IPv6 Snooping

The IPv6 Snooping feature bundles several Layer 2 IPv6 first-hop security features, including IPv6 neighbor discovery inspection, IPv6 device tracking, IPv6 address glean, and IPv6 binding table recovery, to provide security and scalability. IPv6 ND inspection operates at Layer 2, or between Layer 2 and Layer 3, to provide IPv6 functions with security and scalability.

Restrictions for IPv6 Snooping

The IPv6 snooping feature is not supported on Etherchannel ports.

Information About IPv6 Snooping

The following sections provide information about IPv6 snooping.

IPv6 Snooping

The IPv6 Snooping feature bundles several Layer 2 IPv6 first-hop security features, including IPv6 Address Glean and IPv6 Device Tracking. The feature operates at Layer 2, or between Layer 2 and Layer 3, and provides IPv6 features with security and scalability. This feature mitigates some of the inherent vulnerabilities for the neighbor discovery mechanism, such as attacks on duplicate address detection (DAD), address resolution, device discovery, and the neighbor cache.

IPv6 Snooping learns and secures bindings for stateless autoconfiguration addresses in Layer 2 neighbor tables and analyzes ND messages in order to build a trusted binding table. IPv6 ND messages that do not have valid bindings are dropped. An ND message is considered trustworthy if its IPv6-to-MAC mapping is verifiable.

When IPv6 Snooping is configured on a target (which varies depending on platform target support and may include device ports, switch ports, Layer 2 interfaces, Layer 3 interfaces, and VLANs), capture instructions are downloaded to the hardware to redirect the ND protocol and Dynamic Host Configuration Protocol (DHCP) for IPv6 traffic up to the switch integrated security features (SISF) infrastructure in the routing device. For

ND traffic, messages such as NS, NA, RS, RA, and REDIRECT are directed to SISF. For DHCP, UDP messages sourced from port 546 or 547 are redirected.

IPv6 Snooping registers its "capture rules" to the classifier, which aggregates all rules from all features on a given target and installs the corresponding ACL down into the platform-dependent modules. Upon receiving redirected traffic, the classifier calls all entry points from any registered feature (for the target on which the traffic is being received), including the IPv6 snooping entry point. This entry point is the last to be called, so any decision (such as drop) made by another feature supersedes the IPv6 Snooping decision.

IPv6 Device Tracking

IPv6 device tracking provides IPv6 host liveness tracking so that a neighbor table can be immediately updated when an IPv6 host disappears.

IPv6 First-Hop Security Binding Table

The IPv6 First-Hop Security Binding Table recovery mechanism feature enables the binding table to recover in the event of a device reboot. A database table of IPv6 neighbors connected to the device is created from information sources such as ND snooping. This database, or binding, table is used by various IPv6 guard features to validate the link-layer address (LLA), the IPv4 or IPv6 address, and prefix binding of the neighbors to prevent spoofing and redirect attacks.

This mechanism enables the binding table to recover in the event of a device reboot. The recovery mechanism will block any data traffic sourced from an unknown source; that is, a source not already specified in the binding table and previously learned through ND or DHCP gleaning. This feature recovers the missing binding table entries when the resolution for a destination address fails in the destination guard. When a failure occurs, a binding table entry is recovered by querying the DHCP server or the destination host, depending on the configuration.

Recovery Protocols and Prefix Lists

The IPv6 First-Hop Security Binding Table Recovery Mechanism feature introduces the capability to provide a prefix list that is matched before the recovery is attempted for both DHCP and NDP.

If an address does not match the prefix list associated with the protocol, then the recovery of the binding table entry will not be attempted with that protocol. The prefix list should correspond to the prefixes that are valid for address assignment in the Layer 2 domain using the protocol. The default is that there is no prefix list, in which case the recovery is attempted for all addresses. The command to associate a prefix list to a protocol is **protocol** {**dhcp** | **ndp**} [**prefix-list** *prefix-list-name*].

