CHAPTER 38

Getting Started With Application Layer Protocol Inspection

This chapter describes how to configure application layer protocol inspection. Inspection engines are required for services that embed IP addressing information in the user data packet or that open secondary channels on dynamically assigned ports. These protocols require the adaptive security appliance to do a deep packet inspection instead of passing the packet through the fast path (see the "Stateful Inspection Overview" section on page 1-13 for more information about the fast path). As a result, inspection engines can affect overall throughput. Several common inspection engines are enabled on the adaptive security appliance by default, but you might need to enable others depending on your network.

This chapter includes the following sections:

Information about Application Layer Protocol Inspection

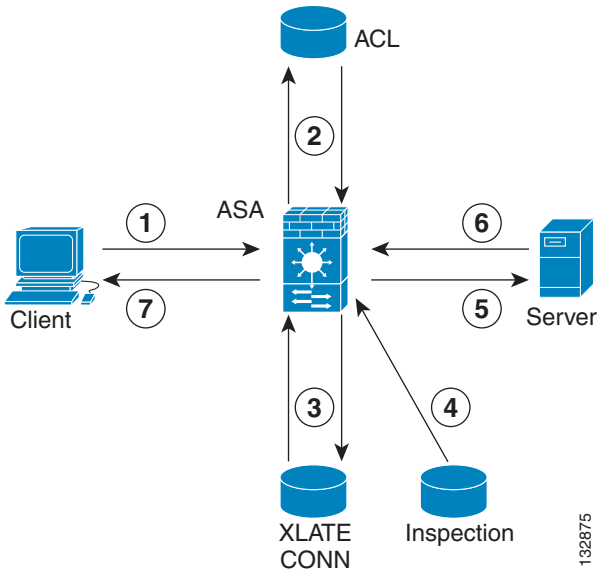
This section includes the following topics:

How Inspection Engines Work

As illustrated in Figure 38-1, the adaptive security appliance uses three databases for its basic operation:

- Access lists—Used for authentication and authorization of connections based on specific networks, hosts, and services (TCP/UDP port numbers).
- Inspections—Contains a static, predefined set of application-level inspection functions.
- Connections (XLATE and CONN tables)—Maintains state and other information about each established connection. This information is used by the Adaptive Security Algorithm and cut-through proxy to efficiently forward traffic within established sessions.

Figure 38-1 How Inspection Engines Work



In Figure 38-1, operations are numbered in the order they occur, and are described as follows:

1. A TCP SYN packet arrives at the adaptive security appliance to establish a new connection.
2. The adaptive security appliance checks the access list database to determine if the connection is permitted.
3. The adaptive security appliance creates a new entry in the connection database (XLATE and CONN tables).
4. The adaptive security appliance checks the Inspections database to determine if the connection requires application-level inspection.
5. After the application inspection engine completes any required operations for the packet, the adaptive security appliance forwards the packet to the destination system.
6. The destination system responds to the initial request.
7. The adaptive security appliance receives the reply packet, looks up the connection in the connection database, and forwards the packet because it belongs to an established session.

The default configuration of the adaptive security appliance includes a set of application inspection entries that associate supported protocols with specific TCP or UDP port numbers and that identify any special handling required.

When to Use Application Protocol Inspection

When a user establishes a connection, the adaptive security appliance checks the packet against access lists, creates an address translation, and creates an entry for the session in the fast path, so that further packets can bypass time-consuming checks. However, the fast path relies on predictable port numbers and does not perform address translations inside a packet.

Many protocols open secondary TCP or UDP ports. The initial session on a well-known port is used to negotiate dynamically assigned port numbers.

Other applications embed an IP address in the packet that needs to match the source address that is normally translated when it goes through the adaptive security appliance.

If you use applications like these, then you need to enable application inspection.

When you enable application inspection for a service that embeds IP addresses, the adaptive security appliance translates embedded addresses and updates any checksum or other fields that are affected by the translation.

When you enable application inspection for a service that uses dynamically assigned ports, the adaptive security appliance monitors sessions to identify the dynamic port assignments, and permits data exchange on these ports for the duration of the specific session.

Guidelines and Limitations

This section includes the guidelines and limitations for this feature.

Context Mode Guidelines

Supported in single and multiple context mode.

Firewall Mode Guidelines

Supported in routed and transparent firewall mode.

