Layer 3 EVPN and Layer 3 VPN

This chapter describes tasks to configure the Layer 3 EVPN and stitching of L3 EVPN and L3VPN router. Perform the following tasks to complete the configuration:

- Configuring VRF and Route Targets for Import and Export Rules, on page 1
- Configuring BGP EVPN and Label Allocation Mode, on page 2
- Configuring BGP Layer 3 EVPN and Layer 3 VPN Stitching, on page 5
- Configuring the Features to Enable Layer3 EVPN and Layer3 VPN, on page 7
- Configuring BGP L3 VPN over Segment Routing, on page 8
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Configuring VRF and Route Targets for Import and Export Rules

Procedure

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**vrf** *vrf-name*	Defines a VPN routing and forwarding (VRF) instance and enters the VRF configuration mode.
Step 3	**rd auto**	Automatically assigns a unique route distinguisher (RD) to VRF.
Step 4	**address-family** { **ipv4** | **ipv6** } **unicast**	Specifies either the IPv4 or IPv6 address family for the VRF instance and enters address family configuration submode.
Step 5	**route-target import** *route-target-id*	Configures importing of routes to the VRF from the L3VPN BGP NLRIs that have the matching route-target value.
Step 6	**route-target export** *route-target-id*	Configures exporting of routes from the VRF to the L3VPN BGP NLRIs and assigns the

	Command or Action	Purpose
		specified route-target identifiers to the L3VPN BGP NLRIs.
Step 7	**route-target import** *route-target-id* **evpn**	Configures importing of routes from the L3 EVPN BGP NLRI that have the matching route-target value.
Step 8	**route-target export** *route-target-id* **evpn**	Configures exporting of routes from the VRF to the L3 EVPN BGP NLRIs and assigns the specified route-target identifiers to the BGP EVPN NLRIs.

Configuring BGP EVPN and Label Allocation Mode

You can use MPLS tunnel encapsulation using the **encapsulation mpls** command. You can configure the label allocation mode for the EVPN address family. The default tunnel encapsulation in EVPN for IP Route type in NX-OS is VXLAN.

Advertisement of (IP or Label) bindings from a Cisco Nexus 9000 Series switch via BGP EVPN enables a remote switch to send the routed traffic to that IP using the label for that IP to the switch that advertised the IP over MPLS.

The IP prefix route (Type-5) is:

- Type-5 route with MPLS encapsulation

```
RT-5 Route – IP Prefix

RD:  L3 RD
IP Length:  prefix length
IP address:  IP (4 bytes)
Label1:  BGP MPLS Label
Route Target
RT for IP-VRF
```

The default label allocation mode is per-VRF for Layer 3 EVPN over MPLS.

Complete the following steps to configure BGP EVPN and label allocation mode:

Before you begin

You must install and enable the MPLS feature set using the **install feature-set mpls** and **feature-set mpls** commands.

You must enable the MPLS segment routing feature.

Procedure

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.

	Command or Action	Purpose

Step 2	[**no**] **router bgp** *autonomous-system-number*
	Example:
	`switch(config)# router bgp 64496`
	`switch(config-router)#`
		Enables BGP and assigns the AS number to the local BGP speaker. The AS number can be a 16-bit integer or a 32-bit integer in the form of a higher 16-bit decimal number and a lower 16-bit decimal number in xx.xx format.
		Use the **no** option with this command to remove the BGP process and the associated configuration.

Step 3	Required: **address-family l2vpn evpn**
	Example:
	`switch(config-router)# address-family l2vpn evpn`
	`switch(config-router-af)#`
		Enters global address family configuration mode for the Layer 2 VPN EVPN.

Step 4	Required: **exit**
	Example:
	`switch(config-router-af)# exit`
	`switch(config-router)#`
		Exits global address family configuration mode.

Step 5	**neighbor** *ipv4-address* **remote-as** *autonomous-system-number*
	Example:
	`switch(config-router)# neighbor 10.1.1.1 remote-as 64497`
	`switch(config-router-neighbor)#`
		Configures the IPv4 address and AS number for a remote BGP peer.

Step 6	**address-family l2vpn evpn**
	Example:
	`switch(config-router-neighbor)# address-family l2vpn evpn`
	`switch(config-router-neighbor-af)#`
		Advertises the labeled Layer 2 VPN EVPN.

