

Configuring SRv6

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Licensing Requirements

See the Cisco NX-OS Licensing Guide and Cisco NX-OS Licensing Options Guide for Cisco NX-OS licensing recommendations and instructions to obtain and apply licenses.

Supported Platforms

See the Nexus Switch Platform Support Matrix to know from which Cisco NX-OS releases various Cisco Nexus 9000 and 3000 switches support a selected feature.

About Segment Routing Over IPv6

Segment Routing (SR) can be applied on both MPLS and IPv6 data planes. In a SR-MPLS enabled network, an MPLS label is used as the Segment Identifier (SID) and the source router chooses a path to the destination and encodes the path in the packet header as a stack of labels. In a Segment Routing over IPv6 (SRv6) network, the IPv6 address serves as the SID. The source router encodes the path to destination as an ordered list of segments (list of IPv6 addresses) in the IPv6 packet. To encode an ordered list of IPv6 addresses in an IPv6 packet, a new routing header which is an extension header is used. This new header for SRv6 is called Segment

Routing Header (SRH). In an SRv6 enabled network, the active segment is indicated by the destination address of the packet, and the next segment is indicated by a pointer in the SRH.

SRv6 works on IPv6 data forwarding and is suitable for all data center deployments. SRv6 with SRH facilitates traffic engineering and path protection capabilities. Minus the SRH, SRv6 also supports traffic forwarding for multi-tenants with only the IPv6 packet header. In this case, the IPv6 destination address (128-bit) represents the reachability (locator) and the VPN function.

The forwarding methodology is such that if the destination address is within the locator prefix space is not in the SID table, it checks the standard routing table for a match.

Beginning Cisco NX-OS Release 9.3(3), Cisco Nexus 9300-GX series switches support SRv6 functionality as follows:

- IPv6
- processing of packets with SRHs at line rate
- BGP, OSPFv3, and IS-IS protocols
- L3VPN over SRv6 for both, IPv4 and IPv6 VPN prefixes
- global IPv4 and IPv6 (Internet) over SRv6

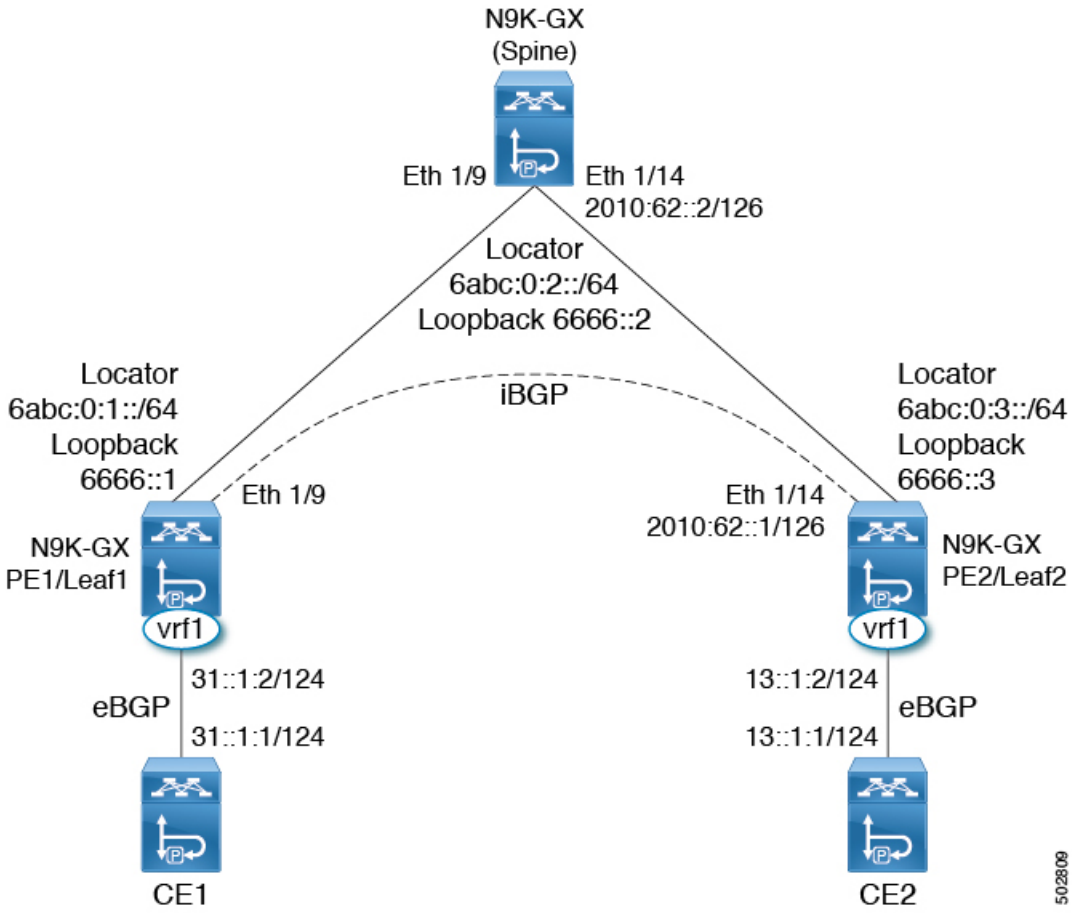
The following functions are supported in Cisco NX-Release 9.3(3):