Failover Guidelines

State information for multimedia sessions that require inspection are not passed over the state link for stateful failover. The exception is GTP, which is replicated over the state link.

IPv6 Guidelines

Supports IPv6 for the following inspections:

- FTP
- HTTP
- ICMP
- SIP
- SMTP
- IPSec pass-through

Additional Guidelines and Limitations

Some inspection engines do not support PAT, NAT, outside NAT, or NAT between same security interfaces. See "Default Settings" for more information about NAT support.

For all the application inspections, the adaptive security appliance limits the number of simultaneous, active data connections to 200 connections. For example, if an FTP client opens multiple secondary connections, the FTP inspection engine allows only 200 active connections and the 201 connection is dropped and the adaptive security appliance generates a system error message.

Inspected protocols are subject to advanced TCP-state tracking, and the TCP state of these connections is not automatically replicated. While these connections are replicated to the standby unit, there is a best-effort attempt to re-establish a TCP state.

Default Settings

By default, the configuration includes a policy that matches all default application inspection traffic and applies inspection to the traffic on all interfaces (a global policy). Default application inspection traffic includes traffic to the default ports for each protocol. You can only apply one global policy, so if you want to alter the global policy, for example, to apply inspection to non-standard ports, or to add inspections that are not enabled by default, you need to either edit the default policy or disable it and apply a new one.

Table 38-1 lists all inspections supported, the default ports used in the default class map, and the inspection engines that are on by default, shown in bold. This table also notes any NAT limitations.

Table 38-1 Supported Application Inspection Engines

Application[1]	Default Port	NAT Limitations	Standards[2]	Comments
CTIQBE	TCP/2748	—	—	—
DCERPC	TCP/135	—	—	—
DNS over UDP	UDP/53	No NAT support is available for name resolution through WINS.	RFC 1123	No PTR records are changed.
FTP	TCP/21	—	RFC 959	—
GTP	UDP/3386 UDP/2123	—	—	Requires a special license.
H.323 H.225 and **RAS**	TCP/1720 UDP/1718 UDP (RAS) 1718-1719	No NAT on same security interfaces. No static PAT.	ITU-T H.323, H.245, H225.0, Q.931, Q.932	—
HTTP	TCP/80	—	RFC 2616	Beware of MTU limitations stripping ActiveX and Java. If the MTU is too small to allow the Java or ActiveX tag to be included in one packet, stripping may not occur.
ICMP	—	—	—	All ICMP traffic is matched in the default class map.
ICMP ERROR	—	—	—	All ICMP traffic is matched in the default class map.
ILS (LDAP)	TCP/389	No PAT.	—	—
Instant Messaging (IM)	Varies by client	—	RFC 3860	—
IP Options	—	—	RFC 791, RFC 2113	All IP Options traffic is matched in the default class map.
MMP	TCP 5443	—	—	—
MGCP	UDP/2427, 2727	—	RFC 2705bis-05	—
NetBIOS Name Server over IP	UDP/137, 138 (Source ports)	—	—	NetBIOS is supported by performing NAT of the packets for NBNS UDP port 137 and NBDS UDP port 138.

Table 38-1 Supported Application Inspection Engines (continued)

Application[1]	Default Port	NAT Limitations	Standards[2]	Comments
PPTP	TCP/1723	—	RFC 2637	—
RADIUS Accounting	1646	—	RFC 2865	—
RSH	TCP/514	No PAT	Berkeley UNIX	—
RTSP	TCP/554	No PAT. No outside NAT.	RFC 2326, 2327, 1889	No handling for HTTP cloaking.
SIP	TCP/5060 UDP/5060	No outside NAT. No NAT on same security interfaces.	RFC 2543	—
SKINNY (SCCP)	TCP/2000	No outside NAT. No NAT on same security interfaces.	—	Does not handle TFTP uploaded Cisco IP Phone configurations under certain circumstances.
SMTP and **ESMTP**	TCP/25	—	RFC 821, 1123	—
SNMP	UDP/161, 162	No NAT or PAT.	RFC 1155, 1157, 1212, 1213, 1215	v.2 RFC 1902-1908; v.3 RFC 2570-2580.
SQL*Net	TCP/1521	—	—	v.1 and v.2.
Sun RPC over UDP and TCP	UDP/111	No NAT or PAT.	—	The default rule includes UDP port 111; if you want to enable Sun RPC inspection for TCP port 111, you need to create a new rule that matches TCP port 111 and performs Sun RPC inspection.
TFTP	UDP/69	—	RFC 1350	Payload IP addresses are not translated.
WAAS	—	—	—	—
XDCMP	UDP/177	No NAT or PAT.	—	—

1. Inspection engines that are enabled by default for the default port are in bold.
2. The adaptive security appliance is in compliance with these standards, but it does not enforce compliance on packets being inspected. For example, FTP commands are supposed to be in a particular order, but the adaptive security appliance does not enforce the order.

