example Configuring Class Maps for Local URL Filtering

The following example shows class maps for trusted domains, untrusted domains, and URL keywords. The required parameter maps are configured first.

```
parameter-map type urlf-glob trusted-domain-param
 pattern www.example1.com
 pattern *.example2.com
!
parameter-map type urlf-glob untrusted-domain-param
 pattern www.example3.com
 pattern www.example4.com
!
parameter-map type urlf-glob keyword-param
 pattern mp3
 pattern jobs
```

```
class-map type urlfilter match-any untrusted-domain-class
 match server-domain urlf-glob untrusted-domain-param
class-map type urlfilter match-any trusted-domain-class
 match server-domain urlf-glob trusted-domain-param
class-map type urlfilter match-any keyword-class
 match url-keyword urlf-glob keyword-param
```

Example Configuring Class Maps for Trend Micro URL Filtering

The following example shows a class map that defines the class drop-category, which specifies traffic that matches the defined URL categories:

```
class-map type urlfilter trend match-any drop-category
 match url category Gambling
 match url category Personals-Dating
```

Example Configuring Parameter Maps for Trend Micro URL Filtering

The following example shows a parameter map for global Trend Micro parameters and a parameter map for per-policy Trend Micro parameters:

```
parameter-map type trend-global global-param-map
 server trps1.trendmicro.com retrans 5 timeout 200
 cache-entry-lifetime 1
 cache-size maximum-memory 128000
parameter-map type urlfpolicy trend trend-param-map
 block-page message "group2 is blocked by trend"
 max-request 2147483647
 max-resp-pak 20000
 truncate hostname
```

Example Attaching a URL Filtering Policy

The following example configures an HTTP traffic class and an inspect type policy map that inspects all HTTP traffic, applies the URL filtering policy to that traffic, and ignores all other traffic. Finally, the inspect policy is attached as a service policy to the target zone pair.

```
class-map type inspect match-all http-class
 match protocol http
policy-map type inspect urlfilter trend-global-policy
 class type inspect http-class
  inspect global
  service-policy urlfilter trend-policy
 class class-default
  drop
zone-pair security zp-in source zone-in destination zone-out
 service-policy type inspect trend-global-policy
```

Example Subscription-Based Content Filtering Sample Configuration

The following sample subscription-based content filtering configuration specifies two different URL filtering policies--one for group one and one for group two:

```
! port map to indicate FW that all 8080 connections are http connections
ip port-map http port 8080
! Trend global parameter-map to specify the TRPS server and cache-sizes
parameter-map type trend-global hello
 server trps1.trendmicro.com
 cache-size maximum-memory 300
! Trend Policy parameter map for group one.
!   If server is down, allow the HTTP connections
```

```
parameter-map type urlfpolicy trend trend-g1-param
 allow-mode on
 block-page message "You are prohibited from accessing this web page"
! Trend Policy parameter map for group two.
!   If the server is down block the HTTP connections
parameter-map type urlfpolicy trend trend-g2-params
 block-page message "Restricted access. Please contact your administrator"
! Trend class map for group one
!   Just match bad reputation sites
class-map type urlfilter trend trend-g1-c
 match url reputation ADWARE
 match url reputation DIALER
! Trend class map for group two
!   Match on bad reputation sites and on Gambling and Personals-Dating sites
class-map type urlfilter trend trend-g2-c
 match url reputation ADWARE
 match url reputation PHISHING
 match url category Gambling
 match url category Personals-Dating
! Local filtering class to permit certain domains
parameter-map type urlf-glob p-domains
 pattern "www.example.com"
 pattern "www.example1.com"
class-map type urlfilter p-domains
   match server-domain urlf-glob p-domains
! Local filtering class to deny certain domains
parameter-map type urlf-glob d-domains
 pattern "*.example2.com"
 pattern "www.example3.com"
class-map type urlfilter d-domains
   match server-domain urlf-glob d-domains
! Urlfilter Policy map for group one.
! Don't block any of the domains locally
policy-map type inspect urlfilter g1-pol
 parameter type urlfpolicy trend trend-g1-param
 class type urlfilter p-domains
  allow
 class type urlfilter d-domains
  reset
 class type urlfilter trend trend-g1-c
  reset
! Url filter policy map for group two
!   Block the deny domains locally
policy-map type inspect urlfilter g2-pol
 parameter type urlfpolicy trend trend-g2-param
 class type urlfilter p-domains
  allow
 class type urlfilter d-domains
  log
  reset
 class type urlfilter trend trend-g2-c
  reset
! First level class to prevent content filtering for websites that are local to the
enterprise
! The first deny line is to make the http connections going to the proxy to not match
this class
ip access-list extended 101
 deny tcp any host 192.168.1.10 eq 8080
 permit tcp any 192.168.0.0 0.0.255.255 eq 80 8080
 permit tcp any 10.0.0.0 0.255.255.255 eq 80 8080
class-map type inspect no-urlf-c
   match access-group 101
! First level class map to support url-filtering for group one
ip access-list extended 102
 permit tcp 192.168.1.0 0.0.0.255 any
class-map type inspect urlf-g1-c
 match protocol http
 match access-group 102
! First level class map to support url-filtering for group two
ip access-list extended 103
 permit tcp 192.168.2.0 0.0.0.255 any
class-map type inspect urlf-g1-c
 match protocol http
```

```
 match access-group 103
! First level class map to allow ICMP from protected network to outside
class-map type inspect icmp-c
   match protocol icmp
! First level policy map that brings everything together
! Always configure the class with most restrictions first
policy-map type inspect fw-pol
 class type inspect icmp
  inspect
 class type inspect no-urlf-c
  inspect
 class type inspect urlf-g2-c
  inspect
  service-policy urlfilter g2-pol
 class type inspect urlf-g1-c
  inspect
  service-policy urlfilter g1-pol
! Create targets to which the FW policy is applied
zone security z1
zone security z2
zone-pair security z1z2 source z1 destination z2
 service-policy type inspect fw-pol
! inside interface
interface FastEthernet 0/0
 ip address 10.1.1.1 255.255.0.0
 zone-member security z1
!outside interface
interface FastEthernet 1/0
 ip address 209.165.200.225 255.255.255.224
 zone-member security z2
```

Example Configuring URL Filtering with a Websense Server

The following example configures URL filtering with a Websense server:

```
parameter-map type urlfpolicy websense websense-param-map
/* define vendor related info */
 server 192.168.3.1
 port 5000 retrans 3 timeout 200
/* define global info related with URL filtering */
 alert on
 allow-mode off
 urlf-server-log on
 max-request 2000
 max-resp-pak 200
 truncate hostname
 cache-size 256
 cache-entry-lifetime 2
 block-page “This page has been blocked.”

/* define trusted-domain lists */
! Local filtering class to permit certain domains
parameter-map type urlf-glob p-domains
 pattern "www.example.com"
 pattern "www.example1.com"
class-map type urlfilter p-domains
 match server-domain urlf-glob p-domains
! Local filtering class to deny certain domains
parameter-map type urlf-glob d-domains
 pattern "*.example2.com"
 pattern "www.example3.com"
class-map type urlfilter d-domains
 match server-domain urlf-glob d-domains
class-map type urlfilter websense match-any websense-map
 match server-response any
policy-map type inspect urlfilter url-websense-policy
 parameter-map urlfpolicy websense websense-param-map
 class type urlfilter trusted-domain-lists
  allow
 class type urlfilter untrusted-domain-lists
  reset
```

```
 class type urlfilter block-url-keyword-lists
  reset
 class type urlfilter websense websense-map
  server-specified-action
/* define customer group */
access-list 101 permit ip 192.168.1.0 0.0.0.255 any
class-map type inspect match-all urlf-traffic
 match protocol http
 match access-list 101
policy-map type inspect urlfilter-policy
 class type inspect urlf-traffic
  inspect
  service-policy urlfilter url-websense-policy
```

