Configuring VLAN Mapping

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Prerequisites for VLAN Mapping

- By default, no VLAN mapping is configured.
- Ensure that you run the **Network Advantage** license. VLAN Mapping is supported only with the **Network Advantage** license level.
- To process control traffic consistently, either enable Layer 2 protocol tunneling (recommended), as follows:

```
Applicable for C9500-12Q, C9500-16X, C9500-24Q, C9500-40X models of the Cisco Catalyst
 9500 Series Switches.
!
Device(config)# interface HundredGigE1/0/1
Device(config-if)# switchport mode access
Device(config-if)# l2protocol-tunnel stp
Device(config-if)# end
Applicable for C9500-32C, C9500-32QC, C9500-48Y4C, and C9500-24Y4C models of the Cisco
 Catalyst 9500 Series Switches.
Device(config)# interface HundredGigE1/0/1
Device(config-if)# switchport mode trunk
Device(config-if)# switchport vlan mapping 20 300
Device(config-if)# l2protocol-tunnel stp
Device(config-if)# end
```

or insert a BPDU filter for spanning tree, as follows:

```
!
Device(config)# interface HundredGigE1/0/1
Device(config-if)# switchport mode trunk
Device(config-if)# switchport vlan mapping 10 20
```

```
Device(config-if)# spanning-tree bpdufilter enable
Device(config-if)# end
```

Prerequisites for One to One VLAN Mapping

- One-to-One VLAN mapping can be configured only on trunk ports and not on dynamic trunk.
- One-to-One VLAN mapping should be identical on both ports.
- S-VLAN should be created and present in the allowed VLAN list of the trunk port where One-to-One VLAN mapping is configured.

Restrictions for VLAN Mapping

- If VLAN mapping is enabled on an EtherChannel, the configuration does not apply to all member ports of the EtherChannel bundle but applies only to the EtherChannel interface.
- If VLAN mapping is enabled on an EtherChannel and a conflicting mapping translation is enabled on a member port, the configuration is rejected on the member port. This is applicable to Cisco Catalyst 9500 Series Switches and Cisco Catalyst 9500 Series Switches - High Performance and the Cisco Catalyst 9500X Series Switches.
- If a port with VLAN mapping is configured as a part of EtherChannel with a conflicting mapping translation, the port restricted from becoming a member of the port-channel. This is applicable to Cisco Catalyst 9500 Series Switches and Cisco Catalyst 9500 Series Switches - High Performance and the Cisco Catalyst 9500X Series Switches.
- The member port of an EtherChannel is suspended from the EtherChannel bundle if the mode of the port is changed to anything other than ‘trunk’ mode. This is applicable to Cisco Catalyst 9500 Series Switches and Cisco Catalyst 9500 Series Switches - High Performance and the Cisco Catalyst 9500X Series Switches.
- Default native VLANs, user-configured native VLANs, and reserved VLANs cannot be used for VLAN mapping.
- The S-VLAN used for VLAN mapping cannot be a part of any other Layer 3 configurations, EVPN, or LISP.
- PVLAN support is not available when VLAN mapping is configured.

Restrictions for One to One VLAN Mapping

- When One-to-One VLAN mapping is configured, multiple C-VLANs cannot be mapped to the same S-VLAN
- Merging of C-VLAN and S-VLAN spanning-tree topology is not supported in case of one-to-one vlan mapping.

About VLAN Mapping

Note Q-in-Q on a Trunk Port is not supported on the C9500-12Q, C9500-16X, C9500-24Q, C9500-40X models of the Cisco Catalyst 9500 Series Switches.

In a typical deployment of VLAN mapping, you want service provider to provide a transparent switching infrastructure that includes customers' switches at the remote location as a part of local site. This allows customers to use the same VLAN ID space and run Layer 2 control protocols seamlessly across the provider network. In such scenarios, we recommend that service providers do not impose their VLAN IDs on their customers.