Step 7	**encapsulation mpls**
	Example:
	`router bgp 100`
	`  address-family l2vpn evpn`
	`neighbor NVE2 remote-as 100`
	`    address-family l2vpn evpn`
	`      send-community extended`
	`      encapsulation mpls`
	`  vrf foo`
	`    address-family ipv4 unicast`
	`      advertise l2vpn evpn`
	BGP segment routing configuration:
	`router bgp 100`
	`address-family ipv4 unicast`
		Enables BGP EVPN address family and sends EVPN type-5 route update to the neighbors.
		Note The default tunnel encapsulation in EVPN for the IP route type in NX-OS is VXLAN. To override that, a new CLI is introduced to indicate MPLS tunnel encapsulation.

	Command or Action	Purpose
	network 200.0.0.1/32 route-map label_index_pol_100 network 192.168.5.1/32 route-map label_index_pol_101 network 101.0.0.0/24 route-map label_index_pol_103 allocate-label all neighbor 192.168.5.6 remote-as 20 address-family ipv4 labeled-unicast send-community extended	
Step 8	**vrf** <*customer_name*>	Configures the VRF.
Step 9	**address-family ipv4 unicast**	Enters global address family configuration mode for the IPv4 address family.
Step 10	**advertise l2vpn evpn**	Advertises Layer 2 VPN EVPN.
Step 11	**redistribute direct route-map DIRECT_TO_BGP**	Redistributes the directly connected routes into BGP-EVPN.
Step 12	**label-allocation-mode per-vrf**	Sets the label allocation mode to per-VRF. If you want to configure the per-prefix label mode, use the **no label-allocation-mode per-vrf** CLI command. For the EVPN address family, the default label allocation is per-vrf, compared to per-prefix mode for the other address-families where the label allocation CLI is supported. No form of CLI is displayed in the running configuration.

Example

See the following example for configuring per-prefix label allocation:

```
router bgp 65000
    [address-family l2vpn evpn]
    neighbor 10.1.1.1
        remote-as 100
        address-family l2vpn evpn
        send-community extended
    neighbor 20.1.1.1
        remote-as 65000
        address-family l2vpn evpn
        encapsulation mpls
        send-community extended
    vrf customer1
        address-family ipv4 unicast
            advertise l2vpn evpn
            redistribute direct route-map DIRECT_TO_BGP
            no label-allocation-mode per-vrf
```

Configuring BGP Layer 3 EVPN and Layer 3 VPN Stitching

In order to configure the stitching on the same router, configure the layer 3 VPN neighbor relationship and router advertisement.

Procedure

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	[**no**] **router bgp** *autonomous-system-number*
	Example:
	`switch# configure terminal`
	`switch(config)# router bgp 64496`
	`switch(config-router)#`
		Enables BGP and assigns the AS number to the local BGP speaker. The AS number can be a 16-bit integer or a 32-bit integer in the form of a higher 16-bit decimal number and a lower 16-bit decimal number in xx.xx format.
		Use the **no** option with this command to remove the BGP process and the associated configuration.

Step 3	**address-family** {**vpnv4** | **vpnv6**} **unicast**
	Example:
	`switch(config-router)# address-family vpnv4 unicast`
	`switch(config-router-af)# address-family vpnv6 unicast`
	`switch(config-router-af)#`
		Enters global address family configuration mode for the Layer 3 VPNv4 or VPNv6.

Step 4	**exit**
	Example:
	`switch(config-router-af)# exit`
	`switch(config-router)#`
		Exits global address family configuration mode.

Step 5	**neighbor** *ipv4-address* **remote-as** *autonomous-system-number* **Example:** `switch(config-router)# neighbor 20.1.1.1 remote-as 64498`	Configures the IPv4 address and AS number for a remote BGP L3VPN peer.

Step 6	**address-family** {**vpnv4** | **vpnv6**} **unicast**
	Example:
	`switch(config-router)# address-family vpnv4 unicast`
	`switch(config-router-af)# address-family vpnv6 unicast`
	`switch(config-router-af)#`
		Configure the neighbor address-family for VPNv4 or VPNv6.

	Command or Action	Purpose
Step 7	**send-community extended**	Enables BGP VPN address family
Step 8	**import l2vpn evpn reoriginate**	Configures import of routing information from the Layer 3 VPN BGP NLRIs that has route target identifier matching the normal route target identifier and exports this routing information after re-origination that assigns it with stitching route target identifier, to the BGP EVPN neighbor.

Step 9	**neighbor** *ipv4-address* **remote-as** *autonomous-system-number*
	Example:
	`switch(config-router)# neighbor 10.1.1.1 remote-as 64497`
	`switch(config-router-neighbor)#`
		Configures the IPv4 address and AS number for a remote Layer 3 EVPN BGP peer.

