Device Sensor

The Device Sensor feature is used to gather raw endpoint data from network devices using protocols such as Cisco Discovery Protocol (CDP), Link Layer Discovery Protocol (LLDP), and DHCP. The endpoint data that is gathered is made available to registered clients in the context of an access session.

Restrictions for Device Sensor

- Only Cisco Discovery Protocol, LLDP, DHCP, MDNS, SIP, and H323 protocols are supported.
- The session limit for profiling ports is 32.
- The length of one Type-Length-Value (TLV) must not be more than 1024 and the total length of TLVs (combined length of TLVs) of all protocols must not be more than 4096.
- The sensor profiles devices that are only one hop away.
- The Device Sensor feature is enabled by default, but cannot be disabled. Disabling device classifier using **no device classifier** command in global configuration mode does not disable device sensor. This is because device sensor is independent of IP device tracking and device classifier.

Note In Cisco IOS Release 15.2(1)E and later releases, you can exclude the protocols so that the Device Sensor feature does not analyze the data. To exclude the protocols, use the **device-sensor filter-spec** *protocol* **exclude all** command in global configuration mode.

Information About Device Sensor

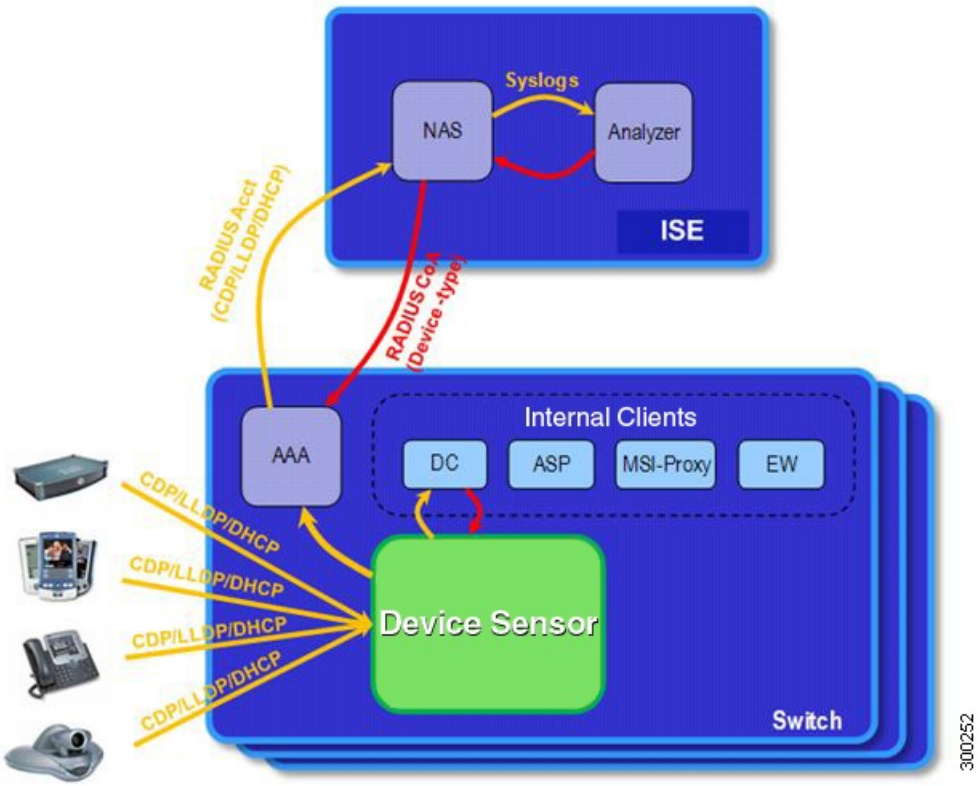
Device Sensor

The device sensor is used to gather raw endpoint data from network devices. The endpoint information that is gathered helps in completing the profiling capability of devices. Profiling is the determination of the endpoint type based on information gleaned from various protocol packets from an endpoint during its connection to a network.

The profiling capability consists of two parts:

- Collector—Gathers endpoint data from network devices.
- Analyzer—Processes the data and determines the type of device.

The device sensor represents the embedded collector functionality. The illustration below shows the Cisco sensor in the context of the profiling system and also features other possible clients of the sensor.