- End
- End DT4/DT6/DT46
- T Encaps Red
- Transit Functionality (with and without SRH)

SRv6 Topology

This diagrams describes the SRv6 topology.

Figure 1: SRv6 Topology



In this example, the underlay IPv6 is enable with IS-IS. The interface between PE1 and spine are enabled with the link local addresses, while the interfaces between PE2 and spine are configured with the IPv6 addresses. In this topology, the configuration spine is also enabled for SRv6. The spine can act as a pure IPv6 underlay. The PE1/Leaf1 peers with PE2/Leaf2 over iBGP session to exchange VPN prefixes. The PE1 is attached to CE1 in vrf1 and learns VPN prefixes via eBGP session. Similarly, the PE2 is attached to CE2 in vrf1 and learns VPN prefixes via eBGP session.

Guidelines and Limitations for SRv6

SRv6 has the following guidelines and limitations:

- Beginning with NX-OS Release 9.3(3), only a single locator is supported.
- Layer 3 interface and Layer 3 port-channel are the supported uplinks toward the fabric. SVI and subinterfaces are not supported.
- Coexistence of the SRv6 feature and the MPLS SR-TE feature is not supported on Cisco Nexus 9000 switches.
- The vPC feature is not supported with SRv6 feature.

- The first 32 bits of the SRv6 locator should be the same on all the nodes in a fabric.

Supported platforms

The SRv6 feature is supported on the platforms listed in the table through Cisco NX-OS Releases.

Platform	Release
9300-GX and 9300-GX2	9.3(3)
N9K-C9332D-H2R	10.4(1)F
N9K-C93400LD-H1	10.4(2)F
N9K-C9364C-H1	10.4(3)F

Configuring SRv6

You can enable SRv6 and configure the locator with its prefix.

SUMMARY STEPS

1. **configure terminal**
2. **segment-routing**
3. **srv6**
4. **locators**
5. **locator** *name*
6. **prefix** *ipv6 address*/*len*
7. **exit**

DETAILED STEPS

Procedure

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

Step 2	**segment-routing**
	Example:
	`switch(config)#segment-routing`
	`switch(config-sr)#`
		Enables segment routing over SRv6.

Step 3	**srv6** **Example:**	Enables segment routing over SRv6.

	Command or Action	Purpose
	`switch(config-sr)#srv6` `switch(config-sr-srv6)#`	

Step 4	**locators**
	Example:
	`switch(config-srv6)#locators`
	`switch(config-srv6-locators)#`
		Enter locator configuration mode.

Step 5	**locator** *name* **Example:** `switch(config-srv6-locators)#locator loc1`	Configure the locator.
Step 6	**prefix** *ipv6 address*/*len* **Example:** `switch(config-srv6-locator)# prefix 6abc:0:1::/64`	Configures the locator prefix.
Step 7	**exit** **Example:** `switch(config-srv6-locators)# exit`	Exits the locator configuration mode.