Step 10	**address-family** {**l2vpn** | **evpn**
	Example:
	`switch(config-router-neighbor)# address-family l2vpn evpn`
	`switch(config-router-neighbor-af)#`
		Configure the neighbor address-family for Layer 3 EVPN.

Step 11	**import vpn unicast reoriginate**	Enables import of routing information from BGP EVPN NLRIs that has route target identifier matching the stitching route target identifier and exports this routing information after re-origination to the Layer 3 VPN BGP neighbor.
Step 12	**vrf** <*customer_name*>	Configures the VRF.
Step 13	**address-family ipv4 unicast**	Enters global address family configuration mode for the IPv4 address family.
Step 14	**advertise l2vpn evpn**	Advertises Layer 2 VPN EVPN.

Example

```
vrf context Customer1
    rd auto
    address-family ipv4 unicast
        route-target import 100:100
        route-target export  100:100
        route-target import 100:100 evpn
        route-target export 100:100 evpn

segment-routing
    mpls
      global-block 11000 20000
      connected-prefix-sid
         address-family ipv4 unicast
```

```
         200.0.0.1 index 101
!
int lo1
  ip address 200.0.0.1/32
!
interface e1/13
  description "MPLS interface towards Core"
  ip address 192.168.5.1/24
  mpls ip forwarding
  no shut

router bgp 100
address-family ipv4 unicast
allocate-label all
address-family ipv6 unicast
address-family l2vpn evpn
address-family vpnv4 unicast
address-family vpnv6 unicast
 neighbor 10.0.0.1 remote-as 200
    update-source loopback1
    address-family vpnv4 unicast
      send-community extended
      import l2vpn evpn reoriginate
    address-family vpnv6 unicast
      import l2vpn evpn reoriginate
      send-community extended
  neighbor 20.0.0.1 remote-as 300
    address-family l2vpn evpn
      send-community extended
      import vpn unicast reoriginate
      encapsulation mpls
  neighbor 192.168.5.6 remote-as 300
      address-family ipv4 labeled-unicast
  vrf Customer1
    address-family ipv4 unicast
      advertise l2vpn evpn
    address-family ipv6 unicast
      advertise l2vpn evpn
```

Configuring the Features to Enable Layer3 EVPN and Layer3 VPN

Before you begin

Install the VPN Fabric license.

Make sure that the **feature interface-vlan** command is enabled.

Procedure

	Command or Action	Purpose
Step 1	**feature bgp**	Enables BGP feature and configurations.
Step 2	**install feature-set mpls**	Enables MPLS configuration commands.

	Command or Action	Purpose
Step 3	**feature-set mpls**	Enables MPLS configuration commands.
Step 4	**feature mpls segment-routing**	Enables segment routing configuration commands.
Step 5	**feature mpls evpn**	Enables EVPN over MPLS configuration commands. This command is mutually exclusive with the **feature-nv** CLI command.
Step 6	**feature mpls l3vpn**	Enables EVPN over MPLS configuration commands. This command is mutually exclusive with the **feature-nv** CLI command.

Configuring BGP L3 VPN over Segment Routing

Before you begin

You must install and enable the MPLS feature set using the **install feature-set mpls** and **feature-set mpls** commands.

You must enable the MPLS segment routing feature.

You must enable the MPLS L3 VPN feature using the **feature mpls l3vpn** command.

Procedure

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	[**no**] **router bgp** *autonomous-system-number*
	Example:
	`switch(config)# router bgp 64496`
	`switch(config-router)#`
		Enables BGP and assigns the AS number to the local BGP speaker. The AS number can be a 16-bit integer or a 32-bit integer in the form of a higher 16-bit decimal number and a lower 16-bit decimal number in xx.xx format.
		Use the **no** option with this command to remove the BGP process and the associated configuration.

Step 3	**address-family** {**vpnv4** | **vpnv6**} **unicast**
	Example:
	`switch(config-router)# address-family vpnv4 unicast`
	`switch(config-router-af)# address-family vpnv6 unicast`
	`switch(config-router-af)#`
		Enters global address family configuration mode for the Layer 3 VPNv4 or VPNv6.

	Command or Action	Purpose
Step 4	[**no**] **allocate-label option-b**	Disables the inter-AS option-b

Step 5	Required: **exit**
	Example:
	`switch(config-router-af)# exit`
	`switch(config-router)#`
		Exits global address family configuration mode.

