Configuring Private VLANs

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Prerequisites for Private VLANs

When configuring private VLANs on the device, always use the default Switch Database Management (SDM) template to balance system resources between unicast routes and Layer 2 entries. If another SDM template is configured, use the **sdm prefer default** global configuration command to set the default template.

Note Private VLANs are supported in transparent mode for VTP 1, 2 and 3. Private VLANS are also supported on server mode with VTP 3.

Restrictions for Private VLANs

Note In some cases, the configuration is accepted with no error messages, but the commands have no effect.

- Do not configure fallback bridging on the device with private VLANs.
- Do not configure a remote SPAN (RSPAN) VLAN as a primary or a secondary VLAN of a private-VLAN.
- Do not configure private VLAN ports on interfaces configured for these other features:
  - Dynamic-access port VLAN membership

- Dynamic Trunking Protocol (DTP)
- IP Source Guard
- IPv6 First Hop Security (FHS)
- IPv6 Security Group (SG)
- Multicast VLAN Registration (MVR)
- Voice VLAN
- Web Cache Communication Protocol (WCCP)

- Port Aggregation Protocol (PAgP) and Link Aggregation Control Protocol (LACP) are supported only for Private VLAN promiscuous trunk ports and Private VLAN isolated trunk ports.
- You can configure IEEE 802.1x port-based authentication on a private-VLAN port, but do not configure 802.1x with port security, voice VLAN, or per-user ACL on private-VLAN ports.
- A private-VLAN host or promiscuous port cannot be a SPAN destination port. If you configure a SPAN destination port as a private-VLAN port, the port becomes inactive.
- If you configure a static MAC address on a promiscuous port in the primary VLAN, you need not add the same static address to all associated secondary VLANs. Similarly, if you configure a static MAC address on a host port in a secondary VLAN, you need not add the same static MAC address to the associated primary VLAN. Also, when you delete a static MAC address from a private-VLAN port, you do not have to remove all instances of the configured MAC address from the private VLAN.

Note Dynamic MAC addresses learned in the secondary VLAN of a private VLAN are replicated to the primary VLANs. All MAC entries are learnt on secondary VLANs, even if the traffic ingresses from primary VLAN. If a MAC address is dynamically learnt in the primary VLAN, it is not replicated in the associated secondary VLANs.

- Configure Layer 3 VLAN interfaces (switch value interfaces) only for primary VLANs.
- Private VLAN configured with MACsec or Virtual Private LAN Services (VPLS) or Cisco Software-Defined Access solution on the same VLAN does not work.

Information About Private VLANs

The following sections provide information about Private VLANs:

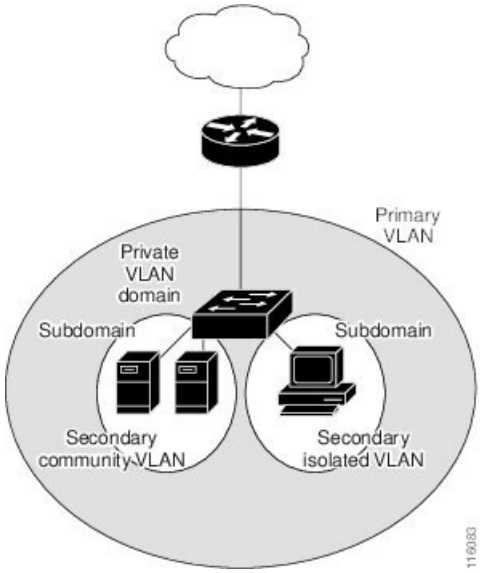
Private VLAN Domains

The private VLAN feature addresses two problems that service providers face when using VLANs:

- To enable IP routing, each VLAN is assigned a subnet address space or a block of addresses, which can result in wasting the unused IP addresses, and cause IP address management problems.

Figure 1: Private VLAN Domain

Using private VLANs addresses the scalability problem and provides IP address management benefits for service providers and Layer 2 security for customers. Private VLANs partition a regular VLAN domain into subdomains. A subdomain is represented by a pair of VLANs: a *primary* VLAN and a *secondary* VLAN. A private VLAN can have multiple VLAN pairs, one pair for each subdomain. All VLAN pairs in a private VLAN share the same primary VLAN. The secondary VLAN ID differentiates one subdomain from another.