Example Configuring URL Filtering with a SmartFilter Server

The following example configures URL filtering with a SmartFilter server:

```
parameter-map type urlfpolicy n2h2 n2h2-param-map
/* define vendor related info */
 server 192.168.3.1
 port 5000 retrans 3 timeout 200
/* define global info related with URL filtering */
 alert on
 allow-mode off
 urlf-server-log on
 max-request 2000
 max-resp-pak 200
 truncate hostname
 cache-size 256
 cache-entry-lifetime 2
 block-page “This page has been blocked.”
/* define trusted-domain lists */
! Local filtering class to permit certain domains
parameter-map type urlf-glob p-domains
 pattern "www.example.com"
 pattern "www.example1.com"
class-map type urlfilter p-domains
 match server-domain urlf-glob p-domains
! Local filtering class to deny certain domains
parameter-map type urlf-glob d-domains
 pattern "*.example2.com"
 pattern "www.example3.com"
class-map type urlfilter d-domains
 match server-domain urlf-glob d-domains
class-map type urlfilter websense match-any n2h2-map
 match server-response any
policy-map type inspect urlfilter url-n2h2-policy
 parameter-map urlfpolicy n2h2 n2h2-param-map
  class type urlfilter trusted-domain-lists
   allow
  class type urlfilter untrusted-domain-lists
  reset
  class type urlfilter block-url-keyword-lists
   reset
  class type urlfilter n2h2 n2h2-map
   server-specified-action
/* define customer group */
access-list 101 permit ip 192.168.1.0 0.0.0.255 any
class-map type inspect match-all urlf-traffic
 match protocol http
 match access-list 101
policy-map type inspect urlfilter-policy
 class type inspect urlf-traffic
  inspect
  service-policy urlfilter url-n2h2-policy
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
Security commands: complete command syntax, command mode, command history, defaults, usage guidelines, and examples	*Cisco IOS Security Command Reference*
The Cisco IOS firewall solution	Cisco IOS Firewall Overview

Standards

Standard	Title
None	--

MIBs

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

RFCs

RFC	Title
RFC 1945	*Hypertext Transfer Protocol--HTTP/1.0*
RFC 2616	*Hypertext Transfer Protocol--HTTP/1.1*

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 Subscription-Based Cisco IOS Content Filtering

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 9 Feature Information for Subscription-Based Cisco IOS Content Filtering

Feature Name	Releases	Feature Information
Cisco IOS Content Filtering	12.4(15)XZ 12.4(20)T	This feature interacts with the Trend Micro URL filtering service so that HTTP requests can be allowed, blocked, or logged, based on a content filtering policy. The content filtering policy specifies how to handle items such as categories, reputations (or security ratings), trusted domains, untrusted domains, and keywords. The following commands were introduced or modified: **class-map type urlfilter**, **class type urlfilter**, **clear zone-pair urlfilter cache**, **debug cce dp named-db urlfilter**, **debug ip trm**, **debug ip urlfilter**, **match server-domain urlf-glob**, **match server-response anymatch url category**, **match url reputation**, **match url- keyword urlf-glob**, **parameter-map type trend-global**, **parameter-map type urlf-glob**, **parameter-map type urlfpolicy**, **policy-map type inspect urlfilter**, **show class-map type urlfilter**, **show ip trm config**, **show ip trm subscription status**, **show parameter-map type trend-global**, **show parameter-map type urlf-glob**, **show parameter-map type urlfpolicy**, **show policy-map type inspect urlfilter**, **show policy-map type inspect zone-pair**, **show policy-map type inspect zone-pair urlfilter**, **trm register**.

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 IOS Firewall Support for Skinny Local Traffic and CME

The Cisco IOS Firewall Support for Skinny Local Traffic and CME feature enhances the Context-Based Access Control (CBAC) functionality to support Skinny traffic that is either generated by or destined to the router. When Cisco Call Manager Express (CME) is enabled on the Cisco IOS firewall router, the CME manages both VoIP and analog phones using Skinny Client Control Protocol (SCCP) over either an intranet or the Internet with flow-around and flow-through modes of CME.

In addition,the Firewall Support of Skinny Client Control Protocol feature extends the support of SCCP to accommodate video channels.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

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 Cisco IOS Firewall Support for Skinny Local Traffic and CME

The Skinny inspection module is part of the inspection subsystem; thus, your router must be running an image that has firewall support.

Restrictions for Cisco IOS Firewall Support for Skinny Local Traffic and CME

This feature has the following restrictions:

- Skinny inspection will inspect only the SCCP sessions that have been established after the firewall is configured with Skinny inspection. That is, any SCCP sessions that were established through the firewall before the Skinny inspection was configured will not be inspected.
- This feature does not support Music on Hold (MOH) when a device other than the Call Manager (CM) is the music server. (This feature does support MOH when the CM is the music server.)
- This feature does not address either the multicast functionality of SCCP or the functionality of multiple active calls on a single Skinny client.

This feature does not support the following Skinny and firewall configurations.

The CM and the Skinny client cannot be on three different networks that are separated at the firewall. The firewall implementation does not inspect sessions that have devices residing on more than two distinct networks that are segregated at the firewall. That is, if more than two interfaces at the firewall, session inspection is not supported.

Information About Cisco IOS Firewall Support for Skinny Local Traffic and CME

Skinny Inspection Overview

Skinny inspection enables voice communication between two Skinny clients by using the Cisco CallManager. The Cisco CallManager uses the TCP port 200 to provide services to Skinny clients. A Skinny client connects to the primary Cisco CallManager by establishing a TCP connection and if available, connects to a secondary Cisco CallManager. After the TCP connection is established, the Skinny client registers with the primary Cisco CallManager, which will be used as the controlling Cisco CallManager until it reboots or a keepalive failure occurs. Thus, the TCP connection between the Skinny client and the Cisco CallManager exists forever and is used to establish calls coming to or from the client. If a TCP connection fails, the secondary Cisco CallManager is used. All data channels established with the initial Cisco CallManager remain active and will be closed after the call ends.

The Skinny protocol inspects the locally generated or terminated Skinny control channels and opens or closes pinholes for media channels that originate from or are destined to the firewall. Pinholes are ports that are opened through a firewall to allow an application controlled access to a protected network. The Skinny traffic that passes through and locally generated or terminated Skinny traffic is treated in the same way at the firewall.

The table below lists the set of messages that are necessary for the data sessions to open and close. Skinny inspection will examine the data sessions that are deemed for opening and closing the access list pinholes.

Table 10 Skinny Data Session Messages

Skinny Inspection Message	Description
StationCloseReceiveChannelMessage	Sent by Cisco CallManager instructing the Skinny client (on the basis of the information in this message) to close the receiving channel.
StationOpenReceiveChannelAckMessage	Contains the IP address and port information of the Skinny client sending this message. This message also contains the status of whether or not the client is willing to receive voice traffic.
StationStartMediaTransmissionMessage	Contains the IP address and port information of the remote Skinny client.
StationStopMediaTransmissionMessage	Sent by the Cisco CallManager instructing the Skinny client (on the basis of the information in this message) to stop transmitting voice traffic.
StationStopSessionTransmissionMessage	Sent by the Cisco CallManager instructing the Skinny client (on the basis of the information in this message) to end the specified session.
StationOpenMultiMediaReceiveChannelAckMessage	Contains the IP address and port information of the Skinny client sending this message. It also contains the status of whether the client is willing to receive video and data channels.
StationCloseMultiMediaReceiveChannel	Sent by the Cisco Unified Communications Manager to the Skinny endpoint to request the closing of the receiving video or data channel.
StationStartMultiMediaTransmitMessage	Sent by the Cisco Unified Communications Manager to the Skinny endpoint whenever Cisco Unified Communications Manager receives an OpenLogicalChannelAck message for the video or data channel.
StationStopMultiMediaTransmission	Sent to Skinny endpoints to request the stopping of the transmission of video or data channel.

Pregenerated Session Handling

When two phones register with the CME running on Cisco IOS firewall, two control channels terminated on the CME box. These two control channels are TCP connections and are inspected by the Firewall Skinny module. When pinholes are opened for the media traffic, a total of four pre-gen sessions are created, two for each control session.

With the flow-through mode of operation of CME, the four pregenerated sessions are converted to two active sessions. The same number of active sessions is retained because there are two media sessions, one from each phone terminating on CME.

With the flow-around mode of operation of CME, the CME is bypassed as there is a direct connection between the two phones. In this mode, there are two possible scenarios:

- When both phones are on the same side of the CME, there is no exchange of media packets between the two phones. However, exchange of media packets is possible with pass-through traffic. In this case, the pre-gen sessions will timeout because the media traffic will not reach the router itself.
- When both phones are located on either side of the CME, the media traffic goes through the CME box. The four pre-gen sessions that are created are converted to one active session. Instead of creating four pre-gen sessions, only two pre-gen sessions are created. These two pre-gen sessions are converted to one active session when you see the media traffic.

NAT with CME and the Cisco IOS Firewall

In typical deployments, both Cisco IOS firewall and Network Address Translator (NAT) will be running on the same router. When CME is also running, typically in the case of an Integrated Services Router (ISR), some complexities and limitations exist.

- If two Skinny phones are registered to CME that is on the Cisco IOS firewall with NAT. When Phone 1 attempts to communicate with Phone 2, the IP and port (mostly private IP) of Phone 1 will be exchanged with Phone 2 over the already established TCP connection.
- If NAT is configured on the outside interface to translate all the private addresses to the router's global address. Some private addresses are exchanged over a TCP connection between the router and the remote phone. If NAT is able to translate the addresses in such flows where one endpoint is the router itself, then NAT and CME running on the same box will not cause any problems. If not, the following scenarios are possible:
- In flow-through mode of operation, the voice data channels, Real-time Transport Protocol (RTP) stream over User Datagram Protocol (UDP), from Phone 1 and Phone 2, both terminate on CME. So, there will be one RTP over UDP connection from Phone 1 to the CME and a second from Phone 2 to the CME. The CME relays the voice data over the two channels. In this case, there should not be any problem with NAT running on the CME box, as the connection is terminated on the router from Phone 2 and the address used for that connection is the global address of the router.
- In flow-around mode of operation, there is a direct connection (RTP over UDP) between Phone1 and Phone 2 for carrying voice data traffic. If NAT does not translate the private IP of Phone 1, then the voice data channel will not be established successfully because the private IP of Phone 1 is shared in the control channel. In such a scenario, the running of CME with NAT breaks down.

New Registry for Locally Generated Traffic

A new registry is created in the Skinny local media traffic path. This path differs from the regular switching path code, where all the controlling and pass-through media traffic is inspected. The Skinny module sends the locally generated traffic using the "fastsend" application program interface (API) which does not put the packet in the regular switching path, but sends it directly (to Layer 2 drivers). This new registry resets the timeouts for the media channels and also reports the number of Skinny media sessions that are established such as the output of **show** commands.

Note The above API is used to update the Firewall sessions when the media channel is active. Firewall will not attempt to protect the CME box based on the nonexistence of pregen. Therefore, the firewall will not drop media packets for which there is no pre-gen/active session. The MTP module in CME protects itself by dropping the packets that do not match the source IP and source port numbers.

How to Configure Cisco IOS Firewall Support for Skinny Local Traffic and CME

Creating a ZonePair Between a Zone and the Self Zone