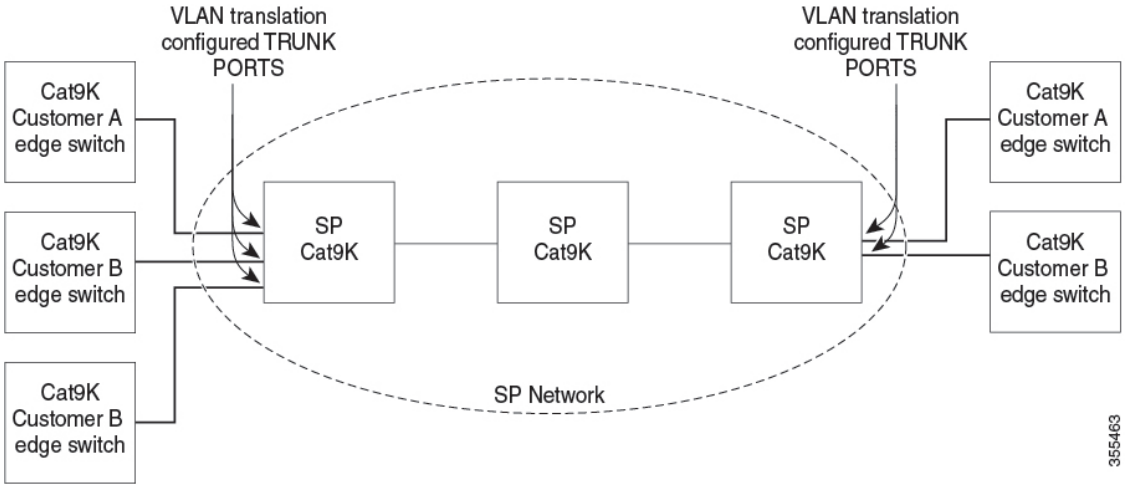
One way to establish translated VLAN IDs (S-VLANs) is to map customer VLANs to VLANs (called VLAN ID translation) on trunk ports that are connected to a customer network. Packets entering the port are mapped to service provider VLAN (S-VLAN) based on the port number and the packet's original customer VLAN-ID (C-VLAN).

Service providers' internal assignments might conflict with a customer's VLAN. To isolate customer traffic, a service provider decides to map a specific VLAN into another one while the traffic is in its cloud.

Deployment Example

In the figure, the service provider provides Layer 2 VPN service to two different customers, A and B. The service provider separates the data and control traffic between the two customers and from the providers' own control traffic. The service provider network must also be transparent to the customer edge devices.

Figure 1: Example of a Service Provider with Layer 2 VPN Service



All forwarding operations on Catalyst 9000 series switch are performed using S-VLAN and not C-VLAN information because the VLAN ID is mapped to the S-VLAN on ingress.

Note When you configure features on a port for VLAN mapping, you always use the S-VLAN rather than C-VLAN.

On an interface configured for VLAN mapping, the specified C-VLAN packets are mapped to the specified S-VLAN when they enter the port. Symmetrical mapping to the customer C-VLAN occurs when packets exit the port.

The switch supports these types of VLAN mapping on trunk ports:

- One-to-one VLAN mapping.
- Selective QinQ.
- QinQ on a trunk port.

Figure 2: Mapping Customer VLANs to Service-Provider VLANs

Figure shows a topology where a customer uses the same VLANs in multiple sites on different sides of a service-provider network. The C-VLAN IDs is mapped to service-provider VLAN IDs for packet travel across the service-provider backbone. The C-VLAN IDs are retrieved at the other side of the service-provider backbone for use in the other customer site. Configure the same set of VLAN mappings at a customer-connected port on each side of the service-provider network.

One-to-One VLAN Mapping

One-to-one VLAN mapping occurs at the ingress and egress of the port and maps the customer C-VLAN ID in the 802.1Q tag to the service-provider S-VLAN ID. Packets with VLAN IDs other than the ones with configured VLAN mapping are forwarded as normal traffic. This is applicable for C9500-12Q, C9500-16X, C9500-24Q, C9500-40X models of the Cisco Catalyst 9500 Series Switches and C9500-32C, C9500-32QC, C9500-48Y4C, and C9500-24Y4C models of the Cisco Catalyst 9500 Series Switches.