Secondary VLANs

There are two types of secondary VLANs:

- Isolated VLANs—Ports within an isolated VLAN cannot communicate with each other at the Layer 2 level.
- Community VLANs—Ports within a community VLAN can communicate with each other but cannot communicate with ports in other communities at the Layer 2 level.

Private VLANs Ports

Private VLANs provide Layer 2 isolation between ports within the same private VLAN. Private VLAN ports are access ports that are one of these types:

- Promiscuous—A promiscuous port belongs to the primary VLAN and can communicate with all interfaces, including the community and isolated host ports that belong to the secondary VLANs associated with the primary VLAN.
- Isolated—An isolated port is a host port that belongs to an isolated secondary VLAN. It has complete Layer 2 separation from other ports within the same private VLAN, except for the promiscuous ports. Private VLANs block all traffic to isolated ports except traffic from promiscuous ports. Traffic received from an isolated port is forwarded only to promiscuous ports.
- Community—A community port is a host port that belongs to a community secondary VLAN. Community ports communicate with other ports in the same community VLAN and with promiscuous ports. These

interfaces are isolated at Layer 2 from all other interfaces in other communities and from isolated ports within their private VLAN.

Note Trunk ports carry traffic from regular VLANs and also from primary, isolated, and community VLANs.

Primary and secondary VLANs have these characteristics:

- Primary VLAN—A private VLAN has only one primary VLAN. Every port in a private VLAN is a member of the primary VLAN. The primary VLAN carries unidirectional traffic downstream from the promiscuous ports to the (isolated and community) host ports and to other promiscuous ports.
- Isolated VLAN —A private VLAN has only one isolated VLAN. An isolated VLAN is a secondary VLAN that carries unidirectional traffic upstream from the hosts toward the promiscuous ports and the gateway.
- Community VLAN—A community VLAN is a secondary VLAN that carries upstream traffic from the community ports to the promiscuous port gateways and to other host ports in the same community. You can configure multiple community VLANs in a private VLAN.

A promiscuous port can serve only one primary VLAN, one isolated VLAN, and multiple community VLANs. Layer 3 gateways are typically connected to the device through a promiscuous port. With a promiscuous port, you can connect a wide range of devices as access points to a private VLAN. For example, you can use a promiscuous port to monitor or back up all the private VLAN servers from an administration workstation.

Private VLANs in Networks

In a switched environment, you can assign an individual private VLAN and associated IP subnet to each individual or common group of end stations. The end stations need to communicate only with a default gateway to communicate outside the private VLAN.

You can use private VLANs to control access to end stations in these ways:

- Configure selected interfaces connected to end stations as isolated ports to prevent any communication at Layer 2. For example, if the end stations are servers, this configuration prevents Layer 2 communication between the servers.
- Configure interfaces connected to default gateways and selected end stations (for example, backup servers) as promiscuous ports to allow all end stations access to a default gateway.

You can extend private VLANs across multiple devices by trunking the primary, isolated, and community VLANs to other devices that support private VLANs. To maintain the security of your private VLAN configuration and to avoid other use of the VLANs configured as private VLANs, configure private VLANs on all intermediate devices, including devices that have no private VLAN ports.

IP Addressing Scheme with Private VLANs

Assigning a separate VLAN to each customer creates an inefficient IP addressing scheme:

- Assigning a block of addresses to a customer VLAN can result in unused IP addresses.