To inspect the traffic that is destined to the router or the traffic originating from the router, you need to create a zonepair between a zone (containing the incoming/outgoing interface) and the self zone.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **parameter-map type inspect** *parameter-map-name*
4. **alert** {**on** | **off**}
5. **audit-trail** {**on** | **off**}
6. **class-map type inspect** protocol-name [**match-any**| **match-all**] class-map-name
7. **policy-map type inspect** *policy-map-name*
8. **class type inspect** *class-map-name*
9. **zone security** *name*
10. **zone security** *name*
11. exit
12. **zone-pair security** *zone-pair-name* {**source** *source-zone-name*| **self**} **destination** [**self** | *destination-zone-name*]
13. **service-policy type inspect** *policy-map-name*
14. **interface** *type number*
15. **zone-member security** *zone-name*

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**parameter-map type inspect** *parameter-map-name* **Example:** `Router(config)# parameter-map type inspect insp-pmap`	Configures an inspect parameter map for connecting thresholds, timeouts, and other parameters pertaining to the **inspect** action. • Enters parameter-map type inspect configuration mode.
Step 4	**alert** {**on** | **off**} **Example:** `Router(config-profile)# alert on`	(Optional) Turns on and off Cisco IOS stateful packet inspection alert messages that are displayed on the console.
Step 5	**audit-trail** {**on** | **off**} **Example:** `Router(config-profile)# audit-trail on`	(Optional) Turns audit trail messages on or off.
Step 6	**class-map type inspect** protocol-name [**match-any**| **match-all**] class-map-name **Example:** `Router(config-profile)# class-map type inspect skinnycmap match-any protocol skinny`	Creates a class map for the Skinny protocol so that you can enter match criteria. • Enters class-map configuration mode.
Step 7	**policy-map type inspect** *policy-map-name* **Example:** `Router(config-profile)# policy-map type inspect skinnypmap`	Creates a policy map so that you can enter match criteria. • Enters policy map configuration mode.
Step 8	**class type inspect** *class-map-name* **Example:** `Router(config-profile)#` **class type inspect** *skinnycmap*	Specifies the name of the class on which an action is to be performed. • The value of the *class-map-name* argument must match the appropriate class name specified via the **class-map type inspect** command.

	Command or Action	Purpose
Step 9	**zone security** *name* **Example:** `Router(config-profile)# zone security z1`	Creates a zone for phone 1. • Enters global configuration mode.
Step 10	**zone security** *name* **Example:** `Router(config-profile)# zone security z2`	Creates a zone for phone 2.
Step 11	exit **Example:** `Router(config-profile)#exit`	Exits profile configuration mode.
Step 12	**zone-pair security** *zone-pair-name* {**source** *source-zone-name*| **self}** **destination** [**self** | *destination-zone-name*] **Example:** `Router(config)# zone-pair security z1-self source z1 destination self`	Creates a zone-pair. • Enters security zone-pair configuration mode.
Step 13	**service-policy type inspect** *policy-map-name* **Example:** `Router(config-sec-zone-pair)# service-policy type inspect skinnypmap`	Attaches a firewall policy map to the destination zone-pair. • If a policy is not configured between a pair of zones, traffic is dropped by default. • Enters global configuration mode.
Step 14	**interface** *type number* **Example:** `Router(config)# interface FastEthernet4/1`	Specifies the type of interface to be configured and the port, connector, or interface card number.
Step 15	**zone-member security** *zone-name* **Example:** `Router(config-sec-zone-pair)#` **zone-member security** *z1*	Specifies the name of the security zone to which an interface is attached.

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
Firewall support of SCCP	"Firewall Support of Skinny Client Control Protocol (SCCP)" chapter in th e *Cisco IOS Security Configuration Guide*
Firewall commands	*Cisco IOS Security Command Reference*

Standards

Standard	Title
None	--

MIBs

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

RFCs

RFC	Title
None	--

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 Cisco IOS Firewall Support for Skinny Local Traffic and CME

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 Cisco IOS Firewall Support for Skinny Local Traffic and CME

Feature Name	Releases	Feature Information
IOS Firewall Support for Skinny Local Traffic and CME	12.4(20)T	The Cisco IOS Firewall Support for Skinny Local Traffic and CME feature enhances the Context-Based Access Control (CBAC) functionality to support 'router generated/destined to router' Skinny traffic. When CME is enabled on the IOS firewall router, it manages both VoIP and analog phones using Skinny Client Control Protocol (SCCP) over intranet or internet with flow-around and flow-through modes of CME. The following commands were introduced or modified: **class-map type inspect, class type inspect, interface, parameter-map type inspect, policy-map type inspect, service-policy type inspect, zone-member security, zone-pair security.**
IOS Zone-Based Firewall SCCP Video Support	15.1(2)T	The IOS Zone-Based Firewall SCCP Video Support (SCCP) feature extends support to accommodate video channels.

User-Based Firewall Support

Firewalls traditionally apply rules based on source and destination IP addresses. In the new, highly dynamic mobile world, IP addresses of end systems constantly change. Therefore it becomes increasingly difficult to have a particular user group function assigned to a particular block of IP addresses. It is also difficult to apply firewall policies for a user group that is the source of the traffic. This feature allows source IP addresses to be associated with user groups. Network administrators can apply firewall policies based on user-groups, and the infrastructure can seamlessly apply these security policies.

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information for User-Based Firewall Support section.

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

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

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 User-Based Firewall Support

- Software Requirements, page 232

Hardware Requirements

- Access Control Server
- Cisco Network Access Device, which can be any of the following:
  - Cisco 7200 router
  - Cisco 1800 router
  - Cisco 2800 router
  - Cisco 3800 router

Software Requirements

- Cisco IOS Release 12.4(20)T or a later release
- An Ingress Security feature that uses the Identity Policy infrastructure for policy application

Restrictions for User-Based Firewall Support

User-group mapping is based on the IPv4 address of the end-host's source. The "user-group" match criterion is supported for inspect class-maps.

Authentication Proxy and IP Admission

Authentication Proxy and IP Admission is an input-only feature that should be configured on all the interfaces of the source zone. The Authentication Proxy and IP Admission feature is not virtual routing and forwarding (VRF)-aware; therefore, the user-group Zone Policy Firewall policies cannot be applied on a per VRF basis.

Information About User-Based Firewall Support

- Feature Design of User-Based Firewall Support, page 232
- Firewall Support, page 233
- Authentication Proxy, page 233
- Zone-Based Policy Firewall, page 234
- Tag and Template, page 234
- Access Control List Overview, page 234

Feature Design of User-Based Firewall Support

The User-Based Firewall Support feature was designed to provide identity or user-group based security that provides differentiated access for different classes of users. Classification can be provided on the basis of user identity, device type (for example, IP phones), location (for example, building) and role (for example, engineer). Because of the dynamic nature of end-host access, where every user is different and the resource he or she accesses is different, it is important to associate end-user's identity, role, or location with security

policies. This association prevents the need for administrators to constantly update policy filters, a cumbersome task. The end-user identity can be derived through a variety of different mechanisms. Once a user's identity is established, security policies will be aware of the user's identity, not just the source address. Individual policies can be enforced allowing for greater control.

Cisco IOS supports several features that offer dynamic, per-user authentication and authorization of network access connections. These features include 802.1X, IKE, Authentication Proxy, Network Admission Control (NAC), and so on. These features allow network administrators to enforce security policies on per-user basis. By integrating authentication features with Cisco Policy Language-based features such as Zone Based Firewall, quality of service (QoS), and so on, the combination can provide a transparent, reliable, ease to manage and deploy security solution to dynamically authenticate and enforce polices on a per user basis.

Cisco IOS User-Based Firewall Support leverages existing authentication and validation methods to associate each source IP address to a user-group. User-group association can be achieved using two methods. The first method (Tag and Template) uses locally defined policies to achieve the association, while the second method obtains the user-group information from the access control server (ACS) and requires no further configuration on the network access device (NAD).

The User-Based Firewall Support feature leverages the Tag and Template concept where the authenticating server returns a tag-name on validating the user credentials. This tag received on the authentication device is mapped to a template. The template is a control plane policy map that refers to an identity policy configured on the device. The identity policy contains the access policies that are to be applied for the corresponding tag-name. The identity policy defines one or more user-groups to which the source IP would be associated. This mapping provides administrators with flexibility to associate the end-host with multiple user-group memberships. The scope of the user-group defined in the identity policy is local to the device. Once the end-host's user-group membership has been established, other Cisco IOS policy language based features can enforce security policies on a per user-group basis.

Match Criterion

The match user-group criterion in the inspect type class map configuration can be used to enforce security policies on a per user-group basis. The match criterion filters the traffic stream based on the client's source IP address in the specified user-group, making it independent of the authentication method that established the group membership. The match criterion in the inspect type class map enables inspection for any ingress traffic and for any protocol, thereby enabling inspection for all traffic.

Firewall Support

Cisco IOS Firewall includes multiple security features. Cisco IOS Firewall stateful packet inspection provides true firewall capabilities to protect networks against unauthorized traffic and control legitimate business-critical data. Authentication proxy controls access to hosts or networks based on user credentials stored in an authentication, authorization, and accounting (AAA) server. Multi-VRF firewall offers firewall services on virtual routers with VRF, accommodating overlapping address space to provide multiple isolated private route spaces with a full range of security services. Transparent firewall adds stateful inspection without time-consuming, disruptive IP addressing modifications. Application inspection controls application activity to provide granular policy enforcement of application usage, protecting legitimate application protocols from rogue applications and malicious activity. For more information on firewall support see the Cisco IOS Firewall Design Guide.

Authentication Proxy

The Cisco IOS Firewall Authentication Proxy feature provides dynamic, per-user authentication and authorization, authenticating users against industry standard TACACS+ and RADIUS authentication

protocols. Authenticating and authorizing connections by users provides more robust protection against network attacks. See the Authentication Proxy document for more information about this feature.

Zone-Based Policy Firewall

Cisco IOS Zone-Based Policy Firewall can be used to deploy security policies by assigning interfaces to different zones and configuring a policy to inspect the traffic moving between these zones. The policy specifies a set of actions to be applied on the defined traffic class. For more information see the document Zone-Based Firewall.

Tag and Template

The Tag and Template feature allows network administrators to define enforcement policies on a local device and have a RADIUS server specify the policy selector to be enforced. This feature can be applied to a NAC architecture. See the Tag and Template feature guide for more information about this feature.

Network Admission Control

In a typical Network Admission Control deployment, an ACS or a RADIUS server is used for validating the user posture information and for applying the policies on the NAD. A centralized ACS can be used to support multiple NADs. This solution has inherent problems associated with it, namely:

- Version control of policies. Typically, a specific NAD that is running a Cisco IOS image may support some access control lists (ACLs), and another NAD may support a different version. Managing different versions can be a problem.