The default policy configuration includes the following commands:

```
class-map inspection_default
 match default-inspection-traffic
policy-map type inspect dns preset_dns_map
 parameters
  message-length maximum 512
policy-map global_policy
 class inspection_default
  inspect dns preset_dns_map
  inspect ftp
  inspect h323 h225
  inspect h323 ras
  inspect rsh
  inspect rtsp
  inspect esmtp
```

```
  inspect sqlnet
  inspect skinny
  inspect sunrpc
  inspect xdmcp
  inspect sip
  inspect netbios
  inspect tftp
service-policy global_policy global
```

Configuring Application Layer Protocol Inspection

This feature uses Modular Policy Framework to create a service policy. Service policies provide a consistent and flexible way to configure adaptive security appliance features. For example, you can use a service policy to create a timeout configuration that is specific to a particular TCP application, as opposed to one that applies to all TCP applications. See Chapter 30, "Configuring a Service Policy Using the Modular Policy Framework," for more information. For some applications, you can perform special actions when you enable inspection. See Chapter 30, "Configuring a Service Policy Using the Modular Policy Framework," for more information.

Inspection is enabled by default for some applications. See the "Default Settings" section for more information. Use this section to modify your inspection policy.

Detailed Steps

Step 1 To identify the traffic to which you want to apply inspections, add either a Layer 3/4 class map for through traffic or a Layer 3/4 class map for management traffic. See the "Creating a Layer 3/4 Class Map for Through Traffic" section on page 30-12 and "Creating a Layer 3/4 Class Map for Management Traffic" section on page 30-15 for detailed information. The management Layer 3/4 class map can be used only with the RADIUS accounting inspection.

The default Layer 3/4 class map for through traffic is called "inspection_default." It matches traffic using a special **match** command, **match default-inspection-traffic**, to match the default ports for each application protocol. This traffic class (along with **match any**, which is not typically used for inspection) matches both IPv4 and IPv6 traffic for inspections that support IPv6. See the "Guidelines and Limitations" section on page 38-3 for a list of IPv6-enabled inspections.

You can specify a **match access-list** command along with the **match default-inspection-traffic** command to narrow the matched traffic to specific IP addresses. Because the **match default-inspection-traffic** command specifies the ports to match, any ports in the access list are ignored.

Tip We suggest that you only inspect traffic on ports on which you expect application traffic; if you inspect all traffic, for example using **match any**, the adaptive security appliance performance can be impacted.

If you want to match non-standard ports, then create a new class map for the non-standard ports. See the "Default Settings" section on page 38-4 for the standard ports for each inspection engine. You can combine multiple class maps in the same policy if desired, so you can create one class map to match certain traffic, and another to match different traffic. However, if traffic matches a class map that contains an inspection command, and then matches another class map that also has an inspection command, only the first matching class is used. For example, SNMP matches the inspection_default class. To enable SNMP inspection, enable SNMP inspection for the default class in Step 5. Do not add another class that matches SNMP.

For example, to limit inspection to traffic from 10.1.1.0 to 192.168.1.0 using the default class map, enter the following commands:

```
hostname(config)# access-list inspect extended permit ip 10.1.1.0 255.255.255.0
192.168.1.0 255.255.255.0
hostname(config)# class-map inspection_default
hostname(config-cmap)# match access-list inspect
```

View the entire class map using the following command:

```
hostname(config-cmap)# show running-config class-map inspection_default
!
class-map inspection_default
 match default-inspection-traffic
 match access-list inspect
!
```