Selective Q-in-Q

Selective QinQ maps the specified customer VLANs entering the UNI to the specified S-VLAN ID. The S-VLAN ID is added to the incoming unmodified C-VLAN and the packet travels the service provider network double-tagged. At the egress, the S-VLAN ID is removed and the customer VLAN-ID is retained on the packet. By default, packets that do not match the specified customer VLANs are dropped.

Q-in-Q on a Trunk Port

QinQ on a trunk port maps all the customer VLANs entering the UNI to the specified S-VLAN ID. Similar to Selective QinQ, the packet is double-tagged and at the egress, the S-VLAN ID is removed.

Configuration Guidelines for VLAN Mapping

Note

- By default, no VLAN mapping is configured.
- Maximum number of VLAN mapping configurations that are supported on Cisco Catalyst 9500 High Performance series switches is 1000 system wide.
- Maximum number of VLAN mapping configurations that are supported on Cisco Catalyst 9500 series switches is 512 system wide.

Guidelines include the following:

- If the VLAN mapping is enabled on an EtherChannel, the configuration does not apply to all member ports of the EtherChannel bundle and applies only to the EtherChannel interface.
- If VLAN mapping is enabled on an EtherChannel and a conflicting mapping translation is enabled on a member port, the configuration is rejected on the member port.
- If a port belonging to an EtherChannel is configured with a VLAN mapping and the EtherChannel is configured with a conflicting VLAN mapping, then the port is removed from the EtherChannel (Applicable for C9500-12Q, C9500-16X, C9500-24Q, C9500-40X models of the Cisco Catalyst 9500 Series Switches)
- If a port with VLAN mapping is configured as a part of EtherChannel with a conflicting mapping translation, the port is restricted from becoming a member of the port-channel (Applicable for C9500-32C, C9500-32QC, C9500-48Y4C, and C9500-24Y4C models of the Cisco Catalyst 9500 Series Switches).
- The member port of an EtherChannel is suspended from the EtherChannel bundle if the mode of the port is changed to anything other than ‘trunk’ mode.
- To process control traffic consistently, either enable Layer 2 protocol tunneling (recommended), as follows:

```
!
Device(config)# interface HundredGigE1/0/1
Device(config-if)# switchport mode trunk
Device(config-if)#switchport vlan mapping 20 300
Device(config-if)# l2protocol-tunnel stp
Device(config-if)# end
```

or insert a BPDU filter for spanning tree, as follows:

```
!
Device(config)# interface HundredGigE1/0/1
Device(config-if)# switchport mode trunk
Device(config-if)# switchport vlan mapping 10 20
Device(config-if)# spanning-tree bpdufilter enable
Device(config-if)# end
```

- Default native VLANs, user-configured native VLANs, and reserved VLANs (range 1002-1005) cannot be used for VLAN mapping.
- The S-VLAN used for VLAN mapping cannot be a part of any other Layer 3 configurations like EVPN or LISP.
- PVLAN support is not available when VLAN mapping is configured.

Configuration Guidelines for One-to-One VLAN Mapping

- One-to-One VLAN mapping can be configured only on trunk ports and not on dynamic trunk.
- One-to-One VLAN mapping should be identical on both ports.
- S-VLAN should be created and present in the allowed VLAN list of the trunk port where One-to-One VLAN mapping is configured.
- When One-to-One VLAN mapping is configured, multiple C-VLANs cannot be mapped to the same S-VLAN.
- Merging of C-VLAN and S-VLAN spanning-tree topology is not supported in case of one-to-one VLAN mapping.