Step 6	**neighbor** *ipv4-address* **remote-as** *autonomous-system-number*
	Example:
	`switch(config-router)# neighbor 20.1.1.1 remote-as 64498`
	`switch(config-router-neighbor)#`
		Configures the IPv4 address and AS number for a remote BGP L3VPN peer.

Step 7	**address-family** {**vpnv4** | **vpnv6** } **unicast**
	Example:
	`switch(config-router-neighbor)# address-family vpnv4 unicast`
	`switch(config-router-neighbor-af)#`
		Configure the neighbor address-family for VPNv4 or VPNv6.

Step 8	**send-community extended**	Enables BGP VPN address family.
Step 9	**vrf** <*customer_name*>	Configures the VRF.
Step 10	**allocate-index x**	Configure the allocate-index.
Step 11	**address-family ipv4 unicast**	Enters global address family configuration mode for the IPv4 address family.
Step 12	**redistribute direct route-map DIRECT_TO_BGP**	Redistributes the directly connected routes into BGP-L3VPN.

BGP Layer3 VPN Over SRTE

This feature enables the traffic engineering capabilities towards the Segment Routing core for Data-Center Interconnect (DCI)/WAN Edge deployments. It enables DCI hand off (VxLAN to L3VPN based on SR and vice-versa) and can use SRTE capabilities in SR Core so that SLA's can be achieved by different traffic classes. SRTE capabilities can be applied on DCI or edge routers by applying SR-Policy for L3VPN prefixes. L3VPN prefixes can be advertised(by DCI or Edge nodes) after setting extended community color and BGP L3VPN neighbor can apply SR-policy based on that color to create SRTE. Listed below are the configurations for configuring extended community color on L3VPN prefixes.

Guidelines and Limitations for Configuring Layer 3 VPN Over SRTE

Beginning with Cisco NX-OS Release 10.1(2), segment routing traffic engineering is supported over Layer 3 VPN on Cisco Nexus 9300-FX3, N9K-C9316D-GX , N9K-C93180YC-FX, N9K-C93240YC-FX2, and N9K-C9364C platform switches.

The limitations for this feature are as follows:

- UnderLay IPv6 is not supported. SRv6 is the alternate.
- PCE using BGP underlay is not supported, due to PCE's shortcoming on BGP only fabric.
- OSPF-SRTE with PCE is not supported, due NXOS's inability to advertise LSA in BGP-LS.
- Supports total SRTE policy scale of 1000, BGP VPNv4 32K routes, BGP VPNV6 32k routes, and underlay SR prefixes of 1000.

Beginning with Cisco NX-OS Release 10.2(3)F, the option of color-only (CO) bits is added in route map. If the value of the CO bits change for a given prefix that is using an SRTE policy, BGP will delete the old policy and add a new policy.

Configuring Extended Community Color

This section includes the following topics:

Configuring Extended Community Color at the Ingress Node

To configure extended community color at the ingress node when the prefix is announced by the ingress node, where the SRTE policy is instantiated, perform the following steps:

Procedure

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	**route-map** *map-name*
	Example:
	`switch(config)# route-map ABC`
	`switch(config-route-map)`
		Creates a route map or enters route-map configuration mode for an existing route map.

Step 3	**set extcommunity color** *color-num* **Example:**	Sets BGP extcommunity attribute for color extended community.

	Command or Action	Purpose
	`switch(config-route-map)# set extcommunity color 20` `switch(config-route-map)#`	

Step 4	**exit**
	Example:
	`switch(config-route-map)# exit`
	`switch(config)#`
		Exits route-map configuration mode.

Step 5	[**no**] **router bgp** *autonomous-system-number*
	Example:
	`switch(config)# router bgp1`
	`switch(config-router)#`
		Enables BGP and assigns the AS number to the local BGP speaker. The AS number can be a 16-bit integer or a 32-bit integer in the form of a higher 16-bit decimal number and a lower 16-bit decimal number in xx.xx format.
		Use the no option with this command to remove the BGP process and the associated configuration.

Step 6	**neighbor** *ip-address*
	Example:
	`switch(config-router)# neighbor 209.165.201.1`
	`switch(config-router-neighbor)#`
		Adds an entry to the BGP or multiprotocol BGP neighbor table. The ip-address argument specifies the IP address of the neighbor in dotted decimal notation.

Step 7	**address-family vpnv4/vpnv6 unicast**
	Example:
	`switch(config-router-neighbor)# address-family vpnv4/vpnv6 unicast`
	`switch(config-router-neighbor-af)#`
		Enters router address-family configuration mode for the vpnv4/vpnv6 address family type.