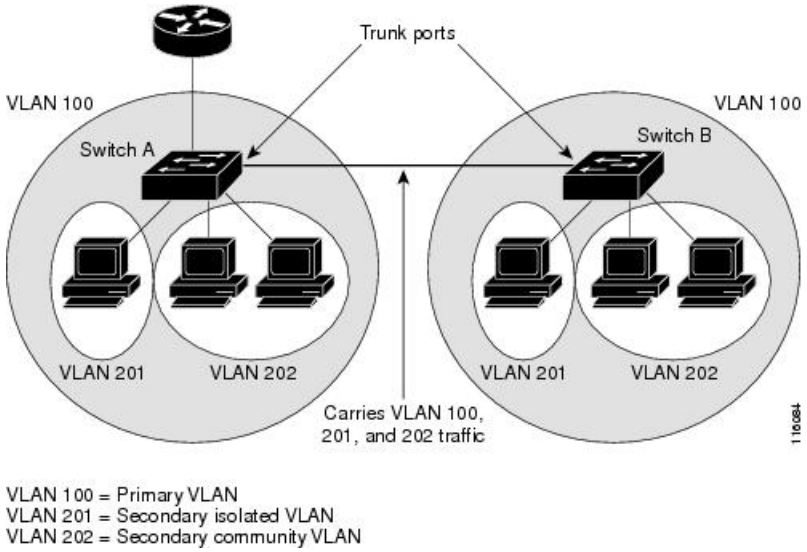
- If the number of devices in the VLAN increases, the number of assigned address might not be large enough to accommodate them.

These problems are reduced by using private VLANs, where all members in the private VLAN share a common address space, which is allocated to the primary VLAN. Hosts are connected to secondary VLANs and the DHCP server assigns them IP addresses from the block of addresses allocated to the primary VLAN. Subsequent IP addresses can be assigned to customer devices in different secondary VLANs, but in the same primary VLAN. When new devices are added, the DHCP server assigns them the next available address from a large pool of subnet addresses.

Private VLANs Across Multiple Devices

Figure 2: Private VLANs Across Switches

As with regular VLANs, private VLANs can span multiple switches. A trunk port carries the primary VLAN and secondary VLANs to a neighboring switch. The trunk port treats the private VLAN as any other VLAN. A feature of private VLANs across multiple switches is that traffic from an isolated port in the Switch A does not reach an isolated port on Switch B.



Private VLANs are supported in transparent mode for VTP 1, 2 and 3. Private VLAN is also supported on server mode for VTP 3. If you have a server client setup using VTP 3, private VLANs configured on the server should be reflected on the client.

Private-VLAN Interaction with Other Features

The following sections provide information about Private-VLAN interaction with other features:

Private VLANs and Unicast, Broadcast, and Multicast Traffic

In regular VLANs, devices in the same VLAN can communicate with each other at the Layer 2 level, but devices connected to interfaces in different VLANs must communicate at the Layer 3 level. In private VLANs, the promiscuous ports are members of the primary VLAN, while the host ports belong to secondary VLANs. Because the secondary VLAN is associated with the primary VLAN, members of the these VLANs can communicate with each other at the Layer 2 level.

In a regular VLAN, broadcasts are forwarded to all ports in that VLAN. Private VLAN broadcast forwarding depends on the port sending the broadcast:

- An isolated port sends a broadcast only to the promiscuous ports or trunk ports.
- A community port sends a broadcast to all promiscuous ports, trunk ports, and ports in the same community VLAN.
- A promiscuous port sends a broadcast to all ports in the private VLAN (other promiscuous ports, trunk ports, isolated ports, and community ports).

Multicast traffic is routed or bridged across private VLAN boundaries and within a single community VLAN. Multicast traffic is not forwarded between ports in the same isolated VLAN or between ports in different secondary VLANs.

Private VLAN multicast forwarding supports the following:

- Sender can be outside the VLAN and the Receivers can be inside the VLAN domain.
- Sender can be inside the VLAN and the Receivers can be outside the VLAN domain.
- Sender and Receiver can both be in the same community VLAN.

Private VLANs and SVIs

A switch virtual interface (SVI) represents the Layer 3 interface of a VLAN. Layer 3 devices communicate with a private VLAN only through the primary VLAN and not through secondary VLANs. Configure Layer 3 VLAN interfaces (SVIs) only for primary VLANs. You cannot configure Layer 3 VLAN interfaces for secondary VLANs. SVIs for secondary VLANs are inactive while the VLAN is configured as a secondary VLAN.

- If you try to configure a VLAN with an active SVI as a secondary VLAN, the configuration is not allowed until you disable the SVI.
- If you try to create an SVI on a VLAN that is configured as a secondary VLAN and the secondary VLAN is already mapped at Layer 3, the SVI is not created, and an error is returned. If the SVI is not mapped at Layer 3, the SVI is created, but it is automatically shut down.