Configuration Guidelines for Selective Q-in-Q

- S-VLAN should be created and present in the allowed VLAN list of the trunk port where Selective Q-in-Q is configured.
- When Selective Q-in-Q is configured, the device supports Layer 2 protocol tunneling for CDP, STP, LLDP, and VTP. For emulated point-to-point network topologies, it also supports PAgP, LACP, and UDLD protocols.
- IP routing is not supported on Selective Q-in-Q enabled ports.
- IPSG is not supported on Selective Q-in-Q enabled ports.
- Applicable for Cisco Catalyst 9500 Series Switches - High Performance.

  The tagging of native VLAN packets and selective QinQ ports is mutually exclusive and cannot be supported together on the same port. If the native VLAN tagging global command is enabled on the switch, you should disable the tagging of native VLAN packets on selective QinQ enabled ports using the command **no switchport trunk native vlan tag** command.

Configuration Guidelines for Q-in-Q on a Trunk Port

- S-VLAN should be created and present in the allowed VLAN list of the trunk port where Q-in-Q on a trunk port is configured.
- When Q-in-Q on a trunk port is configured, the device supports Layer 2 protocol tunneling for CDP, STP, LLDP, and VTP. For emulated point-to-point network topologies, it also supports PAgP, LACP, and UDLD protocols.
- Ingress and egress SPAN, and RSPAN are supported on trunk ports with QinQ enabled.
- When QinQ is enabled, the SPAN filtering can be enabled to monitor only the traffic on the mapped VLAN, i.e. S-VLANs.
- IGMP snooping is not supported on the C-VLAN.
- Applicable for Cisco Catalyst 9500 Series Switches - High Performance.

  The tagging of native VLAN packets and QinQ on a trunk port are mutually exclusive and cannot be supported together on the same port. If the native VLAN tagging global command is enabled on the

switch, you should disable the tagging of native VLAN packets on the QinQ enabled trunk ports using the command **no switchport trunk native vlan tag** command.

How to Configure VLAN Mapping

The following sections provide information about configuring VLAN mapping:

One-to-One VLAN Mapping

Note VLAN Mapping is supported only with the **network-advantage** license level.

To configure one-to-one VLAN mapping to map a customer VLAN ID to a service-provider VLAN ID, perform this task:

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	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet1/0/1`	Enters interface configuration mode for the interface that is connected to the service-provider network. You can enter a physical interface or an EtherChannel port channel.
Step 4	**switchport mode trunk** **Example:** `Device(config-if)# switchport mode trunk`	Configures the interface as a trunk port.
Step 5	**switchport vlan mapping** *vlan-id translated-id* **Example:** `Device(config-if)# switchport vlan mapping 2 102`	Enters the VLAN IDs to be mapped: • vlan-id —the customer VLAN ID (C-VLAN) entering the switch from the customer network. The range is from 1 to 4094. • translated-id —the assigned service-provider VLAN ID (S-VLAN). The range is from 1 to 4094.

	Command or Action	Purpose
		By default, the packets with VLAN IDs other than the ones with configured VLAN mapping are forwarded as normal traffic.
Step 6	**exit** **Example:** `Device(config-if)# exit`	Returns to global configuration mode.
Step 7	**spanning-tree bpdufilter enable** **Example:** `Device(config)# spanning-tree bpdufilter enable`	Inserts a BPDU filter for spanning tree. **Note** To process control traffic consistently, either enable Layer 2 protocol tunneling (recommended) or insert a BPDU filter for spanning tree.
Step 8	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 9	**show vlan mapping** **Example:** `Device# show vlan mapping`	Verifies the configuration.
Step 10	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Example

Use **no switchport vlan mapping** command to remove the VLAN mapping information. Entering **no switchport vlan mapping all** command deletes all mapping configurations.