IPv6 Device Tracking

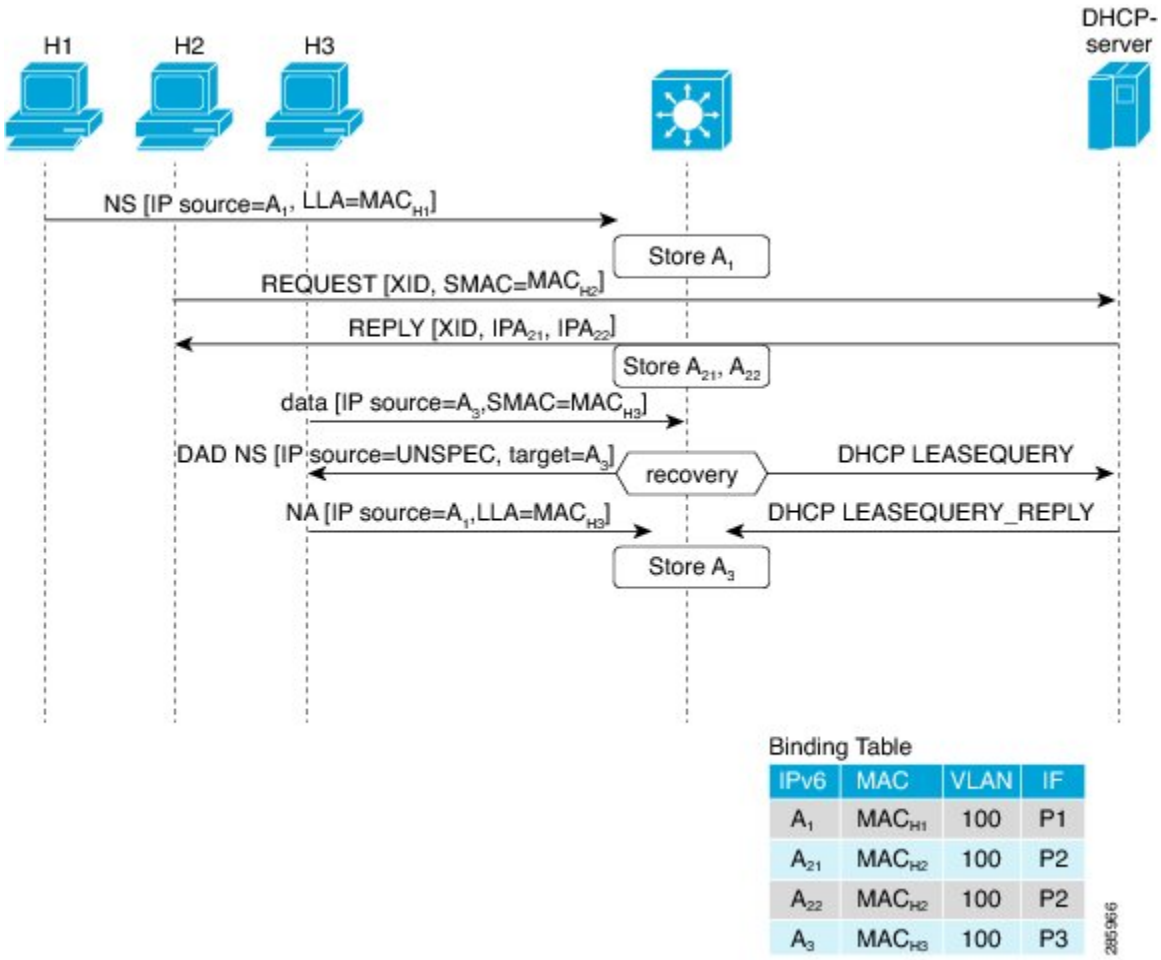
IPv6 device tracking provides IPv6 host liveness tracking so that a neighbor table can be immediately updated when an IPv6 host disappears.

IPv6 Address Glean

IPv6 address glean is the foundation for many other IPv6 features that depend on an accurate binding table. It inspects ND and DHCP messages on a link to glean addresses, and then populates the binding table with these addresses. This feature also enforces address ownership and limits the number of addresses any given node is allowed to claim.

The following figure shows how IPv6 address glean works.

Figure 1: IPv6 Address Glean



Support for Multiple IA_NA and IA_PD

In some cases, a network device can request and receive more than one IPv6 address from the DHCP server. This may be done to provide addresses to multiple clients of the device, such as when a residential gateway requests addresses to distribute to its LAN clients. When the device sends out a DHCPv6 packet, the packet includes all of the addresses that have been assigned to the device.