A device with sensor capability gathers endpoint information from network devices using protocols such as Cisco Discovery Protocol, LLDP, and DHCP, subject to statically configured filters, and makes this information available to its registered clients in the context of an access session. An access session represents an endpoint's connection to the network device.

The device sensor has internal and external clients. The internal clients include components such as the embedded Device Classifier (local analyzer), ATM switch processor (ASP), MSI-Proxy, and EnergyWise

(EW). The external client, that is the Identity Services Engine (ISE) analyzer, will use RADIUS accounting to receive additional endpoint data.

Client notifications and accounting messages containing profiling data along with the session events and other session-related data, such as the MAC address and the ingress port, are generated and sent to the internal and external clients (ISE). By default, for each supported peer protocol, client notifications and accounting events are only generated where an incoming packet includes a TLV that has not previously been received in the context of a given session. You can enable client notifications and accounting events for all TLV changes, where either a new TLV has been received or a previously received TLV has been received with a different value using CLI commands.

The device sensor's port security protects the switch from consuming memory and crashing during deliberate or unintentional denial-of-service (DoS) type attacks. The sensor limits the maximum device monitoring sessions to 32 per port (access ports and trunk ports). In case of lack of activity from hosts, the age session time is 12 hours.

How to Configure Device Sensor

The device sensor is enabled by default.

Note In Cisco IOS Release 15.2(1)E and later releases, you can exclude the protocols so that the Device Sensor feature does not analyze the data. To exclude the protocols, use the **device-sensor filter-spec** *protocol* **exclude all** command in global configuration mode.

The following tasks are applicable only if you want to configure the sensor based on your specific requirements.

Note If you do not perform these configuration tasks, then the following TLVs are included by default:

- Cisco Discovery Protocol filter—secondport-status-type and powernet-event-type (type 28 and 29).
- LLDP filter—organizationally-specific (type 127).
- DHCP filter—message-type (type 53).

Enabling Accounting Augmentation

Perform this task to add device sensor protocol data to accounting records.

Before you begin

For the sensor protocol data to be added to the accounting messages, you must enable session accounting by using the following standard authentication, authorization, and accounting (AAA), and RADIUS configuration commands:

```
Device(config)#aaa new-model
Device(config)#aaa accounting dot1x default start-stop group radius
Device(config)#radius-server host{hostname | ip-address}[auth-port
port-number][acct-port port-number][timeout seconds][retransmit retries][key
```

```
string]
Device(config)#radius-server vsa send accounting
```

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**device-sensor accounting** **Example:** `Device(config)# device-sensor accounting`	Enables the addition of sensor protocol data to accounting records and also enables the generation of additional accounting events when new sensor data is detected.
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Creating a Cisco Discovery Protocol Filter

Perform this task to create a Cisco Discovery Protocol filter containing a list of TLVs that can be included or excluded in the device sensor output.

Procedure

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

	Command or Action	Purpose
Step 3	**device-sensor filter-list cdp list** *tlv-list-name* **Example:** `Device(config)# device-sensor filter-list cdp list cdp-list`	Creates a TLV list and enters CDP sensor configuration mode, where you can configure individual TLVs.
Step 4	**tlv** {**name** *tlv-name* | **number** *tlv-number*} **Example:** `Device(config-sensor-cdplist)# tlv number 10`	Adds individual Cisco Discovery Protocol TLVs to the TLV list. • You can delete the TLV list without individually removing TLVs from the list by using the **no device-sensor filter-list cdp list** *tlv-list-name* command.
Step 5	**end** **Example:** `Device(config-sensor-cdplist)# end`	Returns to privileged EXEC mode.

Creating an LLDP Filter

Perform this task to create an LLDP filter containing a list of TLVs that can be included or excluded in the device sensor output.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**device-sensor filter-list lldp list** *tlv-list-name* **Example:** `Device(config)# device-sensor filter-list lldp list lldp-list`	Creates a TLV list and enters LLDP sensor configuration mode, where you can configure individual TLVs.
Step 4	**tlv** {**name** *tlv-name* | **number** *tlv-number*} **Example:**	Adds individual LLDP TLVs to the TLV list. • You can delete the TLV list without individually removing TLVs from the list

	Command or Action	Purpose
	`Device(config-sensor-lldplist)# tlv number 15`	by using the **no device-sensor filter-list lldp list** *tlv-list-name* command.
Step 5	**end** **Example:** `Device(config-sensor-lldplist)# end`	Returns to privileged EXEC mode.