This example shows how to map VLAN IDs 2 to 6 in the customer network to VLANs 101 to 105 in the service-provider network (Figure 3-5). You configure the same VLAN mapping commands for a port in Switch A and Switch B; the traffic on all other VLAN IDs is forwarded as normal traffic.

```
Device> enable
Device# configure terminal
Device(config)# interface gigabiethernet0/1
Device(config-if)# switchport vlan mapping 2 101
Device(config-if)# switchport vlan mapping 3 102
Device(config-if)# switchport vlan mapping 4 103
Device(config-if)# switchport vlan mapping 5 104
Device(config-if)# switchport vlan mapping 6 105
Device(config-if)# exit
```

In the previous example, at the ingress of the service-provider network, VLAN IDs 2 to 6 in the customer network are mapped to VLANs 101 to 105, in the service provider network. At the egress

of the service provider network, VLANs 101 to 105 in the service provider network are mapped to VLAN IDs 2 to 6, in the customer network.

Note Packets with VLAN IDs other than the ones with configured VLAN Mapping are forwarded as normal traffic.

Use **show vlan mapping** command to view information about configured vlans.

```
Device> enable
Device# configure terminal
Device(config)# show vlan mapping
Total no of vlan mappings configured: 1
Interface Po5:
VLANs on wire                   Translated     VLAN Operation
------------------------------ --------------- --------------
20                               30             1-to-1
```

Selective Q-in-Q on a Trunk Port

To configure VLAN mapping for selective Q-in-Q on a trunk port, perform this task:

Note You cannot configure one-to-one mapping and selective Q-in-Q on the same interface.

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	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet1/0/1`	Enters interface configuration mode for the interface that is connected to the service-provider network. You can enter a physical interface or an EtherChannel port channel.
Step 4	**switchport mode trunk** **Example:** `Device(config-if)# switchport mode trunk`	Configures the interface as a trunk port.
Step 5	**switchport vlan mapping** *vlan-id* **dot1q-tunnel** *outer vlan-id*	Enters the VLAN IDs to be mapped:

	Command or Action	Purpose
	Example: `Device(config-if)# switchport vlan mapping 16 dot1q-tunnel 64`	• vlan-id —the customer VLAN ID (C-VLAN) entering the switch from the customer network. The range is from 1 to 4094. You can enter a string of VLAN-IDs. • outer-vlan-id —The outer VLAN ID (S-VLAN) of the service provider network. The range is from 1 to 4094. Use the no form of this command to remove the VLAN mapping configuration. Entering the **no switchport vlan mapping all** command deletes all mapping configurations.
Step 6	**switchport vlan mapping default dot1q-tunnel** *vlan-id* **Example:** `Device(config-if)# switchport vlan mapping default dot1q-tunnel 22`	Specifies that all unmapped packets on the port are forwarded with the specified S-VLAN. By default, packets that do not match the mapped VLANs, are dropped. Untagged traffic are forwarded without dropping.
Step 7	**exit** **Example:** `Device(config-if)# exit`	Returns to global configuration mode.
Step 8	**spanning-tree bpdufilter enable** **Example:** `Device(config)# spanning-tree bpdufilter enable`	Inserts a BPDU filter for spanning tree. **Note** To process control traffic consistently, either enable Layer 2 protocol tunneling (recommended) or insert a BPDU filter for spanning tree.
Step 9	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 10	**show interfaces** *interface-id* **vlan mapping** **Example:** `Device# show interfaces gigabitethernet1/0/1 vlan mapping`	Verifies the configuration.
Step 11	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Example

This example shows how to configure selective QinQ mapping on the port so that traffic with a C-VLAN ID of 2 to 5 enters the switch with an S-VLAN ID of 100. By default, the traffic of any other VLAN ID is dropped.

```
Device(config)# interface GigabitEthernet0/1
Device(config-if)# switchport vlan mapping 2-5 dot1q-tunnel 100
Device(config-if)# exit
```