When the primary VLAN is associated with and mapped to the secondary VLAN, any configuration on the primary VLAN is propagated to the secondary VLAN SVIs. For example, if you assign an IP subnet to the primary VLAN SVI, this subnet is the IP subnet address of the entire private VLAN.

Private VLANs and Switch Stacks

Private VLANs can operate within the switch stack, and private-VLAN ports can reside on different member switches in the stack. However, the following changes to the stack can impact private-VLAN operation:

- If a stack contains only one private-VLAN promiscuous port and the member switch that contains that port is removed from the stack, host ports in that private VLAN lose connectivity outside the private VLAN.
- If an active switch that contains the only private-VLAN promiscuous port in the stack fails or leaves the stack and a new active switch is elected, host ports in a private VLAN that had its promiscuous port on the old active switch lose connectivity outside of the private VLAN.

- If two stacks merge, private VLANs on the winning stack are not affected, but private-VLAN configuration on the losing switch is lost when that switch reboots.

Private VLAN with Dynamic MAC Address

The MAC addresses learnt in the secondary VLAN are replicated to the primary VLAN and not vice-versa. This saves the hardware l2 cam space. The primary VLAN is always used for forwarding lookups in both directions.

Dynamic MAC addresses learned in Primary VLAN of a private VLAN are then, if required, replicated in the secondary VLANs. For example, if a MAC-address is dynamically received on the secondary VLAN, it will be learnt as part of primary VLAN. In case of isolated VLANs, a blocked entry for the same mac will be added to secondary VLAN in the mac address table. So, MAC learnt on host ports in secondary domain are installed as blocked type entries. All mac entries are learnt on secondary VLANs, even if the traffic ingresses from primary VLAN.

However, if a MAC-address is dynamically learnt in the primary VLAN it will not get replicated in the associated secondary VLANS.

Private VLAN with Static MAC Address

Users are not required to replicate the Static MAC Address CLI for private VLAN hosts as compare to legacy model.

Example:

- In the legacy model, if the user configures a static MAC address, they need to add the same static MAC address in the associated VLAN too. For example, if MAC address A is user configured on port 1/0/1 in VLAN 101, where VLAN 101 is a secondary VLAN and VLAN 100 is a primary VLAN, then the user has to configure

```
mac-address static A vlan 101 interface G1/0/1
mac-address static A vlan 100 interface G1/0/1
```

- In this device, the user does not need to replicate the mac address to the associated VLAN. For the above example, user has to configure only

```
mac-address static A vlan 101 interface G1/0/1
```

Private VLAN Interaction with VACL/QOS

Private VLANs are bidirectional in case of this device, as compared to “Unidirectional” in other platforms.

After layer-2 forward lookup, proper egress VLAN mapping happens and all the egress VLAN based feature processing happens in the egress VLAN context.

When a frame in Layer-2 is forwarded within a private VLAN, the VLAN map is applied at the ingress side and at the egress side. When a frame is routed from inside a private VLAN to an external port, the private-VLAN map is applied at the ingress side. Similarly, when the frame is routed from an external port to a Private VLAN, the private-VLAN is applied at the egress side. This is applicable to both bridged and routed traffic.

Bridging:

- For upstream traffic from secondary VLAN to primary VLAN, the MAP of the secondary VLAN is applied on the ingress side and the MAP of the primary VLAN is applied on the egress side.

- For downstream traffic from primary VLAN to secondary VLAN, the MAP of the primary VLAN is applied in the ingress direction and the MAP of the secondary VLAN is applied in the egress direction.

Routing

If we have two private VLAN domains - PV1 (sec1, prim1) and PV2 (sec2, prim2). For frames routed from PV1 to PV2:

- The MAP of sec1 and L3 ACL of prim1 is applied in the ingress port.
- The MAP of sec2 and L3 ACL of prim2 is applied in the egress port.

For packets going upstream or downstream from isolated host port to promiscuous port, the isolated VLAN's VACL is applied in the ingress direction and primary VLAN's VACL is applied in the egress direction. This allows user to configure different VACL for different secondary VLAN in a same primary VLAN domain.