When SISF analyzes a DHCPv6 packet, it examines the IA_NA (Identity Association-Nontemporary Address) and IA_PD (Identity Association-Prefix Delegation) components of the packet, and extracts each IPv6 address contained in the packet. SISF adds each extracted address to the binding table.

How to Configure IPv6 Snooping

Configuring IPv6 Snooping on an Interface

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 snooping policy** *snooping-policy*
4. **exit**
5. **interface** *type number*
6. **ipv6 snooping attach-policy** *snooping-policy*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 snooping policy** *snooping-policy* **Example:** `Device(config)# ipv6 snooping policy policy1`	Configures an IPv6 snooping policy and enters IPv6 snooping configuration mode.
Step 4	**exit** **Example:** `Device(config-ipv6-snooping)# exit`	Exits IPv6 snooping configuration mode.
Step 5	**interface** *type number* **Example:** `Device(config)# interface Gigabitethernet 0/0/1`	Enters interface configuration mode.
Step 6	**ipv6 snooping attach-policy** *snooping-policy* **Example:** `Device(config-if)# ipv6 snooping attach-policy policy1`	Attaches the IPv6 snooping policy to the interface.

Verifying and Troubleshooting IPv6 ND Inspection

SUMMARY STEPS

1. **enable**
2. **show ipv6 snooping capture-policy** [**interface** *type number*]
3. **show ipv6 snooping counter** [**interface** *type number*]
4. **show ipv6 snooping features**
5. **show ipv6 snooping policies** [**interface** *type number*]
6. **debug ipv6 snooping**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show ipv6 snooping capture-policy** [**interface** *type number*] **Example:** `Device# show ipv6 snooping capture-policy interface ethernet 0/0`	Displays snooping ND message capture policies.
Step 3	**show ipv6 snooping counter** [**interface** *type number*] **Example:** `Device# show ipv6 snooping counter interface FastEthernet 4/12`	Displays information about the packets counted by the interface counter.
Step 4	**show ipv6 snooping features** **Example:** `Device# show ipv6 snooping features`	Displays information about snooping features configured on the device.
Step 5	**show ipv6 snooping policies** [**interface** *type number*] **Example:** `Device# show ipv6 snooping policies`	Displays information about the configured policies and the interfaces to which they are attached.
Step 6	**debug ipv6 snooping** **Example:** `Device# debug ipv6 snooping`	Enables debugging for snooping information in IPv6.

Configuring IPv6 Device Tracking

Configuring IPv6 First-Hop Security Binding Table Content

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 neighbor binding** {*ipv6-address* | *ipv6-prefix*} **interface** *type number* [*hardware-address* | *mac-address*][**tracking** [**disable** | **enable** | **retry-interval** *value*] | **reachable-lifetime** *value*]
4. **ipv6 neighbor binding max-entries** *entries*
5. **ipv6 neighbor binding logging**
6. **exit**
7. **show ipv6 neighbor binding**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 neighbor binding** {*ipv6-address* | *ipv6-prefix*} **interface** *type number* [*hardware-address* | *mac-address*][**tracking** [**disable** | **enable** | **retry-interval** *value*] | **reachable-lifetime** *value*] **Example:** `Device(config)# ipv6 neighbor binding 2001:DB8:0:ABCD::1 interface GigabitEthernet 0/0/1 reachable-lifetime 100`	Adds a static entry to the binding table database.
Step 4	**ipv6 neighbor binding max-entries** *entries* **Example:** `Device(config)# ipv6 neighbor binding max-entries 100`	Specifies the maximum number of entries that are allowed to be inserted in the binding table cache.
Step 5	**ipv6 neighbor binding logging** **Example:** `Device(config)# ipv6 neighbor binding logging`	Enables the logging of binding table main events.

	Command or Action	Purpose
Step 6	**exit** **Example:** `Device(config)# exit`	Exits global configuration mode and enters privileged EXEC mode.
Step 7	**show ipv6 neighbor binding** **Example:** `Device# show ipv6 neighbor binding`	Displays the contents of a binding table.