This example shows how to configure selective QinQ mapping on the port so that traffic with a C-VLAN ID of 2 to 5 enters the switch with an S-VLAN ID of 100. The traffic of any other VLAN ID is forwarded with the S-VLAN ID of 200.

```
Device(config)# interface GigabiEthernet0/1
Device(config-if)# switchport vlan mapping 2-5 dot1q-tunnel 100
Device(config-if)# switchport vlan mapping default dot1q-tunnel 200
Device(config-if)# exit

Device# show vlan mapping
Total no of vlan mappings configured: 5
Interface Hu1/0/50:
VLANs on wire                    Translated VLAN     Operation
-------------------------------  ---------------     --------------
2-5                                   100            selective QinQ
*                                     200            default QinQ
```

Q-in-Q on a Trunk Port

To configure VLAN mapping for Q-in-Q on a trunk port, perform this task:

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	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet1/0/1`	Enters interface configuration mode for the interface that is connected to the service-provider network. You can enter a physical interface or an EtherChannel port channel.
Step 4	**switchport mode trunk** **Example:**	Configures the interface as a trunk port.

	Command or Action	Purpose
	`Device(config-if)# switchport mode trunk`	
Step 5	**switchport vlan mapping default dot1q-tunnel** *vlan-id* **Example:** `Device(config-if)# switchport vlan mapping default dot1q-tunnel 16`	Specifies that all unmapped C-VLAN packets on the port are forwarded with the specified S-VLAN.
Step 6	**exit** **Example:** `Device(config-if)# exit`	Returns to global configuration mode.
Step 7	**spanning-tree bpdufilter enable** **Example:** `Device(config)# spanning-tree bpdufilter enable`	Inserts a BPDU filter for spanning tree. **Note** To process control traffic consistently, either enable Layer 2 protocol tunneling (recommended) or insert a BPDU filter for spanning tree.
Step 8	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 9	**show interfaces** *interface-id* **vlan mapping** **Example:** `Device# show interfaces gigabitethernet1/0/1 vlan mapping`	Verifies the configuration.
Step 10	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Example

This example shows how to configure QinQ mapping on the port so that traffic of any VLAN ID is forwarded with the S-VLAN ID of 200.

```
Device(config)# interface gigabiethernet0/1
Device(config-if)# switchport vlan mapping default dot1q-tunnel 200
Device(config-if)# exit
```

Feature History for VLAN Mapping

This table provides release and related information for features explained in this module.

These features are available on all releases subsequent to the one they were introduced in, unless noted otherwise.

Release	Feature	Feature Information
Cisco IOS XE Fuji 16.8.1a	One-to-One VLAN mapping	One-to-One VLAN mapping allows to map customer VLANs to service-provider VLANs on trunk ports that are connected to a customer network. Support for this feature was introduced only on the C9500-32C, C9500-32QC, C9500-48Y4C, and C9500-24Y4C models of the Cisco Catalyst 9500 Series Switches.
Cisco IOS XE Gibraltar 16.11.1	One-to-One VLAN mapping	One-to-One VLAN mapping allows to map customer VLANs to service-provider VLANs on trunk ports that are connected to a customer network. Support for this feature was introduced only on the C9500-12Q, C9500-16X, C9500-24Q, C9500-40X models of the Cisco Catalyst 9500 Series Switches.
Cisco IOS XE Gibraltar 16.11.1	Selective Q-in-Q	Support for selective Q-in-Q was introduced Support for this feature was introduced only on the C9500-32C, C9500-32QC, C9500-48Y4C, and C9500-24Y4C models of the Cisco Catalyst 9500 Series Switches.
	Q-in-Q on a Trunk Port	Support for Q-in-Q on a trunk port was introduced Support for this feature was introduced only on the C9500-32C, C9500-32QC, C9500-48Y4C, and C9500-24Y4C models of the Cisco Catalyst 9500 Series Switches.
Cisco IOS XE Bengaluru 17.5.1	Selective Q-in-Q	Support for selective Q-in-Q was introduced Support for this feature was introduced on the C9500-12Q, C9500-16X, C9500-24Q, C9500-40X models of the Cisco Catalyst 9500 Series Switches.
Cisco IOS XE Cupertino 17.7.1	One-to-One VLAN mapping	

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