Note 2-way community VLAN is now not required as the private VLANs on this device are always bi-directional.

Private VLANs and HA Support

PVLAN will work seamlessly with High Availability (HA) feature. The Private VLAN existing on the active switch before changeover should be the same after changeover (new active switch should have similar PVLAN configuration both on IOS side and FED side as that of the old active switch).

Private-VLAN Configuration Guidelines

The following sections provide information about Private-VLAN configuration guidelines:

Default Private-VLAN Configurations

No private VLANs are configured.

Secondary and Primary VLAN Configuration

Follow these guidelines when configuring private VLANs:

- Private VLANs are supported in transparent mode for VTP 1, 2 and 3. If the device is running VTP version 1 or 2, you must set VTP to transparent mode. After you configure a private VLAN, you should not change the VTP mode to client or server. VTP version 3 supports private VLANs in all modes.
- With VTP version 1 or 2, after you have configured private VLANs, use the **copy running-config startup config** privileged EXEC command to save the VTP transparent mode configuration and private-VLAN configuration in the device startup configuration file. Otherwise, if the device resets, it defaults to VTP server mode, which does not support private VLANs. VTP version 3 does support private VLANs.
- VTP version 1 and 2 do not propagate private-VLAN configuration. You must configure private VLANs on each device where you want private-VLAN ports unless the devices are running VTP version 3, as VTP3 propagate private vlans.
- You cannot configure VLAN 1 or VLANs 1002 to 1005 as primary or secondary VLANs. Extended VLANs (VLAN IDs 1006 to 4094) can belong to private VLANs.

- A primary VLAN can have one isolated VLAN and multiple community VLANs associated with it. An isolated or community VLAN can have only one primary VLAN associated with it.
- Although a private VLAN contains more than one VLAN, only one Spanning Tree Protocol (STP) instance runs for the entire private VLAN. When a secondary VLAN is associated with the primary VLAN, the STP parameters of the primary VLAN are propagated to the secondary VLAN.
- When copying a PVLAN configuration from a tftp server and applying it on a running-config, the PVLAN association will not be formed. You will need to check and ensure that the primary VLAN is associated to all the secondary VLANs.

  You can also use **configure replace flash:config_file force** instead of **copy flash:config_file running-config**.
- You can enable DHCP snooping on private VLANs. When you enable DHCP snooping on the primary VLAN, it is propagated to the secondary VLANs. If you configure DHCP on a secondary VLAN, the configuration does not take effect if the primary VLAN is already configured.
- When you enable IP source guard on private-VLAN ports, you must enable DHCP snooping on the primary VLAN.
- We recommend that you prune the private VLANs from the trunks on devices that carry no traffic in the private VLANs.
- You can apply different quality of service (QoS) configurations to primary, isolated, and community VLANs.
- Note the following considerations for sticky ARP:
  - Sticky ARP entries are those learned on SVIs and Layer 3 interfaces. These entries do not age out.
  - The **ip sticky-arp** global configuration command is supported only on SVIs belonging to private VLANs.
  - The **ip sticky-arp** interface configuration command is only supported on:
    - Layer 3 interfaces
    - SVIs belonging to normal VLANs
    - SVIs belonging to private VLANs

  For more information about using the **ip sticky-arp** *global* configuration and the **ip sticky-arp interface** configuration commands, see the command reference for this release.
- You can configure VLAN maps on primary and secondary VLANs. However, we recommend that you configure the same VLAN maps on private-VLAN primary and secondary VLANs.
- PVLANs are bidirectional. They can be applied at both the ingress and egress sides.

  When a frame inLayer-2 is forwarded within a private VLAN, the VLAN map is applied at the ingress side and at the egress side. When a frame is routed from inside a private VLAN to an external port, the private-VLAN map is applied at the ingress side. Similarly, when the frame is routed from an external port to a Private VLAN, the private-VLAN is applied at the egress side.

  Bridging
  - For upstream traffic from secondary VLAN to primary VLAN, the MAP of the secondary VLAN is applied on the ingress side and the MAP of the primary VLAN is applied on the egress side.