Creating a DHCP Filter

Perform this task to create a DHCP filter containing a list of options that can be included or excluded in the device sensor output.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**device-sensor filter-list dhcp list** *option-list-name* **Example:** `Device(config)# device-sensor filter-list dhcp list dhcp-list`	Creates an options list and enters DHCP sensor configuration mode, where you can configure individual options.
Step 4	**option** {**name** *option-name* | **number** *option-number*} **Example:** `Device(config-sensor-dhcplist)# option number 10`	Adds individual DHCP options to the option list. • You can delete the option list without individually removing options from the list by using the **no device-sensor filter-list dhcp list** *option-list-name* command.
Step 5	**end** **Example:** `Device(config-sensor-dhcplist)# end`	Returns to privileged EXEC mode.

Applying a Protocol Filter to the Sensor Output

Perform this task to apply a Cisco Discovery Protocol, LLDP, or DHCP filter to the sensor output. Session notifications are sent to internal sensor clients and accounting requests.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**device-sensor filter-spec** {**cdp** | **dhcp** | **lldp**} {**exclude** {**all** | **list** *list-name*} | **include list** *list-name*} **Example:** `Device(config)# device-sensor filter-spec cdp include list list1`	Applies a specific protocol filter containing a list of TLV fields to the device sensor output. • **cdp**—Applies a Cisco Discovery Protocol TLV filter list to the device sensor output. • **lldp**—Applies an LLDP TLV filter list to the device sensor output. • **dhcp**—Applies a DHCP TLV filter list to the device sensor output. • **exclude**—Specifies the TLVs that must be excluded from the device sensor output. • **include**—Specifies the TLVs that must be included from the device sensor output. • **all**—Disables all notifications for the associated protocol. • **list** *list-name*—Specifies the protocol TLV filter list name.
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Tracking TLV Changes

Perform this task to enable client notifications and accounting events for all TLV changes. By default, for each supported peer protocol, client notifications and accounting events will only be generated where an incoming packet includes a TLV that has not previously been received in the context of a given session.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**device-sensor notify all-changes** **Example:** `Device(config)# device-sensor notify all-changes`	Enables client notifications and accounting events for all TLV changes, that is, where either a new TLV is received or a previously received TLV is received with a new value in the context of a given session. **Note** Use the **default device-sensor notify** or the **device-sensor notify new-tlvs** command to return to the default TLV.
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Verifying the Device Sensor Configuration

Perform this task to verify the sensor cache entries for all devices.

Procedure

Step 1 **enable**

Enables privileged EXEC mode.

Example:

```
Device> enable
```

Step 2 **show device-sensor cache mac** *mac-address*

Displays sensor cache entries (the list of protocol TLVs or options received from a device) for a specific device.

Example:

```
Device# show device-sensor cache mac 0024.14dc.df4d

Device: 0024.14dc.df4d on port GigabitEthernet1/0/24
-------------------------------------------------
Proto Type:Name                        Len Value
cdp     26:power-available-type         16 00 1A 00 10 00 00 00 01 00 00 00 00 FF FF FF FF
cdp     22:mgmt-address-type            17 00 16 00 11 00 00 00 01 01 01 CC 00 04 09 1B 65
                                           0E
cdp     11:duplex-type                   5 00 0B 00 05 01
cdp      9:vtp-mgmt-domain-type          4 00 09 00 04
cdp      4:capabilities-type             8 00 04 00 08 00 00 00 28
cdp      1:device-name                  14 00 01 00 0E 73 75 70 70 6C 69 63 61 6E 74
lldp     0:end-of-lldpdu                 2 00 00
lldp     8:management-address           14 10 0C 05 01 09 1B 65 0E 03 00 00 00 01 00
lldp     7:system-capabilities           6 0E 04 00 14 00 04
lldp     4:port-description             23 08 15 47 69 67 61 62 69 74 45 74 68 65 72 6E 65
                                           74 31 2F 30 2F 32 34
lldp     5:system-name                  12 0A 0A 73 75 70 70 6C 69 63 61 6E 74
dhcp    82:relay-agent-info             20 52 12 01 06 00 04 00 18 01 18 02 08 00 06 00 24
                                           14 DC DF 80
dhcp    12:host-name                    12 0C 0A 73 75 70 70 6C 69 63 61 6E 74
dhcp    61:client-identifier            32 3D 1E 00 63 69 73 63 6F 2D 30 30 32 34 2E 31 34
                                           64 63 2E 64 66 34 64 2D 47 69 31 2F 30 2F 32 34
dhcp    57:max-message-size              4 39 02 04 80
```

Step 3 **show device-sensor cache all**

Displays sensor cache entries for all devices.