Configuring Encapsulation Parameters

You can obtain the source IPv6 address using the SRv6 encapsulation configuration.

Before you begin

Ensure that **feature srv6** is enabled.

SUMMARY STEPS

1. **configure terminal**
2. **segment-routing**
3. **srv6**
4. **locators**
5. **locator** *name*
6. **encapsulation**
7. **source-address** *ipv6-address*

DETAILED STEPS

Procedure

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

Step 2	**segment-routing**
	Example:
	`switch(config)#segment-routing`
	`switch(config-sr)#`
		Enters the segment routing configuration mode.

Step 3	**srv6**
	Example:
	`switch(config-sr)#srv6`
	`switch(config-sr-srv6)#`
		Enables segment routing over SRv6.

Step 4	**locators**
	Example:
	`switch(config-sr-srv6)#locators`
	`switch(config-sr-srv6-locator)#`
		Enters the locators configuration mode.

Step 5	**locator** *name*
	Example:
	`switch(config-sr-srv6-locator)#locator loc1`
	`switch(config-sr-srv6-locator)#`
		Configures the global locator that can be used for all IPv4 and IPv6 VRFs and enters the locator configuration mode.

Step 6	**encapsulation**
	Example:
	`switch(config-sr-srv6)#encapsulation`
	`switch (config-sr-srv6-encap)#`
		Enters the encapsulation configuration mode.

Step 7	**source-address** *ipv6-address* **Example:** `switch(config-sr-srv6-encap)#source-address 6666::1`	Configures the source IPv6 address for SRv6 encapsulation.

Configuring IPv6 Underlay

You can configure IPv6 underlay with one of the following:

- IS-IS
- OSPFv3

- BGP

Configuring SRv6 with IS-IS Protocol

You can configure SRv6 with IS-IS protocol.

Before you begin

Ensure that the following conditions are met:

- The **feature srv6** is enabled.
- The **feature isis** is enabled.
- SRv6 is enabled under the IPv6 address-family in IS-IS.

SUMMARY STEPS

1. **configure terminal**
2. **router isis** *instance-tag*
3. **address-family** *ipv6* **unicast**
4. **segment-routing srv6**
5. **locator** *name*

DETAILED STEPS

Procedure

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

Step 2	**router isis** *instance-tag*
	Example:
	`switch(config)# router isis 1`
	`switch(config-router)#`
		Creates a new IS-IS instance with the configured instance tag.

Step 3	**address-family** *ipv6* **unicast**
	Example:
	`switch(config-router)# address-family ipv6 unicast`
	`switch(config-router-af)#`
		Enters address family configuration mode.

Step 4	**segment-routing srv6**
	Example:
	`switch(config-router-af)# segment-routing srv6`
	`switch(config-router-af-srv6)#`
		Configures SRv6 with IS-IS protocol.

	Command or Action	Purpose

Step 5	**locator** *name*
	Example:
	`switch(config-router-af-srv6)# locator loc1`
	`switch(config-router-af-srv6)#`
		Configure the locator.

Configuring SRv6 with OSPFv3 Protocol

Before you begin

- Ensure that **feature srv6** is enabled.
- Ensure that feature **ospfv3** is enabled.

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `switch# configure terminal`	Enters global configuration mode.
Step 2	**route-map LOCATOR_MAP permit 10** **Example:** `switch(config-router)# route-map LOCATOR_MAP permit 10`	

Step 3	**router ospfv3** *process_tag*
	Example:
	`switch(config)# router ospfv3`
	`switch(config-router)#`
		Enables the OSPF mode.

Step 4	**address-family ipv6 unicast**
	Example:
	`switch(config-router)# address-family ipv6 unicast`
	`switch(config-router-af)#`
		Enters address family configuration mode.