- For downstream traffic from primary VLAN to secondary VLAN, the MAP of the primary VLAN is applied in the ingress direction and the MAP of the secondary VLAN is applied in the egress direction.

Routing

If we have two private VLAN domains - PV1 (sec1, prim1) and PV2 (sec2, prim2). For frames routed from PV1 to PV2:

- The MAP of sec1 and L3 ACL of prim1 is applied in the ingress port .
- The MAP of sec1 and L3 ACL of prim2 is applied in the egress port.
- For packets going upstream or downstream from isolated host port to promiscuous port, the isolated VLAN's VACL is applied in the ingress direction and primary VLAN'S VACL is applied in the egress direction. This allows user to configure different VACL for different secondary VLAN in a same primary VLAN domain.

To filter out specific IP traffic for a private VLAN, you should apply the VLAN map to both the primary and secondary VLANs.

- You can apply router ACLs only on the primary-VLAN SVIs. The ACL is applied to both primary and secondary VLAN Layer 3 traffic.
- Although private VLANs provide host isolation at Layer 2, hosts can communicate with each other at Layer 3.
- Private VLANs support these Switched Port Analyzer (SPAN) features:
  - You can configure a private-VLAN port as a SPAN source port.
  - You can use VLAN-based SPAN (VSPAN) on primary, isolated, and community VLANs or use SPAN on only one VLAN to separately monitor egress or ingress traffic.

Private VLAN Port Configuration

Follow these guidelines when configuring private VLAN ports:

- Use only the private VLAN configuration commands to assign ports to primary, isolated, or community VLANs. Layer 2 access ports assigned to the VLANs that you configure as primary, isolated, or community VLANs are inactive while the VLAN is part of the private VLAN configuration. Layer 2 trunk interfaces remain in the STP forwarding state.
- Do not configure ports that belong to a PAgP or LACP EtherChannel as private VLAN ports. While a port is part of the private VLAN configuration, any EtherChannel configuration for it is inactive.
- Enable Port Fast and BPDU guard on isolated and community host ports to prevent STP loops due to misconfigurations and to speed up STP convergence. When enabled, STP applies the BPDU guard feature to all Port Fast-configured Layer 2 LAN ports. Do not enable Port Fast and BPDU guard on promiscuous ports.
- If you delete a VLAN used in the private VLAN configuration, the private VLAN ports associated with the VLAN become inactive.
- Private VLAN ports can be on different network devices if the devices are trunk-connected and the primary and secondary VLANs have not been removed from the trunk.

How to Configure Private VLANs

The following sections provide information about configuring Private VLANs:

Configuring Private VLANs

To configure a private VLAN, perform these steps:

Note Private vlans are supported in transparent mode for VTP 1, 2 and 3. Private VLANS are also supported on server mode with VTP 3.

Procedure

Step 1 Set VTP mode to **transparent**

Note
Note: For VTP3, you can set mode to either server or transparent mode.

Step 2 Create the primary and secondary VLANs and associate them.

See Configuring and Associating VLANs in a Private VLAN

Note
If the VLAN is not created already, the private-VLAN configuration process creates it.

Step 3 Configure interfaces to be isolated or community host ports, and assign VLAN membership to the host port.

See Configuring a Layer 2 Interface as a Private VLAN Host Port

Step 4 Configure interfaces as promiscuous ports, and map the promiscuous ports to the primary-secondary VLAN pair.

See Configuring a Layer 2 Interface as a Private VLAN Promiscuous Port

Step 5 If inter-VLAN routing will be used, configure the primary SVI, and map secondary VLANs to the primary.

See Mapping Secondary VLANs to a Primary VLAN Layer 3 VLAN Interface

Step 6 Verify private-VLAN configuration.

Configuring and Associating VLANs in a Private VLAN

The **private-vlan** commands do not take effect until you exit VLAN configuration mode.