Step 8	**route-map** *map-name* **in**
	Example:
	`switch(config-router-neighbor-af)# route-map ABC in`
	`switch(config-router-neighbor-af)#`
		Applies the configured BGP policy to incoming routes.
		The map-name can be any case-sensitive, alphanumeric string up to 63 characters.

Configuring Extended Community Color at the Egress Node

To configure extended community color at the egress node when the prefix is announced by the egress node, perform the following steps:

Procedure

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

	Command or Action	Purpose

Step 2	**route-map** *map-name*
	Example:
	`switch(config)# route-map ABC`
	`switch(config-route-map)`
		Creates a route map or enters route-map configuration mode for an existing route map.

Step 3	**set extcommunity color** *color-num*
	Example:
	`switch(config-route-map)# set extcommunity color 20`
	`switch(config-route-map)#`
		Sets BGP extcommunity attribute for color extended community.

Step 4	**exit**
	Example:
	`switch(config-route-map)# exit`
	`switch(config)#`
		Exits route-map configuration mode.

Step 5	[**no**] **router bgp** *autonomous-system-number*
	Example:
	`switch(config)# router bgp1`
	`switch(config-router)#`
		Enables BGP and assigns the AS number to the local BGP speaker. The AS number can be a 16-bit integer or a 32-bit integer in the form of a higher 16-bit decimal number and a lower 16-bit decimal number in xx.xx format.
		Use the no option with this command to remove the BGP process and the associated configuration.

Step 6	**neighbor** *ip-address*
	Example:
	`switch(config-router)# neighbor 209.165.201.1`
	`switch(config-router-neighbor)#`
		Adds an entry to the BGP or multiprotocol BGP neighbor table. The ip-address argument specifies the IP address of the neighbor in dotted decimal notation.

Step 7	**address-family vpnv4/vpnv6 unicast**
	Example:
	`switch(config-router-neighbor)# address-family vpnv4/vpnv6 unicast`
	`switch(config-router-neighbor-af)#`
		Enters router address-family configuration mode for the vpnv4/vpnv6 address family type.

Step 8	**route-map** *map-name* **out**
	Example:
	`switch(config-router-neighbor-af)# route-map ABC out`
	`switch(config-router-neighbor-af)#`
		Applies the configured BGP policy to outgoing routes.
		The map-name can be any case-sensitive, alphanumeric string up to 63 characters.

Configuring Extended Community Color for Network/Redistribute Command at the Egress Node

To configure extended community color for the network/redistribute command at the egress node when the prefix is announced by the egress node, perform the following steps:

Procedure

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	**route-map** *map-name*
	Example:
	`switch(config)# route-map ABC`
	`switch(config-route-map)`
		Creates a route map or enters route-map configuration mode for an existing route map.

Step 3	**set extcommunity color** *color-num*
	Example:
	`switch(config-route-map)# set extcommunity color 20`
	`switch(config-route-map)#`
		Sets BGP extcommunity attribute for color extended community.

Step 4	**exit**
	Example:
	`switch(config-route-map)# exit`
	`switch(config)#`
		Exits route-map configuration mode.

Step 5	[**no**] **router bgp** *autonomous-system-number*
	Example:
	`switch(config)# router bgp1;`
	`switch(config-router)#`
		Enables BGP and assigns the AS number to the local BGP speaker. The AS number can be a 16-bit integer or a 32-bit integer in the form of a higher 16-bit decimal number and a lower 16-bit decimal number in xx.xx format.
		Use the no option with this command to remove the BGP process and the associated configuration.

Step 6	**vrf** <*customer_name*>	Configures the VRF.

Step 7	**address-family ipv4 unicast**
	Example:
	`switch(config-router-vrf)# address-family ipv4 unicast`
	`switch(config-router-af)#`
		Specifies the IPv4 address family for the VRF instance and enters the address family configuration mode.

	Command or Action	Purpose
Step 8	**redistribute static route-map** *map-name* **out** **Example:** `switch(config-router-vrf-af)# redistribute static route-map ABC switch(config-router-af)#`	Redistributes static routes into BGP. The map-name can be any case-sensitive, alphanumeric string up to 63 characters.
Step 9	**network** *ip-prefix* [**route-map** *map-name*] **Example:** `switch(config-router-vrf-af)# network 1.1.1.1/32 route-map ABC switch(config-router-af-network)#`	Specifies a network as local to this autonomous system and adds it to the BGP routing table.