Step 5	**redistribute srv6 locator route-map LOCATOR_MAP** **Example:** `switch(config-router)# redistribute srv6 locator route-map LOCATOR_MAP`	

Configuring SRv6 with BGP

When locator is configured under BGP, it creates route of the locator prefix in its IPv6 unicast table and advertises it to its peers.

Before you begin

Ensure that **feature srv6** is enabled.

Ensure that **feature bgp** is enabled.

SUMMARY STEPS

1. **configure terminal**
2. **router bgp** *as-number*
3. **segment-routing srv6**
4. **locator** *name*
5. **exit**

DETAILED STEPS

Procedure

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

Step 2	**router bgp** *as-number*
	Example:
	`switch(config)# router bgp 200`
	`switch(config-router)#`
		Enter BGP router configuration mode.

Step 3	**segment-routing srv6**
	Example:
	`switch(config-router)# segment-routing srv6`
	`switch(config-router-srv6)#`
		Configures SRv6 with the BGP.

Step 4	**locator** *name*
	Example:
	`switch(config-router-srv6# locator loc1`
	`switch(config-router-srv6)#`
		Configures the locator.

Step 5	**exit**
	Example:
	`switch(config-router-srv6)# exit`
	`switch(config-router)#`
		Exits the SRv6 configuration mode.

Configuring Layer 3 VPN over SRv6

When a locator is configured under BGP, it creates route of the locator prefix in its IPv6 unicast table and advertises it to it's peers. This locator is used for allocating SRv6 SIDs for VRFs.

In Cisco NX-OS Release 9.3(3), the Cisco NX-OS switches support only one locator.

You can configure DT4 and DT6 SIDs separately under each address family. If the DT46 is configured under the VRF, then End.DT4 and End.DT6 configurations are not allowed under each address family.

Allocating DT46 SIDs for VRF

You can configure SRv6 with Layer 3 VPN fabric.

Before you begin

Ensure that **feature srv6** is enabled.

Ensure that **feature bgp** is enabled.

SUMMARY STEPS

1. **configure terminal**
2. **router bgp** *as-number*
3. **segment-routing srv6**
4. **locator** *name*
5. **exit**
6. **vrf** *name*
7. **segment-routing srv6**
8. **alloc mode per-vrf**

DETAILED STEPS

Procedure

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

Step 2	**router bgp** *as-number*
	Example:
	`switch(config)# router bgp 200`
	`switch(config-router)#`
		Enter BGP router configuration mode.

Step 3	**segment-routing srv6**
	Example:
	`switch(config-router)# segment-routing srv6`
	`switch(config-router-srv6)#`
		Configures SRv6 with the BGP.

Step 4	**locator** *name* **Example:**	Configures the locator.

	Command or Action	Purpose
	`switch(config-router-srv6)# locator loc1` `switch(config-router-srv6)#`	

Step 5	**exit**
	Example:
	`switch(config-router-srv6)# exit`
	`switch(config-router)#`
		Exits the SRv6 configuration mode.

Step 6	**vrf** *name*
	Example:
	`switch(config-router)# vrf vrf1`
	`switch(config-router-vrf)#`
		Configures the VRF.

Step 7	**segment-routing srv6**
	Example:
	`switch(config-router-vrf-af)# segment-routing srv6`
	`switch(config-router-vrf-af-srv6)#`
		Configures SRv6 and enters the VRF SRv6 configuration mode.

Step 8	**alloc mode per-vrf** **Example:** `switch(config-router-vrf-af-srv6)# alloc mode per-vrf`	Allocates SRv6 End DT46 per VRF.

Allocating DT4 and DT6 SIDs Per VRF

You can configure SRv6 with Layer 3 VPN fabric.

Before you begin

Ensure that **feature srv6** is enabled.

Ensure that **feature bgp** is enabled.

SUMMARY STEPS

1. **configure terminal**
2. **router bgp** *as-number*
3. **segment-routing srv6**
4. **locator** *name*
5. **exit**
6. **vrf** *name*
7. **address-family (ipv4 | ipv6} unicast**
8. **segment-routing srv6**
9. **alloc mode per-vrf**

DETAILED STEPS

Procedure

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

Step 2	**router bgp** *as-number*
	Example:
	`switch(config)# router bgp 200`
	`switch(config-router)#`
		Enter BGP router configuration mode.