To configure and associate VLANs in a Private VLAN, perform these steps:

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	**vtp mode transparent** **Example:** `Device(config)# vtp mode transparent`	Sets VTP mode to transparent (disable VTP). **Note** For VTP3, you can set mode to either server or transparent mode
Step 4	**vlan** *vlan-id* **Example:** `Device(config)# vlan 20`	Enters VLAN configuration mode and designates or creates a VLAN that will be the primary VLAN. The VLAN ID range is 2 to 1001 and 1006 to 4094.
Step 5	**private-vlan primary** **Example:** `Device(config-vlan)# private-vlan primary`	Designates the VLAN as the primary VLAN.
Step 6	**exit** **Example:** `Device(config-vlan)# exit`	Returns to global configuration mode.
Step 7	**vlan** *vlan-id* **Example:** `Device(config)# vlan 501`	(Optional) Enters VLAN configuration mode and designates or creates a VLAN that will be an isolated VLAN. The VLAN ID range is 2 to 1001 and 1006 to 4094.
Step 8	**private-vlan isolated** **Example:**	Designates the VLAN as an isolated VLAN.

	Command or Action	Purpose
	`Device(config-vlan)# private-vlan isolated`	
Step 9	**exit** **Example:** `Device(config-vlan)# exit`	Returns to global configuration mode.
Step 10	**vlan** *vlan-id* **Example:** `Device(config)# vlan 502`	(Optional) Enters VLAN configuration mode and designates or creates a VLAN that will be a community VLAN. The VLAN ID range is 2 to 1001 and 1006 to 4094.
Step 11	**private-vlan community** **Example:** `Device(config-vlan)# private-vlan community`	Designates the VLAN as a community VLAN.
Step 12	**exit** **Example:** `Device(config-vlan)# exit`	Returns to global configuration mode.
Step 13	**vlan** *vlan-id* **Example:** `Device(config)# vlan 503`	(Optional) Enters VLAN configuration mode and designates or creates a VLAN that will be a community VLAN. The VLAN ID range is 2 to 1001 and 1006 to 4094.
Step 14	**private-vlan community** **Example:** `Device(config-vlan)# private-vlan community`	Designates the VLAN as a community VLAN.
Step 15	**exit** **Example:** `Device(config-vlan)# exit`	Returns to global configuration mode.

	Command or Action	Purpose
Step 16	**vlan** *vlan-id* **Example:** `Device(config)# vlan 20`	Enters VLAN configuration mode for the primary VLAN designated in Step 4.
Step 17	**private-vlan association** [**add** | **remove**] *secondary_vlan_list* **Example:** `Device(config-vlan)# private-vlan association 501-503`	Associates the secondary VLANs with the primary VLAN. It can be a single private-VLAN ID or a hyphenated range of private-VLAN IDs. • The *secondary_vlan_list* parameter cannot contain spaces. It can contain multiple comma-separated items. Each item can be a single private-VLAN ID or a hyphenated range of private-VLAN IDs. • The *secondary_vlan_list* parameter can contain multiple community VLAN IDs but only one isolated VLAN ID. • Enter a *secondary_vlan_list*, or use the **add** keyword with a *secondary_vlan_list* to associate secondary VLANs with a primary VLAN. • Use the **remove** keyword with a *secondary_vlan_list* to clear the association between secondary VLANs and a primary VLAN. • The command does not take effect until you exit VLAN configuration mode.
Step 18	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 19	**show vlan private-vlan** [**type**] or **show interfaces status** **Example:** `Device# show vlan private-vlan`	Verifies the configuration.
Step 20	**copy running-config startup config** **Example:**	Saves your entries in the device startup configuration file.

	Command or Action	Purpose
	`Device# copy running-config startup-config`	

Configuring a Layer 2 Interface as a Private VLAN Host Port

Follow these steps to configure a Layer 2 interface as a private-VLAN host port and to associate it with primary and secondary VLANs:

Note Isolated and community VLANs are both secondary VLANs.