Example:

```
Device# show device-sensor cache all

Device: 001c.0f74.8480 on port GigabitEthernet2/1
-------------------------------------------------
Proto Type:Name Len Value
dhcp 52:option-overload 3 34 01 03
dhcp 60:class-identifier 11 3C 09 64 6F 63 73 69 73 31 2E 30
dhcp 55:parameter-request-list 8 37 06 01 42 06 03 43 96
dhcp 61:client-identifier 27 3D 19 00 63 69 73 63 6F 2D 30 30 31 63 2E 30 66
37 34 2E 38 34 38 30 2D 56 6C 31
dhcp 57:max-message-size 4 39 02 04 80
Device: 000f.f7a7.234f on port GigabitEthernet2/1
-------------------------------------------------
Proto Type:Name Len Value
cdp 22:mgmt-address-type 8 00 16 00 08 00 00 00 00
cdp 19:cos-type 5 00 13 00 05 00
cdp 18:trust-type 5 00 12 00 05 00
cdp 11:duplex-type 5 00 0B 00 05 01
cdp 10:native-vlan-type 6 00 0A 00 06 00 01
cdp 9:vtp-mgmt-domain-type 9 00 09 00 09 63 69 73 63 6F
```

Troubleshooting Tips

After you have configured AAA Dead-Server Detection, you should verify your configuration using the **show running-config** command. This verification is especially important if you have used the **no** form of the **radius-server dead-criteria** command. The output of the **show running-config** command must show the same values in the "Dead Criteria Details" field that you configured using the **radius-server dead-criteria** command.

Configuration Examples for the Device Sensor Feature

Examples: Configuring the Device Sensor

The following example shows how to create a Cisco Discovery Protocol filter containing a list of TLVs:

```
Device> enable
Device# configure terminal
Device(config)# device-sensor filter-list cdp list cdp-list
Device(config-sensor-cdplist)# tlv name address-type
Device(config-sensor-cdplist)# tlv name device-name
Device(config-sensor-cdplist)# tlv number 34
Device(config-sensor-cdplist)# end
```

The following example shows how to create an LLDP filter containing a list of TLVs:

```
Device> enable
Device# configure terminal
Device(config)# device-sensor filter-list lldp list lldp-list
Device(config-sensor-lldplist)# tlv name chassis-id
Device(config-sensor-lldplist)# tlv name management-address
Device(config-sensor-lldplist)# tlv number 28
Device(config-sensor-lldplist)# end
```

The following example shows how to create a DHCP filter containing a list of options:

```
Device> enable
Device# configure terminal
Device(config)# device-sensor filter-list dhcp list dhcp-list
Device(config-sensor-lldplist)# option name address-type
Device(config-sensor-lldplist)# option name device-name
Device(config-sensor-lldplist)# option number 34
Device(config-sensor-lldplist)# end
```

The following example shows how to apply a Cisco Discovery Protocol TLV filter list to the device sensor output:

```
Device> enable
Device# configure terminal
Device(config)# device-sensor filter-spec cdp include cdp-list1
```

The following example shows how to enable client notifications and accounting events for all TLV changes:

```
Device> enable
Device# configure terminal
Device(config)# device-sensor notify all-changes
```

Additional References for Device Sensor

Related Documents

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

Technical Assistance

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

Feature Information for Device Sensor

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 Device Sensor

Feature Name	Releases	Feature Information
Device Sensor	Cisco IOS XE Fuji 16.8.1a	The Device Sensor feature is used to gather raw endpoint data from network devices using protocols such as Cisco Discovery Protocol, Link Layer Discovery Protocol (LLDP), and DHCP. The endpoint data that is gathered is made available to registered clients in the context of an access session.