- Users connect on different interfaces to the NAD, and on the basis of the interface type, the policies that can be applied to the user can change, and the NAD can determine the policies to be applied. In the current architecture, the ACS sends the same set of policies to all the NADs when a profile is matched, which does not give enough control to the administrator to configure the polices on the basis of the NAD configuration.

Configuring the Tag and Template feature allows the ACS to map users to specific groups and associate a tag with them. For example, the Usergroup1 user group may have a tag with the name usergroup1. When the NAD queries the ACS for the policies, the ACS can return the tag that is associated with the user group. When this tag is received at the NAD, the NAD can map the tag to a specific template that can have a set of policies that are associated with the user group. This mapping provides administrators with the flexibility to configure the template on a NAD basis, and the policies can change from NAD to NAD even though the tag is the same.

In summary, a template must be configured on the NAD, and the template must be associated with a tag. When the ACS sends the policies back to the NAD, the template that matches the tag that was received from the ACS is used.

Access Control List Overview

Cisco provides basic traffic filtering capabilities with access control lists (also referred to as access lists). Access lists can be configured for all routed network protocols (IP, AppleTalk, and so on) to filter the packets of those protocols as the packets pass through a router. You can configure access lists at your router to control access to a network. Access lists can prevent certain traffic from entering or exiting a network.

How to Configure User-Based Firewall Support

Configuring Access Control Lists

To configure ACLs, perform the steps in this section. Policy specific ACLs are defined under the identity policy.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip access-list extended** *access-list-name*
4. **permit** *protocol* **any host** *ip-address*
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.

	Command or Action	Purpose
Step 3	**ip access-list extended** *access-list-name* **Example:** `Router(config)# ip access-list extended auth_proxy_acl`	Defines an IP access list and enters extended named access list configuration mode.
Step 4	**permit** *protocol* **any host** *ip-address* **Example:** `Router(config-ext-nacl)# permit tcp any host 192.168.104.136`	Sets the permission for an access list using TCP.
Step 5	**end** **Example:** `Router(config-ext-nacl)# end`	Exits extended named access list configuration mode.

Configuring the Identity Policy for Tag and Template

To configure the identity policy for Tag and Template, perform the steps in this section. Usergroup support is achieved by configuring the usergroup that is to be associated with the IP address on the NAD itself using a locally defined identity policy. A tag is received from the ACS that matches a template (identity policy) on the NAD. The user-group associated with the IP address is obtained from the NAD.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **identity policy** *policy-name*
4. **user-group** *group-name*
5. **access-group** *group-name*
6. **end**

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**identity policy** *policy-name* **Example:** `Router(config)# identity policy auth_proxy_ip`	Creates an identity policy and enters identity policy configuration mode.
Step 4	**user-group** *group-name* **Example:** `Router(config-identity-policy)# user-group auth_proxy_ug`	Establishes a user-group.
Step 5	**access-group** *group-name* **Example:** `Router(config-identity-policy)# access-group auth_proxy_acl`	Specifies the access-group to be applied to the identity policy.
Step 6	**end** **Example:** `Router(config-identity-policy)# end`	Exits identity policy configuration mode.

Configuring Control Type Tag Class-Maps or Policy-Maps for Tag and Template

To configure control type tag class-maps or policy-maps for Tag and Template, perform the steps in this section. Tag names are received from the AAA server as authorization data and are matched with their respective class-maps. The security policies that are associated with the identity policies are applied to the host. In this way host IP addresses gain membership of user-groups.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **policy-map type control tag** *policy-map-name*
4. **class type control tag** *control-class-name*
5. **identity policy** *policy-name*
6. **exit**
7. **configure terminal**
8. **class-map type control tag match-all** *class-map-name*
9. **match tag** *tag-name*
10. **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 type control tag** *policy-map-name* **Example:** `Router(config)# policy-map type control tag all_tag_cm_pm`	Creates a control policy map and enters policy-map configuration mode.
Step 4	**class type control tag** *control-class-name* **Example:** `Router(config-pmap)# class type control tag auth_proxy_tag_cm`	Creates a control class and enters policy-map-class configuration mode.
Step 5	**identity policy** *policy-name* **Example:** `Router(config-pmap-c)# identity policy auth_proxy_ip`	Creates an identity policy.

	Command or Action	Purpose
Step 6	**exit** **Example:** `Router(config-pmap-c)# exit`	Exits policy-map-class configuration mode.
Step 7	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 8	**class-map type control tag match-all** *class-map-name* **Example:** `Router(config)# class-map type control tag match-all auth_proxy_tag_cm`	Creates a control class map and enters class-map configuration mode.
Step 9	**match tag** *tag-name* **Example:** `Router(config-cmap)# match tag auth_proxy_tag`	Specifies the tag to be matched for a tag type of class map.
Step 10	**end** **Example:** `Router(config-cmap)# end`	Exits class-map configuration mode.

Configuring Supplicant-Group Attribute on the ACS

The supplicant group attribute needs to be configured as a Cisco attribute value (AV) Pair on the ACS for user-based firewall support. To configure the supplicant-group attribute on the ACS, perform the steps in this section. The supplicant-group attribute is defined in the RADIUS and Lightweight Directory Access Protocol (LDAP) authorization group attributes from where all authorization data pertaining to the client resides. The user-group information is obtained from the ACS and no further user-group specific configuration is required on the NAD.

Cisco:Avpair=supplicant-group=eng

Defines the supplicant-group attribute.

Configuring Firewall Class-Maps and Policy-Maps

Perform the following task to configure firewall class-maps and policy-maps. User-groups are configured and attached to policy-maps by using the **inspect** command with each class-map.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map type inspect match-all** *class-map-name*
4. **match protocol** *protocol-name*
5. **match user-group** *group-name*
6. **exit**
7. **configure terminal**
8. **policy-map type inspect** *policy-map-name*
9. **class type inspect** *class-map-name*
10. **inspect**
11. **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 type inspect match-all** *class-map-name* **Example:** `Router(config)# class-map type inspect match-all auth_proxy_ins_cm`	Creates an inspect type class map and enters class-map configuration mode.
Step 4	**match protocol** *protocol-name* **Example:** `Router(config-cmap)# match protocol telnet`	Configures the match criterion for the class map on the basis of the specified protocol.

	Command or Action	Purpose
Step 5	**match user-group** *group-name* **Example:** `Router(config-cmap)# match user-group auth_proxy_ug`	Configures the match criterion for the class map on the basis of the specified user-group.
Step 6	**exit** **Example:** `Router(config-cmap)# exit`	Exits class-map configuration mode.
Step 7	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 8	**policy-map type inspect** *policy-map-name* **Example:** `Router(config)# policy-map type inspect all_ins_cm_pm`	Creates an inspect type policy map and enters policy-map configuration mode.
Step 9	**class type inspect** *class-map-name* **Example:** `Router(config-pmap)# class type inspect auth_proxy_ins_cm`	Specifies the traffic (class) on which an action is to be performed.
Step 10	**inspect** **Example:** `Router(config-pmap)# inspect`	Enables Cisco IOS stateful packet inspection.
Step 11	**end** **Example:** `Router(config-pmap)# end`	Exits policy-map configuration mode.

Configuring Firewall Zone Security and Zone-Pair

To configure firewall zone security and zone -pair, perform the steps in this section. Security zones are configured for untrustworthy (outside) and trustworthy (inside) networks or interfaces. Zone-pairs are configured where the source zone is untrustworthy and the destination zone is trustworthy.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **zone security** *zone-name*
4. **end**
5. **configure terminal**
6. **zone-pair security** *zone-pair-name* **source** *source-zone-name* **destination** *destination-zone-name*
7. **service-policy type inspect** *policy-map-name*
8. **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	**zone security** *zone-name* **Example:** `Router(config)# zone security out_sec_zone`	Creates a security zone, and enters security zone configuration mode.
Step 4	**end** **Example:** `Router(config-sec-zone)# end`	Exits security zone configuration mode.

	Command or Action	Purpose
Step 5	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 6	**zone-pair security** *zone-pair-name* **source** *source-zone-name* **destination** *destination-zone-name* **Example:** `Router(config)# zone-pair security out_in source out_sec_zone destination in_sec_zone`	Creates a zone-pair and enters security zone-pair configuration mode.
Step 7	**service-policy type inspect** *policy-map-name* **Example:** `Router(config-sec-zone-pair)# service-policy type inspect all_ins_cm_pm`	Attaches a firewall policy map to the zone-pair.
Step 8	**end** **Example:** `Router(config-sec-zone-pair)# end`	Exits security zone-pair configuration mode.

Configuring ACLs for Authentication Proxy

To configure ACLs for authentication proxy, perform the steps in this section.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip access-list extended** *access-list-name*
4. **permit** *protocol* **any** *source-ip-address destination-ip-address*
5. **permit** *protocol* **any host** *destination-ip-address*
6. **permit** *protocol* **any any eq bootps**
7. **permit** *protocol* **any any eq domain**
8. **end**
9. **configure terminal**
10. **ip access-list extended** *access-list-name*
11. **permit** *protocol* **any host** *destination-ip-address*
12. **permit** *protocol* **any host** *destination-ip-address* **eq domain**
13. **permit** *protocol* **any host** *destination-ip-address* **eq www**
14. **permit** *protocol* **any host** *destination-ip-address* **eq** *port*
15. **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 access-list extended** *access-list-name* **Example:** `Router(config)# ip access-list extended 102`	Defines an IP access list and enters extended named access list configuration mode.
Step 4	**permit** *protocol* **any** *source-ip-address destination-ip-address* **Example:** `Router(config-ext-nacl)# permit ip any 192.168.100.0 10.0.0.255`	Sets the permission for an access list using IP.

	Command or Action	Purpose
Step 5	**permit** *protocol* **any host** *destination-ip-address* **Example:** `Router(config-ext-nacl)# permit ip any host 192.168.104.136`	Sets the permission for an access list using IP.
Step 6	**permit** *protocol* **any any eq bootps** **Example:** `Router(config-ext-nacl)# permit ip any any eq bootps`	Sets the permission for an access list using IP.
Step 7	**permit** *protocol* **any any eq domain** **Example:** `Router(config-ext-nacl)# permit ip any any eq domain`	Sets the permission for an access list using IP.
Step 8	**end** **Example:** `Router(config-ext-nacl)# end`	Exits extended named access list configuration mode.
Step 9	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 10	**ip access-list extended** *access-list-name* **Example:** `Router(config)# ip access-list extended 103`	Defines an IP access list and enters extended named access list configuration mode.
Step 11	**permit** *protocol* **any host** *destination-ip-address* **Example:** `Router(config-ext-nacl)# permit ip any host 192.168.104.136`	Sets the permission for an access list using IP.

	Command or Action	Purpose
Step 12	**permit** *protocol* **any host** *destination-ip-address* **eq domain** **Example:** `Router(config-ext-nacl)# permit udp any host 192.168.104.136 eq domain`	Sets the permission for an access list using user datagram protocol (UDP).
Step 13	**permit** *protocol* **any host** *destination-ip-address* **eq www** **Example:** `Router(config-ext-nacl)# permit tcp any host 192.168.104.136 eq www`	Sets the permission for an access list using TCP.
Step 14	**permit** *protocol* **any host** *destination-ip-address* **eq** *port* **Example:** `Router(config-ext-nacl)# permit udp any host 192.168.104.136 eq 443`	Sets the permission for an access list using UDP.
Step 15	**end** **Example:** `Router(config-ext-nacl)# end`	Exits extended named access list configuration mode.

Configuring Authentication Proxy

To configure authentication proxy default IP admissions, perform the steps in this task.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip admission auth-proxy-banner http c** *Auth-Proxy-Banner-Text* **c**
4. **ip admission watch-list expiry-time** *expiry-minutes*
5. **ip admission max-login-attempts** *attempt-number*
6. **ip admission inactivity-timer** *timeout-minutes*