Configuring the IPv6 First-Hop Security Binding Table Recovery Mechanism

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 neighbor binding** *ipv6-address* **interface** *type number*
4. **ipv6 prefix-list** *list-name* **permit** *ipv6-prefix/prefix-length* **ge** *ge-value*
5. **ipv6 snooping policy** *snooping-policy-id*
6. **destination-glean** {**recovery** | **log-only**} [**dhcp**]
7. **data-glean** {**recovery** | **log-only**} [**ndp** | **dhcp**]
8. **prefix-glean**
9. **protocol dhcp** [**prefix-list** *prefix-list-name*]
10. **exit**
11. **ipv6 destination-guard policy** *policy-name*
12. **enforcement** {**always** | **stressed**}
13. **exit**
14. **interface** *type number*
15. **ipv6 snooping attach-policy** *snooping-policy*
16. **ipv6 destination-guard attach-policy** *policy-name*
17. **end**

DETAILED STEPS

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

	Command or Action	Purpose
Step 3	**ipv6 neighbor binding** *ipv6-address* **interface** *type number* **Example:** `Device(config)# ipv6 neighbor binding 2001:db8::1 interface Gigabitethernet3/0/1`	Adds a static entry to the binding table database.
Step 4	**ipv6 prefix-list** *list-name* **permit** *ipv6-prefix/prefix-length* **ge** *ge-value* **Example:** `Device(config)# ipv6 prefix-list abc permit 2001:DB8::/64 ge 128`	Creates an entry in an IPv6 prefix list.
Step 5	**ipv6 snooping policy** *snooping-policy-id* **Example:** `Device(config)# ipv6 snooping policy xyz`	Enters IPv6 snooping configuration mode and allows you to modify the configuration of the snooping policy specified.
Step 6	**destination-glean** {**recovery** | **log-only**} [**dhcp**] **Example:** `Device(config-ipv6-snooping)# destination-glean recovery dhcp`	Specifies that destination addresses should be recovered from DHCP. **Note** If logging (without recovery) is required, use the **destination-glean log-only** command.
Step 7	**data-glean** {**recovery** | **log-only**} [**ndp** | **dhcp**] **Example:** `Device(config-ipv6-snooping)# data-glean recovery ndp`	Enables IPv6 first-hop security binding table recovery using source (or "data") address gleaning. **Note** If logging (without recovery) is required, use the **data-glean log-only** command.
Step 8	**prefix-glean** **Example:** `Device(config-ipv6-snooping)# prefix-glean`	Enables the device to glean prefixes from IPv6 router advertisements (RAs) or Dynamic Host Configuration protocol (DHCP)
Step 9	**protocol dhcp** [**prefix-list** *prefix-list-name*] **Example:** `Device(config-ipv6-snooping)# protocol dhcp prefix-list abc`	(Optional) Specifies that addresses should be gleaned with DHCP and associates the protocol with a specific IPv6 prefix list.
Step 10	**exit** **Example:** `Device(config-ipv6-snooping)# exit`	Exits IPv6 snooping configuration mode and returns to global configuration mode.

	Command or Action	Purpose
Step 11	**ipv6 destination-guard policy** *policy-name* **Example:** `Device(config)# ipv6 destination-guard policy xyz`	(Optional) Enters destination guard configuration mode and allows you to modify the configuration of the specified destination guard policy.
Step 12	**enforcement** {**always** | **stressed**} **Example:** `Device(config-destguard)# enforcement stressed`	Sets the enforcement level of the policy to be either enforced under all conditions or only when the system is under stress.
Step 13	**exit** **Example:** `Device(config-destguard)# exit`	Exits destination guard configuration mode and returns to global configuration mode.
Step 14	**interface** *type number* **Example:** `Device(config)# interface Gigabitethernet 0/0/1`	Enters interface configuration mode.
Step 15	**ipv6 snooping attach-policy** *snooping-policy* **Example:** `Device(config-if)# ipv6 snooping attach-policy xyz`	Attaches the IPv6 snooping policy to the interface.
Step 16	**ipv6 destination-guard attach-policy** *policy-name* **Example:** `Device(config-if)# ipv6 destination-guard attach-policy xyz`	Attaches the destination guard policy to the specified interface. **Note** For information about how to configure an IPv6 destination guard policy, see the "IPv6 Destination Guard" module.
Step 17	**end** **Example:** `Device(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

Configuring Address Gleaning and Associating Recovery Protocols with Prefix Lists