Step 3	**segment-routing srv6**
	Example:
	`switch(config-router)# segment-routing srv6`
	`switch(config-router-srv6)#`
		Configures SRv6 with the BGP.

Step 4	**locator** *name*
	Example:
	`switch(config-router-srv6# locator loc1`
	`switch(config-router-srv6)#`
		Configures the locator.

Step 5	**exit**
	Example:
	`switch(config-router-srv6)# exit`
	`switch(config-router)#`
		Exits the SRv6 configuration mode.

Step 6	**vrf** *name*
	Example:
	`switch(config-router)# vrf vrf1`
	`switch(config-router-vrf)#`
		Configures the VRF.

Step 7	**address-family (ipv4 | ipv6} unicast**
	Example:
	`switch(config-router-vrf)# address-family (ipv4 | ipv6} unicast`
	`switch(config-router-vrf-af)#`
		Configures the IPv4 or IPv6 address family and enters the address family configuration mode.

Step 8	**segment-routing srv6**
	Example:
	`switch(config-router-vrf-af)# segment-routing srv6`
	`switch(config-router-vrf-af-srv6)#`
		Configures SRv6 and enters the VRF SRv6 configuration mode.

Step 9	**alloc mode per-vrf** **Example:**	Allocates SRv6 End DT4 or DT6 per VRF.

	Command or Action	Purpose
	`switch(config-router-vrf-af-srv6)# alloc mode per-vrf`	

Allocating SRv6 DT46 SIDs for Global VRF

You can allocate SRv6 DT46 SIDs for global VRF with Layer 3 VPN fabric.

Before you begin

Ensure that **feature srv6** is enabled.

Ensure that **feature bgp** is enabled.

SUMMARY STEPS

1. **configure terminal**
2. **router bgp** *as-number*
3. **segment-routing srv6**
4. **locator** *name*
5. **alloc mode per-vrf**

DETAILED STEPS

Procedure

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

Step 2	**router bgp** *as-number*
	Example:
	`switch(config)# router bgp 200`
	`switch(config-router)#`
		Enter BGP router configuration mode.

Step 3	**segment-routing srv6**
	Example:
	`switch(config-router)# segment-routing srv6`
	`switch(config-router-srv6)#`
		Configures SRv6 with the BGP.

Step 4	**locator** *name*
	Example:
	`switch(config-router-srv6# locator loc1`
	`switch(config-router-srv6)#`
		Configures the locator.

	Command or Action	Purpose
Step 5	**alloc mode per-vrf** **Example:** `switch(config-router-srv6)# alloc mode per-vrf`	Allocates SRv6 End DT4 or DT6 for the global VRF.

Allocating SRv6 DT4 SIDs for IPv4 AF in Global VRF

You can allocate SRv6 DT4 SIDs for IPv4 address family in the global VRF with Layer 3 VPN fabric.

Before you begin

Ensure that **feature srv6** is enabled.

Ensure that **feature bgp** is enabled.

SUMMARY STEPS

1. **configure terminal**
2. **router bgp** *as-number*
3. **address-family ipv4 unicast**
4. **segment-routing srv6**
5. **alloc mode per-vrf**

DETAILED STEPS

Procedure

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

Step 2	**router bgp** *as-number*
	Example:
	`switch(config)# router bgp 200`
	`switch(config-router)#`
		Enter BGP router configuration mode.

Step 3	**address-family ipv4 unicast**
	Example:
	`switch(config-router)# address-family ipv4 unicast`
	`switch(config-router-af)#`
		Configures the IPv4 address family and enters the address family configuration mode.

Step 4	**segment-routing srv6**
	Example:
	`switch(config-router-af)# segment-routing srv6`
	`switch(config-router-af-srv6)#`
		Configures SRv6 with the BGP.

	Command or Action	Purpose
Step 5	**alloc mode per-vrf** **Example:** `switch(config-router-af-srv6)# alloc mode per-vrf`	Allocates SRv6 End DT4 for address family in global VRF.