7. **ip admission absolute-timer** *timeout-minutes*
8. **ip admission init-state-timer** *timeout-minutes*
9. **ip admission auth-proxy-audit**
10. **ip admission watch-list enable**
11. **ip admission ratelimit** *limit*
12. **ip admission name** *admission-name* **proxy http list** *acl*
13. **ip admission name** *admission-name* **proxy telnet list** *acl*
14. **ip admission name** *admission-name* **proxy http list** *acl* **service-policy type tag** *service-policy-name*
15. **exit**

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 admission auth-proxy-banner http c** *Auth-Proxy-Banner-Text* **c** **Example:** `Router(config)# ip admission auth-proxy-banner http c Auth-Proxy-Banner-Text c`	Creates a network admission control rule with an authentication proxy banner to be applied to the interface.

	Command or Action	Purpose
Step 4	**ip admission watch-list expiry-time** *expiry-minutes* **Example:** `Router(config)# ip admission watch-list expiry-time 50`	Creates a network admission control rule with a watch-list to be applied to the interface.
Step 5	**ip admission max-login-attempts** *attempt-number* **Example:** `Router(config)# ip admission max-login-attempts 10`	Creates a network admission control rule with a specified maximum login attempts per user number to be applied to the interface.
Step 6	**ip admission inactivity-timer** *timeout-minutes* **Example:** `Router(config)# ip admission inactivity-timer 205`	Creates a network admission control rule with a specified inactivity timeout to be applied to the interface.
Step 7	**ip admission absolute-timer** *timeout-minutes* **Example:** `Router(config)# ip admission absolute-timer 305`	Creates a network admission control rule with a specified absolute timeout to be applied to the interface.
Step 8	**ip admission init-state-timer** *timeout-minutes* **Example:** `Router(config)# ip admission init-state-timer 15`	Creates a network admission control rule with a specified init-state timeout to be applied to the interface.
Step 9	**ip admission auth-proxy-audit** **Example:** `Router(config)# ip admission auth-proxy-audit`	Creates a network admission control rule with authentication proxy auditing to be applied to the interface.
Step 10	**ip admission watch-list enable** **Example:** `Router(config)# ip admission watch-list enable`	Creates a network admission control rule with a watch-list to be applied to the interface.

	Command or Action	Purpose
Step 11	**ip admission ratelimit** *limit* **Example:** `Router(config)# ip admission ratelimit 100`	Creates a network admission control rule with a specified session rate limit to be applied to the interface.
Step 12	**ip admission name** *admission-name* **proxy http list** *acl* **Example:** `Router(config)# ip admission name auth_rule proxy http list 103`	Creates an IP network admission control rule. • Telnet, HTTP, or both can be configured.
Step 13	**ip admission name** *admission-name* **proxy telnet list** *acl* **Example:** `Router(config)# ip admission name auth_rule proxy telnet list 103`	Creates an IP network admission control rule. • Telnet, HTTP, or both can be configured.
Step 14	**ip admission name** *admission-name* **proxy http list** *acl* **service-policy type tag** *service-policy-name* **Example:** `Router(config)# ip admission name auth_rule proxy http list 103 service-policy type tag all_tag_cm_pm`	(Optional) Creates an IP network admission control rule. • Configures a control plane service policy when the Tag & Template method of user-group association is used. • Control plane tag service policy that is configured using the **policy-map type control tag** *policy name* command, keyword, and argument. This policy map is used to apply the actions on the host when a tag is received.
Step 15	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode.

Configuring AAA and RADIUS

To configure AAA and RADIUS servers, perform the steps in this task.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **aaa new-model**
4. **aaa authentication login default group radius**
5. **aaa authentication login** *list-name* **none**
6. **aaa authentication eou default enable group radius**
7. **aaa authorization network default group radius local**
8. **aaa authorization** *list-name* **default group radius**
9. **aaa accounting auth-proxy default start-stop group** *group-name*
10. **aaa accounting system default start-stop group** *group-name*
11. **aaa session-id common**
12. **radius-server attribute 6 on-for-login-auth**
13. **radius-server attribute 8 include-in-access-req**
14. **radius-server attribute 25 access-request include**
15. **radius-server configure-nas**
16. **radius-server host** *ip-address* **auth-port** *port-number* **acct-port** *port-number* **key** *string*
17. **radius-server host** *ip-address* **auth-port** *port-number* **acct-port** *port-number* **key** *string*
18. **radius-server source-ports extended**
19. **radius-server vsa send authentication**
20. **exit**

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	**aaa new-model** **Example:** `Router(config)# aaa new-model`	Enables the AAA access control model.

	Command or Action	Purpose
Step 4	**aaa authentication login default group radius** **Example:** `Router(config)# aaa authentication login default group radius`	Sets AAA authentication at login using the group radius method.
Step 5	**aaa authentication login** *list-name* **none** **Example:** `Router(config)# aaa authentication login noAAA none`	Sets AAA authentication at login and ensures that the authentication succeeds even if all methods of authentication return an error.
Step 6	**aaa authentication eou default enable group radius** **Example:** `Router(config)# aaa authentication eou default enable group radius`	Sets authentication lists for Extensible Authentication Protocol over User Datagram Protocol (EAPoUDP).
Step 7	**aaa authorization network default group radius local** **Example:** `Router(config)# aaa authorization network default group radius local`	Sets parameters that restrict user access to a network using the group radius and local methods. • The group radius method uses the list of all RADIUS servers for authentication. • The local method uses the local database for authorization.
Step 8	**aaa authorization** *list-name* **default group radius** **Example:** `Router(config)# aaa authorization auth-proxy default group radius`	Sets parameters that restrict user access to a network using the group radius method.
Step 9	**aaa accounting auth-proxy default start-stop group** *group-name* **Example:** `Router(config)# aaa accounting auth-proxy default start-stop group radius`	Creates a method list to provide information about all authenticated-proxy user events. • Sends a “start” accounting notice at the beginning of a process and a “stop” accounting notice at the end of a process.

Command or Action	Purpose
Step 10 **aaa accounting system default start-stop group** *group-name* **Example:** `Router(config)# aaa accounting system default start-stop group radius`	Creates a method list to provide accounting for all system-level events not associated with users. • Sends a “start” accounting notice at the beginning of a process and a “stop” accounting notice at the end of a process.
Step 11 **aaa session-id common** **Example:** `Router(config)# aaa session-id common`	Specifies that the same ID will be assigned for each AAA accounting service type within a call.
Step 12 **radius-server attribute 6 on-for-login-auth** **Example:** `Router(config)# radius-server attribute 6 on-for-login-auth`	Sends the Service-Type attribute in the authentication packets.
Step 13 **radius-server attribute 8 include-in-access-req** **Example:** `Router(config)# radius-server attribute 8 include-in-access-req`	Sends the IP address of a user to the RADIUS server in the access request.
Step 14 **radius-server attribute 25 access-request include** **Example:** `Router(config)# radius-server attribute 25 access-request include`	Sends an arbitrary value that the network access server includes in all accounting packets for the user if supplied by the RADIUS server.
Step 15 **radius-server configure-nas** **Example:** `Router(config)# radius-server configure-nas`	Configures the Cisco router or access server to query the vendor-proprietary RADIUS server for the static routes and IP pool definitions used throughout its domain when the device starts up.

	Command or Action	Purpose
Step 16	**radius-server host** *ip-address* **auth-port** *port-number* **acct-port** *port-number* **key** *string* **Example:** `Router(config)# radius-server host 192.168.104.131 auth-port 1645 acct-port 1646 key string1`	Specifies a RADIUS server host. • Specifies the UDP destination port for authentication requests. • Specifies the UDP destination port for accounting requests.
Step 17	**radius-server host** *ip-address* **auth-port** *port-number* **acct-port** *port-number* **key** *string* **Example:** `Router(config)# radius-server host 192.168.104.132 auth-port 1645 acct-port 1646 key string2`	Specifies a RADIUS server host. • Specifies the UDP destination port for authentication requests. • Specifies the UDP destination port for accounting requests.
Step 18	**radius-server source-ports extended** **Example:** `Router(config)# radius-server source-ports extended`	Enables 200 ports in the range from 21645 to 21844 to be used as the source ports for sending out RADIUS requests. • Ports 1645 and 1646 are used as the source ports for RADIUS requests.
Step 19	**radius-server vsa send authentication** **Example:** `Router(config)# radius-server vsa send authentication`	Configures the network access server (NAS) to recognize and use vendor-specific attributes (VSAs).
Step 20	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode.

Configuring AAA and LDAP

Perform this task to configure AAA and LDAP servers:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **aaa new-model**
4. **aaa authentication login default group ldap**
5. **aaa authentication login** list-name **none**
6. **aaa authorization network default group ldap local**
7. **aaa authorization** *list-name* **default group ldap**
8. **ldap attribute map** *map-name*
9. **map type** *ldap-attr-type aaa-attr-type*
10. **exit**
11. **ldap server** *name*
12. **ipv4** *ipv4-address*
13. **bind authenticate root-dn** *username* **password** [**0** *string* | **7** *string*] *string*
14. **base-dn** *string*
15. **attribute map** *map-name*
16. **exit**

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	**aaa new-model** **Example:** `Router(config)# aaa new-model`	Enables the AAA access control model.

	Command or Action	Purpose
Step 4	**aaa authentication login default group ldap** **Example:** `Router(config)# aaa authentication login default group ldap`	Sets AAA authentication at login using the group LDAP method.
Step 5	**aaa authentication login** list-name **none** **Example:** `Router(config)# aaa authentication login AAA none`	Sets AAA authentication at login and ensures that the authentication succeeds even if all methods of authentication return an error.
Step 6	**aaa authorization network default group ldap local** **Example:** `Router(config)# aaa authorization network default group ldap local`	Sets parameters that restrict user access to a network using the group LDAP and local methods. • The group LDAP method uses the list of all LDAP servers for authentication. • The local method uses the local database for authorization.
Step 7	**aaa authorization** *list-name* **default group ldap** **Example:** `Router(config)# aaa authorization auth-proxy default group ldap`	Sets parameters that restrict user access to a network using the group LDAP method.
Step 8	**ldap attribute map** *map-name* **Example:** `Router(config)# ldap attribute map map1`	Configures dynamic LDAP attribute map and enters attribute-map configuration mode.
Step 9	**map type** *ldap-attr-type aaa-attr-type* **Example:** `Router(config-attr-map)# map type supp-grp supplicant-group`	Defines an attribute map.
Step 10	**exit** **Example:** `Router(config-attr-map)# exit`	Exits the attribute-map configuration mode.

	Command or Action	Purpose
Step 11	**ldap server** *name* **Example:** `Router(config)# ldap server ldap_dir_1`	Specifies the LDAP server name and enters LDAP server configuration mode.
Step 12	**ipv4** *ipv4-address* **Example:** `Router(config-ldap-server)# ipv4 10.0.0.1`	Specifies the IP address of the LDAP server.
Step 13	**bind authenticate root-dn** *username* **password** [**0** *string* | **7** *string*] *string* **Example:** `Router(config-ldap-server)# bind authenticate root-dn “cn=administrator,cn=users, dc=cisco,dc=com password”`	Authenticates a client to a LDAP server.
Step 14	**base-dn** *string* **Example:** `Router(config-ldap-server)# base-dn dc=example,dc=sns,dc=com`	(Optional) Configures the base DN that you want to use to perform search operations in the LDAP directory tree.
Step 15	**attribute map** *map-name* **Example:** `Router(config-ldap-server)# attribute map map1`	Attaches the attribute map to a particular LDAP server.
Step 16	**exit** **Example:** `Router(config-ldap-server)# exit`	Exits LDAP server group configuration mode.

- Troubleshooting Tips, page 256
- Examples, page 257

Troubleshooting Tips

The following commands can be used to troubleshoot User-Based Firewall Support:

- **clear ip admission cache**

- **debug user-group**
- **show debugging**
- **show epm session ip**
- **show ip access-lists**
- **show ip admission**
- **show logging**
- **show policy-map type inspect zone-pair**
- **show user-group**

Examples

show epm session ip

The following example shows sample output of the **show epm session**command when the **summary** keyword is used.