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 snooping policy** *snooping-policy-id*
4. **protocol** {**dhcp** | **ndp**} [**prefix-list** *prefix-list-name*]
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 snooping policy** *snooping-policy-id* **Example:** `Device(config)# ipv6 snooping policy 200`	Enters IPv6 snooping configuration mode and allows you to modify the configuration of the snooping policy specified.
Step 4	**protocol** {**dhcp** | **ndp**} [**prefix-list** *prefix-list-name*] **Example:** `Device(config-ipv6-snooping)# protocol dhcp prefix-list dhcp_prefix_list`	Specifies that address should be gleaned with dynamic Host Configuration Protocol (DHCP) and associates a recovery protocol (DHCP) with the prefix list.
Step 5	**end** **Example:** `Device(config-ipv6-snooping)# end`	Exits IPv6 snooping configuration mode and returns to privileged EXEC mode.

Configuring IPv6 Device Tracking

Perform this task to provide fine tuning for the life cycle of an entry in the binding table for the IPv6 Device Tracking feature. For IPv6 device tracking to work, the binding table needs to be populated.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 neighbor tracking** [**retry-interval** *value*]

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 neighbor tracking** [**retry-interval** *value*] **Example:** `Device(config)# ipv6 neighbor tracking`	Tracks entries in the binding table.

Configuring IPv6 Prefix Glean

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 snooping policy** *snooping-policy*
4. **prefix-glean** [**only**]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 snooping policy** *snooping-policy* **Example:** `Device(config)# ipv6 snooping policy policy1`	Configures an IPv6 snooping policy and enters IPv6 snooping policy configuration mode.
Step 4	**prefix-glean** [**only**] **Example:** `Device(config-ipv6-snooping)# prefix-glean`	Enables the device to glean prefixes from IPv6 RAs or DHCPv6 traffic.

Configuration Examples for IPv6 Snooping

Example: Configuring IPv6 ND Inspection on an Interface

```
Device(config)# ipv6 snooping policy policy1
Device(config-ipv6-snooping)# exit
Device(config)# interface Gigabitethernet 0/0/1
Device(config-if)# ipv6 snooping attach-policy policy1
.
.
.
Device# show ipv6 snooping policies interface gigabitethernet 0/0/1
Target               Type  Policy              Feature        Target range
Gi0/0/1              PORT  my_policy           Destination Gu vlan all
Gi0/0/1              PORT  policy1             Snooping       vlan all
```

Example: Configuring IPv6 Binding Table Content

```
Device(config)# ipv6 neighbor binding 2001:DB8:0:ABCD::1 interface GigabitEthernet 0/0/1
reachable-lifetime 100
Device(config)# ipv6 neighbor binding max-entries 100
Device(config)# ipv6 neighbor binding logging
Device(config)# exit
```

Example: Configuring IPv6 First-Hop Security Binding Table Recovery

```
Device> enable
Device# configure terminal
Device(config)# ipv6 neighbor binding 2001:db8::1 interface Gigabitethernet3/0/1
Device(config)# ipv6 prefix-list abc permit 2001:DB8::/64 ge 128
Device(config)# ipv6 snooping policy xyz
Device(config-ipv6-snooping)# destination-glean recovery dhcp
Device(config-ipv6-snooping)# data-glean recovery ndp
Device(config-ipv6-snooping)# prefix-glean
Device(config-ipv6-snooping)# protocol dhcp prefix-list abc
Device(config-ipv6-snooping)# exit
Device(config)# ipv6 destination-guard policy xyz
Device(config-destguard)# enforcement stressed
Device(config-destguard)# exit
Device(config)# interface Gigabitethernet 0/0/1
Device(config-if)# ipv6 snooping attach-policy xyz
Device(config-if)# ipv6 destination-guard attach-policy xyz
Device(config-if)# end
```

Example: Configuring Address Gleaning and Associating Recovery Protocols with Prefix Lists

The following example shows that NDP will be used for the recovery for all addresses and that DHCP will be used to recover addresses that match the prefix list called dhcp_prefix_list:

```
Device(config-ipv6-snooping)# protocol ndp
Device(config-ipv6-snooping)# protocol dhcp prefix-list dhcp_prefix_list
```

Feature Information for Overview of Cisco TrustSec

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 Overview of Cisco TrustSec

Feature Name	Releases	Feature Information
IPv6 enablement - Inline Tagging	Cisco IOS XE Fuji 16.8.1	The support for IPv6 is introduced.