To inspect FTP traffic on port 21 as well as 1056 (a non-standard port), create an access list that specifies the ports, and assign it to a new class map:

```
hostname(config)# access-list ftp_inspect extended permit tcp any any eq 21
hostname(config)# access-list ftp_inspect extended permit tcp any any eq 1056
hostname(config)# class-map new_inspection
hostname(config-cmap)# match access-list ftp_inspect
```

Step 2 (Optional) Some inspection engines let you control additional parameters when you apply the inspection to the traffic. See the following sections to configure an inspection policy map for your application:

- DCERPC—See the "Configuring a DCERPC Inspection Policy Map for Additional Inspection Control" section on page 42-2
- DNS—See the "Configuring a DNS Inspection Policy Map for Additional Inspection Control" section on page 39-7
- ESMTP—See the "Configuring an ESMTP Inspection Policy Map for Additional Inspection Control" section on page 39-33
- FTP—See the "Configuring an FTP Inspection Policy Map for Additional Inspection Control" section on page 39-12.
- GTP—See the "Configuring a GTP Inspection Policy Map for Additional Inspection Control" section on page 42-4.
- H323—See the "Configuring an H.323 Inspection Policy Map for Additional Inspection Control" section on page 40-6
- HTTP—See the "Configuring an HTTP Inspection Policy Map for Additional Inspection Control" section on page 39-19.
- Instant Messaging—See the "Configuring an Instant Messaging Inspection Policy Map for Additional Inspection Control" section on page 39-24
- IP Options—See the "Configuring an IP Options Inspection Policy Map for Additional Inspection Control" section on page 39-28
- MGCP—See the "Configuring an MGCP Inspection Policy Map for Additional Inspection Control" section on page 40-13.
- NetBIOS—See the "Configuring a NetBIOS Inspection Policy Map for Additional Inspection Control" section on page 39-30
- RADIUS Accounting—See the "Configuring a RADIUS Inspection Policy Map for Additional Inspection Control" section on page 42-10

- RTSP—See the "Configuring an RTSP Inspection Policy Map for Additional Inspection Control" section on page 40-16
- SIP—See the "Configuring a SIP Inspection Policy Map for Additional Inspection Control" section on page 40-21
- Skinny—See the "Configuring a Skinny (SCCP) Inspection Policy Map for Additional Inspection Control" section on page 40-27
- SNMP—See the "Configuring an SNMP Inspection Policy Map for Additional Inspection Control" section on page 42-11.

Step 3 To add or edit a Layer 3/4 policy map that sets the actions to take with the class map traffic, enter the following command:

```
hostname(config)# policy-map name
hostname(config-pmap)#
```

The default policy map is called "global_policy." This policy map includes the default inspections listed in the "Default Settings" section on page 38-4. If you want to modify the default policy (for example, to add or delete an inspection, or to identify an additional class map for your actions), then enter **global_policy** as the name.

Step 4 To identify the class map from Step 1 to which you want to assign an action, enter the following command:

```
hostname(config-pmap)# class class_map_name
hostname(config-pmap-c)#
```

If you are editing the default policy map, it includes the inspection_default class map. You can edit the actions for this class by entering **inspection_default** as the name. To add an additional class map to this policy map, identify a different name. You can combine multiple class maps in the same policy if desired, so you can create one class map to match certain traffic, and another to match different traffic. However, if traffic matches a class map that contains an inspection command, and then matches another class map that also has an inspection command, only the first matching class is used. For example, SNMP matches the inspection_default class map.To enable SNMP inspection, enable SNMP inspection for the default class in Step 5. Do not add another class that matches SNMP.

Step 5 Enable application inspection by entering the following command:

```
hostname(config-pmap-c)# inspect protocol
```

The *protocol* is one of the following values:

Table 38-2 Protocol Keywords

Keywords	Notes
ctiqbe	—
dcerpc [*map_name*]	If you added a DCERPC inspection policy map according to "Configuring a DCERPC Inspection Policy Map for Additional Inspection Control" section on page 42-2, identify the map name in this command.