```
Router# show epm session ip summary
EPM Session Information
-----------------------------
Total sessions seen so far: 8
Total Active sessions: 1
Session IP Address:
-----------------------------
192.168.101.131
```

The following example shows sample output of the **show epm session**command when the *ip-address* argument is specified. The output below is displayed if a locally defined user-group association (Tag and Template method) is used.

```
Router# show epm session ip 192.168.101.131
Admission feature: Authproxy
Tag Received: eng_group_tag
Policy map used: all_tag_cm_pm
Class map matched: eng_tag_cm
```

The following example shows sample output of the **show epm session**command when the *ip-address* argument is specified. The output below is displayed if ACS defined (supplicant-group attribute configured on the ACS) user-group association is used.

```
Router# show epm session ip 192.168.101.131
Admission feature: Authproxy
AAA policies:
ACS ACL: xACSACLx-IP-TEST_ACL-47dfc392
Supplicant-Group: eng
Supplicant-Group: mgr
Proxy ACl: permit udp any any
Router#
```

show ip access-lists

The following example shows sample output of the **show ip access-lists**command.

```
Router# show ip access-lists
Extended IP access list 102
    permit icmp host 192.168.101.131 host 192.168.104.136    Auth-Proxy ACE downloaded
from AAA
    permit udp host 192.168.101.131 host 192.168.104.136    Auth-Proxy ACE downloaded
from AAA
    permit tcp host 192.168.101.131 host 192.168.104.136    Auth-Proxy ACE downloaded
```

```
from AAA
10 permit ip any 192.168.100.0 10.0.0.255 (956 matches)
    20 permit ip any 192.168.101.0 10.0.0.255 (9 matches)
    30 permit ip any host 192.168.104.136 (20 matches)
    40 permit udp any any eq bootps
    50 permit udp any any eq domain
```

Extended IP access list 103

```
    10 permit ip any host 192.168.104.136 (3 matches)
    20 permit udp any host 192.168.104.136 eq domain
    30 permit tcp any host 192.168.104.136 eq www
    40 permit udp any host 192.168.104.136 eq 443
    50 permit tcp any host 192.168.104.136 eq 443
Extended IP access list vendor_group_acl
    10 permit ip any host 192.168.104.136
Extended IP access list auth_proxy_acl
    10 permit tcp any host 192.168.104.136
    20 permit udp any host 192.168.104.136
    30 permit icmp any host 192.168.104.136
Extended IP access list sales_group_acl
    10 permit ip any host 192.168.104.131
Extended IP access list eng_group_acl
    10 permit ip any host 192.168.100.132
Extended IP access list manager_group_acl
    10 permit ip any host 192.168.104.128
Router#
```

show ip admission

The following is sample output of the **show ip admission**command when the **configuration** keyword is used.