Allocating SRv6 DT6 SIDs for IPv6 AF in Global VRF

You can allocate SRv6 DT6 SIDs for IPv6 address family in the global VRF with Layer 3 VPN fabric.

Before you begin

Ensure that **feature srv6** is enabled.

Ensure that **feature bgp** is enabled.

SUMMARY STEPS

1. **configure terminal**
2. **router bgp** *as-number*
3. **address-family ipv6 unicast**
4. **segment-routing srv6**
5. **alloc mode per-vrf**

DETAILED STEPS

Procedure

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

Step 2	**router bgp** *as-number*
	Example:
	`switch(config)# router bgp 200`
	`switch(config-router)#`
		Enter BGP router configuration mode.

Step 3	**address-family ipv6 unicast**
	Example:
	`switch(config-router)# address-family ipv6 unicast`
	`switch(config-router-af)#`
		Configures the IPv6 address family and enters the address family configuration mode.

Step 4	**segment-routing srv6**
	Example:
	`switch(config-router-af)# segment-routing srv6`
	`switch(config-router-af-srv6)#`
		Configures SRv6 with the BGP.

	Command or Action	Purpose
Step 5	**alloc mode per-vrf** **Example:** `switch(config-router-af-srv6)# alloc mode per-vrf`	Allocates SRv6 End DT6 for address family in global VRF.

Verifying the SRv6 Configuration

To display BGP specific SRv6 configuration, perform one of the following tasks:

Command	Purpose
Show bgp segment-routing srv6	Displays the BGP SRv6 locator and SID for all VRFs.
Show bgp process *name*	Displays the BGP SRv6 SID for that VRF and the configured locator.

Configuration Example for SRv6

This example shows the SRv6 configuration:

```
feature bgp
feature isis
feature srv6
segment-routing
  srv6
    locators
      locator first
        prefix 6abc:0:1::/64
    encapsulation
       source-address 6666::1

route-map EVERYTHING permit 10

vrf context vrf1
  rd auto
  address-family ipv4 unicast
    route-target import 6603:1
    route-target export 6603:1
  address-family ipv6 unicast
    route-target import 6603:1
    route-target export 6603:1

interface Ethernet1/7/1
  no shutdown

interface Ethernet1/7/1.1
  encapsulation dot1q 101
  vrf member vrf1
  ip address 31.0.1.2/24
  ipv6 address 31::1:2/124
  no shutdown

interface Ethernet1/9
  ipv6 address use-link-local-only
```

```
  ipv6 router isis SR-ISIS-6
  no shutdown

interface loopback0
  ip address 6.6.6.1/32
  ipv6 address 6666::1/128
  ipv6 router isis SR-ISIS-6

router isis SR-ISIS-6
  net 66.0000.0000.0000.6001.00
  metric-style transition
  log-adjacency-changes
  address-family ipv6 unicast
    segment-routing srv6
      locator first
    maximum-paths 16

router bgp 6603
  router-id 6.6.6.1
  segment-routing srv6
    locator first
    alloc mode per-vrf
  address-family ipv4 unicast
    redistribute direct route-map EVERYTHING
  address-family ipv6 unicast
    redistribute direct route-map EVERYTHING
  neighbor 6666::3
    remote-as 6603
    update-source loopback0
    address-family ipv4 unicast
    address-family ipv6 unicast
    address-family vpnv4 unicast
      send-community
      send-community extended
    address-family vpnv6 unicast
      send-community
      send-community extended
vrf vrf1
    address-family ipv4 unicast
      redistribute direct route-map EVERYTHING
      segment-routing srv6
        alloc mode per-vrf
    address-family ipv6 unicast
      redistribute direct route-map EVERYTHING
      segment-routing srv6
        alloc mode per-vrf
    neighbor 31::1:1
      remote-as 1001
      update-source Ethernet1/7/1.1
      address-family ipv6 unicast
    neighbor 31.0.1.1
      remote-as 1001
      update-source Ethernet1/7/1.1
      address-family ipv4 unicast
```