Table 38-2 Protocol Keywords

Keywords	Notes
dns [*map_name*] [**dynamic-filter-snoop**]	If you added a DNS inspection policy map according to "Configuring a DNS Inspection Policy Map for Additional Inspection Control" section on page 39-7, identify the map name in this command. The default DNS inspection policy map name is "preset_dns_map." The default inspection policy map sets the maximum DNS packet length to 512 bytes. To enable DNS snooping for the Botnet Traffic Filter, enter the **dynamic-filter-snoop** keyword. See the "Enabling DNS Snooping" section on page 51-10 for more information.
esmtp [*map_name*]	If you added an ESMTP inspection policy map according to "Configuring an ESMTP Inspection Policy Map for Additional Inspection Control" section on page 39-33, identify the map name in this command.
ftp [**strict** [*map_name*]]	Use the **strict** keyword to increase the security of protected networks by preventing web browsers from sending embedded commands in FTP requests. See the "Using the strict Option" section on page 39-11 for more information. If you added an FTP inspection policy map according to "Configuring an FTP Inspection Policy Map for Additional Inspection Control" section on page 39-12, identify the map name in this command.
gtp [*map_name*]	If you added a GTP inspection policy map according to the "Configuring a GTP Inspection Policy Map for Additional Inspection Control" section on page 42-4, identify the map name in this command.
h323 h225 [*map_name*]	If you added an H323 inspection policy map according to "Configuring an H.323 Inspection Policy Map for Additional Inspection Control" section on page 40-6, identify the map name in this command.
h323 ras [*map_name*]	If you added an H323 inspection policy map according to "Configuring an H.323 Inspection Policy Map for Additional Inspection Control" section on page 40-6, identify the map name in this command.
http [*map_name*]	If you added an HTTP inspection policy map according to the "Configuring an HTTP Inspection Policy Map for Additional Inspection Control" section on page 39-19, identify the map name in this command.
icmp	—
icmp error	—
ils	—
im [*map_name*]	If you added an Instant Messaging inspection policy map according to "Configuring an Instant Messaging Inspection Policy Map for Additional Inspection Control" section on page 39-24, identify the map name in this command.

Table 38-2 Protocol Keywords

Keywords	Notes
ip-options [*map_name*]	If you added an IP Options inspection policy map according to "Configuring an IP Options Inspection Policy Map for Additional Inspection Control" section on page 39-28, identify the map name in this command.
mgcp [*map_name*]	If you added an MGCP inspection policy map according to "Configuring an MGCP Inspection Policy Map for Additional Inspection Control" section on page 40-13, identify the map name in this command.
netbios [*map_name*]	If you added a NetBIOS inspection policy map according to "Configuring a NetBIOS Inspection Policy Map for Additional Inspection Control" section on page 39-30, identify the map name in this command.
pptp	—
radius-accounting [*map_name*]	The **radius-accounting** keyword is only available for a management class map. See the "Creating a Layer 3/4 Class Map for Management Traffic" section on page 30-15 for more information about creating a management class map. If you added a RADIUS accounting inspection policy map according to "Configuring a RADIUS Inspection Policy Map for Additional Inspection Control" section on page 42-10, identify the map name in this command.
rsh	—
rtsp [*map_name*]	If you added a RTSP inspection policy map according to "Configuring an RTSP Inspection Policy Map for Additional Inspection Control" section on page 40-16, identify the map name in this command.
sip [*map_name*]	If you added a SIP inspection policy map according to "Configuring a SIP Inspection Policy Map for Additional Inspection Control" section on page 40-21, identify the map name in this command.
skinny [*map_name*]	If you added a Skinny inspection policy map according to "Configuring a Skinny (SCCP) Inspection Policy Map for Additional Inspection Control" section on page 40-27, identify the map name in this command.
snmp [*map_name*]	If you added an SNMP inspection policy map according to "Configuring an SNMP Inspection Policy Map for Additional Inspection Control" section on page 42-11, identify the map name in this command.
sqlnet	—
sunrpc	The default class map includes UDP port 111; if you want to enable Sun RPC inspection for TCP port 111, you need to create a new class map that matches TCP port 111, add the class to the policy, and then apply the **inspect sunrpc** command to that class.
tftp	—

Table 38-2 Protocol Keywords

Keywords	Notes
waas	—
xdmcp	—

Step 6 To activate the policy map on one or more interfaces, enter the following command:

```
hostname(config)# service-policy policymap_name {global | interface interface_name}
```

Where **global** applies the policy map to all interfaces, and **interface** applies the policy to one interface. By default, the default policy map, "global_policy," is applied globally. Only one global policy is allowed. You can override the global policy on an interface by applying a service policy to that interface. You can only apply one policy map to each interface.