```
Router# show ip admission configuration
Authentication Proxy Banner
    HTTP Protocol Banner: Auth-Proxy-Banner-Text
Authentication global cache time is 205 minutes
Authentication global absolute time is 305 minutes
Authentication global init state time is 15 minutes
Authentication Proxy Session ratelimit is 100
Authentication Proxy Session Watch-list is enabled
Watch-list expiry timeout is 50 minutes
Authentication Proxy Auditing is enabled
Max Login attempts per user is 10
Authentication Proxy Rule Configuration
Auth-proxy name auth_rule
 http list 103 inactivity-timer 205 minutes
Router#
```

The following is sample output of the **show ip admission**command when the **cache** keyword is used. After a successful Telnet/HTTP-proxy session, from a Cisco Trust Agent (CTA) client to an Audit Server, is established, logs are displayed.

```
Router# show ip admission cache
Authentication Proxy Cache
Client Name aaatestuser, Client IP 192.168.101.131, Port 1870, timeout 205, Time
Remaining 205, state ESTAB
```

show logging

The following is sample output of the **show logging**command.

```
Router# show logging
Log Buffer (65000 bytes):
*Jul 3 05:33:13:935: %SYS-5-CONFIG_I: Configured from console by console
*Jul 3 05:33:18.471: USRGRP-API: [Type=IPv4 Val=192.168.101.131 Group-h_ug]: Usergroup
opcode entry deletion.
*Jul 3 05:33:18.471: %UG-6-MEMBERSHIP: IP=192.168.101.131| INTERFACE=Vlan|
```

```
USERGROUP=eng_group_ug| STATUS-REMOVED
*Jul 3 05:33:18.471: USRGRP-ENTRY: [Type=IPv4 Val=192.168.101.131 :: Group=eng_group_ug
Count=0]:Usergroup entry deleted
*Jul 3 05:33:18.471: USRGRP-ENTRY: [Type=IPv4 Val=192.168.101.131 :: Group=eng_group_ug
Count=0]:Usergroup entry clean up and free
*Jul 3 05:33:18.471: USRGRP-DB: Group=h_ug Count=0: Usergroup is empty. Destroy Group.
*Jul 3 05:33:18.471: USRGRP-DB: Group=h_ug Count=0: Clean up and free usergroup db.
*Jul 3 05:33:22.383: USRGRP-API: [Type=IPv4 Val=192.168.101.131 Group=eng_group_ug]:
Usergroup opcode entry addition.
*Jul 3 05:33:22.383: USRGRP-DB: Group=h_ug Count=0 New usergroup db created.
*Jul 3 05:33:22.383: %UG-6-MEMBERSHIP: IP=192.168.101.131| INTERFACE=Vlan333|
USERGROUP=eng_group_ug| STATUS=ESTABLISHED
*Jul 3 05:33:22.383: USRGRP-ENTRY: [Type=IPv4 Val=192.168.101.131 :: Group=eng_group_ug
Count=1]: Usergroup entry added
*Jul 3 05:33:41.239: USRGRP-API: [Type=IPv4 Val=192.168.101.131 Group=eng_group_ug]:
Usergroup opcode entry deletion.
*Jul 3 05:33:41.239: %UG-6-MEMBERSHIP: IP=192.168.101.131| INTERFACE=Vlan333|
USERGROUP=eng_group_ug| STATUS=REMOVED
*Jul 3 05:33:41.239: USRGRP-ENTRY: [Type=IPv4 Val=192.168.101.131 :: Group=eng_group_ug
Count=0]: Usergroup entry deleted
*Jul 3 05:33:41.239: USRGRP-ENTRY: [Type=IPv4 Val=192.168.101.131 :: Group=eng_group_ug
Count=0]: Usergroup entry clean up and free
*Jul 3 05:33:41.239: USRGRP-DB: Group=eng_group_ug Count=0: Usergroup is empty. Destroy
group.
*Jul 3 05:33:41.239: USRGRP-DB: Group=eng_group_ug Count=0: Clean up and free usergroup
db.
*Jul 3 05:33:50.687: USRGRP-API: {Type=IPv4 Val=192.168.101.131 Group=eng_group_ug]:
Usergroup opcode entry addition.
*Jul 3 05:33:50.687: USRGRP-DB: Group=eng_group_ug Count=0: New usergroup db created.
*Jul 3 05:33:50.687: %UG-6-MEMBERSHIP: IP=192.168.101.131| INTERFACE=Vlan333|
USERGROUP=eng_group_ug| STATUS=ESTABLISHED
*Jul 3 05:33:50.687: USRGRP-ENTRY: [Type=IPv4 Val=192.168.101.131 :: Group=eng_group_ug
Count=1]: Usergroup entry added
```

show policy-map type inspect zone-pair

The following is sample output of the **show policy-map type inspect zone-pair**command when the **sessions** keyword is used.

```
Router# show policy-map type inspect zone-pair sessions
policy exists on zp out_in
 Zone-pair: out_in
  Service-policy inspect: all_ins_cm_pm
   Class-map: vendor_group_ins_cm (match-all)
    Match: user-group vendor_group_ug
   Class-map: manager_group_ins_cm (match-all)
    Match: protocol telnet
    Match: user-group manager_group_ug
   Class-map: auth_proxy_ins_cm (match-all)
    Match: user-group auth_proxy_ug
    Match: protocol telnet
    Number of Established Sessions = 1
    Established Sessions
     Session 49D12BE0 (192.168.101.131:1872)=>(192.168.104.136:23) telnet:tcp SIS_OPEN
      Created 00:00:15, Last heard 00:00:09
      Bytes sent (initiator:responder) [171:249]
   Class-map: eng_group_ins_cm (match-all)
    Match: user-group eng_group_ug
    Match: protocol ftp
    Number of Established Sessions = 1
    Established Sessions
     Session 49D12E20 (192.168.101.131:1874)=>(192.168.104.136:21) ftp:tcp SIS_OPEN
      Created 00:00:12, Last heard 00:00:06
      Bytes sent (initiator:responder) [45:137]
   Class-map: sales_group_ins_cm (match-all)
    Match: protocol ftp
    Match: user-group sales_group_ug
   Class-map: class-default (match-any)
    Match: any
```

show user-group

The following is sample output of the **show user-group**command when the **configuration** keyword is used.

```
Router# show user-group
Usergroup: auth_proxy_ug
------------------------------------------------------------
User Name                Type        Interface            Learn        Age (min)
------------------------------------------------------------
192.168.101.131    IPv4                    Vlan333            Dynamic        0
Usergroup: eng_group_ug
------------------------------------------------------------
User Name                Type        Interface            Learn        Age (min)
------------------------------------------------------------
192.168.101.131    IPv4                    Vlan333            Dynamic        0
```

The following is sample output of the **show user-group**command when the *group-name* argument is used.

```
Router# show user-group auth_proxy_ug
Usergroup: auth_proxy_ug
------------------------------------------------------------
User Name                Type        Interface            Learn        Age (min)
------------------------------------------------------------
192.168.101.131    IPv4                    Vlan333            Dynamic        0
```

The following is sample output of the **show user-group**command when the **count**keyword is used.

```
Router# show user-group count
Total Usergroup: 2
------------------------------------------------------------
User Group               Members
------------------------------------------------------------
auth_proxy_ug               1
eng_proxy_ug               1
```

Configuration Examples for User-Based Firewall Support

Cisco IOS Authentication Proxy Example

The following example shows how to configure User-Based Firewall Support. The Cisco IOS Authentication Proxy maps two users to different user-groups. Zone Policy Firewall policies are configured on a per user-group basis.

```
!IP Admission configuration
Configure the rule for HTTP based proxy authentication and associate the control plane
tag service policy.
!
configure terminal
ip admission name auth-http proxy http service-policy type tag global-policy
ip http server
ip http secure-server
!AAA configuration
!
aaa new-model
!
aaa authentication login default group radius
aaa authentication login noAAA none
aaa authentication eou default group radius
aaa authorization network default group radius local
aaa authorization auth-proxy default group radius
```

```
aaa accounting auth-proxy default start-stop group radius
aaa accounting system default start-stop group radius
aaa session-id common
!
radius-server attribute 6 on-for-login-auth
radius-server attribute 8 include-in-access-req
radius-server attribute 25 access-request include
radius-server configure-nas
radius-server host 192.168.104.131 auth-port 1645 acct-port 1646 key cisco
radius-server host 192.168.104.132 auth-port 1645 acct-port 1646 key cisco
radius-server source-ports extended
radius-server vsa send authentication
!
!Tag and Template configuration.
Configuration policy attributes for the engineer.
!
identity policy engineer-policy
 access-group engineer-acl
 user-group group-engineer
identity policy manager-policy
 access-group manager-acl
 user-group group-manager
!Define type control tag class-maps
!
class-map type control tag match-all auth_proxy_tag_cm
match tag auth_proxy_tag
class-map type control tag match-all eng_tag_cm
match tag eng_group_tag
class-map type control tag match-all manager_tag_cm
match tag manager_group_tag
!
!Define the control plane tag policy map.
!
policy-map type tag control tag global-policy
 class engineer-class
  identity policy engineer-policy
 class manager-class
  identity policy manager-policy
!Define per-user group traffic classification based on membership of the source IP
address in the specified user-group.
!
class-map type inspect match-all engineer-insp-cmap
 match user-group group-engineer
 match protocol tcp
 match protocol udp
class-map type inspect match-all manager-insp-cmap
 match user-group group-manager
 match protocol http
!Zone Policy Firewall configuration.
Configure zones z1 and z2.
!
zone security z1
zone security z2
!Configure the policy map to inspect traffic between z1 and z2.
!
policy-map type inspect z1-z2-policy
 class type inspect engineer-insp-cmap
  inspect
 class type inspect manager-insp-cmap
  inspect
!Configure interfaces to their respective zones and apply the ip admission rule on the
source zone member(s).
!
interface e0
 ip admission auth-http
 zone-member security z1
interface e1
 zone-member security z2
!Configure the zone-pair and apply the appropriate policy-map.
!
zone-pair security z1-z2 source z1 destination z2
 service-policy type inspect z1-z2-policy
```

Additional References

The following sections provide references related to the User-Based Firewall Support feature.

Related Documents

Related Topic	Document Title
Cisco IOS Firewall Design	The Cisco IOS Firewall Design Guide
Cisco IOS firewall commands	*Cisco IOS Security Command Reference*
Cisco IOS Tag and Template	“Tag and Template” module
Cisco IOS Zone-Based Policy Firewall	Zone-Based Policy Firewall” module
Cisco IOS Authentication Proxy	“Authentication Proxy” module

Standards

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

MIBs

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

RFCs

RFC	Title
None	--

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 User-Based Firewall Support

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

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

Table 12 Feature Information for User-Based Firewall Support

Feature Name	Releases	Feature Information
User-Based Firewall Support	12.4(20)T	This feature provides the option for configuring a security solution to dynamically authenticate and enforce policies on a per user basis in Cisco IOS software for Release 12.4(20)T and later releases. In Release 12.4(20)T, this feature was introduced on the Cisco 7200, Cisco 1800, Cisco 2800, and Cisco 3800 routers. The following commands were introduced or modified: **debug user-group**, **match user-group**, **show debugging**, **show user-group**, **user-group**, **user-group logging**.

Feature Name	Releases	Feature Information
LDAP Active Directory support for authproxy	15.1(1)T	This feature enables the authentication proxy to authenticate and authorize the users with the Active Directory server using LDAP. The following commands were introduced or modified: **aaa authentication** , **aaa authorization**, **attribute map**, **bind authenticate**, **base-dn**, **ipv4**, **ldap attribute map**, **map type**, **ldap server**.

Virtual Fragmentation Reassembly

Currently, the Cisco IOS Firewall--specifically context-based access control (CBAC) and the intrusion detection system (IDS)--cannot identify the contents of the IP fragments nor can it gather port information from the fragment. These inabilities allow the fragments to pass through the network without being examined or without dynamic access control list (ACL) creation.

Virtual fragmentation reassembly (VFR) enables the Cisco IOS Firewall to create the appropriate dynamic ACLs, thereby, protecting the network from various fragmentation attacks.

Feature History for Virtual Fragmentation Reassembly

Release	Modification
12.3(8)T	This feature was introduced.

Finding Support Information for Platforms and Cisco IOS Software Images

Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at http://www.cisco.com/go/fn . You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.

Restrictions for Virtual Fragmentation Reassembly

Performance Impact

VFR will cause a performance impact on the basis of functions such as packet copying, fragment validation, and fragment reorder. This performance impact will vary depending on the number of concurrent IP datagram that are being reassembled.

VFR Configuration Restriction

VFR should not be enabled on a router that is placed on an asymmetric path. The reassembly process requires all of the fragments within an IP datagram. Routers placed in the asymmetric path may not receive all of the fragments, so the fragment reassembly will fail.

SIP and RTSP Limitation

The Session Initiation Protocol (SIP) and the Real-Time Streaming Protocol (RTSP) do not have the ability to parse port information across noncontiguous buffers. Thus, virtual fragmentation reassembly may fail. (If the application fails, the session will be blocked.)

Information About Virtual Fragmentation Reassembly

To use fragmentation support for Cisco IOS Firewall, you should understand the following concept:

- Detected Fragment Attacks, page 266
- Automatically Enabling or Disabling VFR, page 267

Detected Fragment Attacks

VFR is responsible for detecting and preventing the following types of fragment attacks:

- Tiny Fragment Attack--In this type of attack, the attacker makes the fragment size small enough to force Layer 4 (TCP and User Datagram Protocol (UDP)) header fields into the second fragment. Thus, the ACL rules that have been configured for those fields will not match.

VFR drops all tiny fragments, and an alert message such as follows is logged to the syslog server: “VFR-3-TINY_FRAGMENTS.”

- Overlapping Fragment Attack--In this type of attack, the attacker can overwrite the fragment offset in the noninitial IP fragment packets. When the firewall reassembles the IP fragments, it might create wrong IP packets, causing the memory to overflow or your system to crash.

VFR drops all fragments within a fragment chain if an overlap fragment is detected, and an alert message such as follows is logged to the syslog server: “VFR-3-OVERLAP_FRAGMENT.”

- Buffer Overflow Attack--In this type of denial-of-service (DoS) attack, the attacker can continuously send a large number of incomplete IP fragments, causing the firewall to lose time and memory while trying to reassemble the fake packets.

To avoid buffer overflow and control memory usage, configure a maximum threshold for the number of IP datagrams that are being reassembled and the number of fragments per datagram. (Both of these parameters can be specified via the **ip virtual-reassembly** command.)

When the maximum number of datagrams that can be reassembled at any given time is reached, all subsequent fragments are dropped, and an alert message such as the following is logged to the syslog server: “VFR-4_FRAG_TABLE_OVERFLOW.”

When the maximum number of fragments per datagram is reached, subsequent fragments will be dropped, and an alert message such as the following is logged to the syslog server: “VFR-4_TOO_MANY_FRAGMENTS.”

In addition to configuring the maximum threshold values, each IP datagram is associated with a managed timer. If the IP datagram does not receive all of the fragments within the specified time, the timer will expire and the IP datagram (and all of its fragments) will be dropped.

Automatically Enabling or Disabling VFR

VFR is designed to work with any feature that requires fragment reassembly (such as Cisco IOS Firewall and NAT). Currently, NAT enables and disables VFR internally; that is, when NAT is enabled on an interface, VFR is automatically enabled on that interface.

If more than one feature attempts to automatically enable VFR on an interface, VFR will maintain a reference count to keep track of the number of features that have enabled VFR. When the reference count is reduced to zero, VFR is automatically disabled.

How to Use Virtual Fragmentation Reassembly

- Configuring VFR, page 267

Configuring VFR

Use this task to enable VFR on an interface, specify maximum threshold values to combat buffer overflow and control memory usage, and verify any VFR configurations.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. ip virtual-reassembly [max-reassemblies number] [max-fragments number] [timeout seconds] [drop-fragments]
5. **exit**
6. **exit**
7. show ip virtual-reassembly [interface type]

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* **Example:** `Router(config)# interface ethernet1/1`	Configures an interface type and enters interface configuration mode.
Step 4	ip virtual-reassembly [max-reassemblies number] [max-fragments number] [timeout seconds] [drop-fragments] **Example:** `Router(config-if)# ip virtual-reassembly max-reassemblies 64 max-fragments 16 timeout 5`	Enables VFR on an interface.
Step 5	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode.
Step 6	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode.
Step 7	show ip virtual-reassembly [interface type] **Example:** `Router# show ip virtual-reassembly ethernet1/1`	Displays the configuration and statistical information of the VFR. If an interface is not specified, VFR information is shown for all configured interfaces.

- Troubleshooting Tips, page 268

Troubleshooting Tips

To view debugging messages related to the VFR subsystem, use the **debug ip virtual-reassembly** command.

Configuration Examples for Fragmentation Reassembly

Additional References

The following sections provide references related to virtual fragmentation reassembly.

Related Documents

Related Topic	Document Title
Dynamic IDS	*Cisco IOS Intrusion Prevention System*
CBAC	*Configuring Context-Based Access Control*

Standards

Standards	Title
None	--

MIBs

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

RFCs

RFCs	Title
RFC 791	Internet Protocol
RFC 1858	Security Considerations for IP Fragment Filtering

Technical Assistance

Description	Link
Technical Assistance Center (TAC) home page, containing 30,000 pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/public/support/tac/home.shtml

Command Reference

The following commands are introduced or modified in the feature or features documented in this module. For information about these commands, see the *Cisco IOS Security Command Reference*. For information

about all Cisco IOS commands, go to the Command Lookup Tool at http://tools.cisco.com/Support/CLILookup or to the *Cisco IOS Master Commands List*.

- **debug ip virtual-reassembly**
- **ip virtual-reassembly**
- **show ip virtual-reassembly**

Glossary

fragment --Part of an IP datagram that is fragmented into multiple pieces. Each piece is called a fragment or an IP fragment.

fragmentation --Process of breaking down an IP datagram into smaller packets (fragments) that are transmitted over different types of network media.

initial fragment -- First fragment within a fragment set. This fragment should have a Layer 4 header and should have an offset of zero.

noninitial fragment --All fragments within a fragment set, except the initial fragment.