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 gigabitethernet1/0/22`	Enters interface configuration mode for the Layer 2 interface to be configured.
Step 4	**switchport mode private-vlan host** **Example:** `Device(config-if)# switchport mode private-vlan host`	Configures the Layer 2 port as a private-VLAN host port.
Step 5	**switchport private-vlan host-association** *primary_vlan_id secondary_vlan_id* **Example:**	Associates the Layer 2 port with a private VLAN. **Note**

	Command or Action	Purpose
	`Device(config-if)# switchport private-vlan host-association 20 501`	This is a required step to associate the PVLAN to a Layer 2 interface.
Step 6	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 7	**show interfaces** [*interface-id*] **switchport** **Example:** `Device# show interfaces gigabitethernet1/0/22 switchport`	Verifies the configuration.
Step 8	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring a Layer 2 Interface as a Private VLAN Promiscuous Port

Follow these steps to configure a Layer 2 interface as a private VLAN promiscuous port and map it to primary and secondary VLANs:

Note Isolated and community VLANs are both secondary VLANs.

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	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet1/0/2`	Enters interface configuration mode for the Layer 2 interface to be configured.
Step 4	**switchport mode private-vlan promiscuous** **Example:** `Device(config-if)# switchport mode private-vlan promiscuous`	Configures the Layer 2 port as a private VLAN promiscuous port.
Step 5	**switchport private-vlan mapping** *primary_vlan_id* {**add** | **remove**} *secondary_vlan_list* **Example:** `Device(config-if)# switchport private-vlan mapping 20 add 501-503`	Maps the private VLAN promiscuous port to a primary VLAN and to selected secondary VLANs. • The *secondary_vlan_list* parameter cannot contain spaces. It can contain multiple comma-separated items. Each item can be a single private VLAN ID or a hyphenated range of private VLAN IDs. • Enter a *secondary_vlan_list*, or use the **add** keyword with a *secondary_vlan_list* to map the secondary VLANs to the private VLAN promiscuous port. • Use the **remove** keyword with a *secondary_vlan_list* to clear the mapping between secondary VLANs and the private VLAN promiscuous port.
Step 6	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 7	**show interfaces** [*interface-id*] **switchport** **Example:** `Device# show interfaces gigabitethernet1/0/2 switchport`	Verifies the configuration.
Step 8	**copy running-config startup config** **Example:**	Saves your entries in the device startup configuration file.

	Command or Action	Purpose
	`Device# copy running-config startup-config`	

Mapping Secondary VLANs to a Primary VLAN Layer 3 VLAN Interface

If the private VLAN will be used for inter-VLAN routing, you configure an SVI for the primary VLAN and map secondary VLANs to the SVI.

Note Isolated and community VLANs are both secondary VLANs.

Follow these steps to map secondary VLANs to the SVI of a primary VLAN to allow Layer 3 switching of private VLAN traffic:

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 vlan** *primary_vlan_id* **Example:** `Device(config)# interface vlan 20`	Enters interface configuration mode for the primary VLAN, and configures the VLAN as an SVI. The VLAN ID range is 2 to 1001 and 1006 to 4094.
Step 4	**private-vlan mapping** [**add** | **remove**] *secondary_vlan_list* **Example:** `Device(config-if)# private-vlan mapping 501-503`	Maps the secondary VLANs to the Layer 3 VLAN interface of a primary VLAN to allow Layer 3 switching of private VLAN ingress traffic. **Note** The **private-vlan mapping** interface configuration command only affects private VLAN traffic that is Layer 3 switched.

	Command or Action	Purpose
		• The *secondary_vlan_list* parameter cannot contain spaces. It can contain multiple comma-separated items. Each item can be a single private-VLAN ID or a hyphenated range of private-VLAN IDs. • Enter a *secondary_vlan_list*, or use the **add** keyword with a *secondary_vlan_list* to map the secondary VLANs to a primary VLAN. • Use the **remove** keyword with a *secondary_vlan_list* to clear the mapping between secondary VLANs and a primary VLAN.
Step 5	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 6	**show interfaces private-vlan mapping** **Example:** `Device# show interfaces private-vlan mapping`	Verifies the configuration.
Step 7	**copy running-config startup config** **Example:** `Device# copy running-config startup-config`	Saves your entries in the device startup configuration file.

Monitoring Private VLANs

The following table displays the commands used to monitor private VLANs.

Table 1: Private VLAN Monitoring Commands

Command	Purpose
show interfaces status	Displays the status of interfaces, includ
show vlan private-vlan [**type**]	
show interface switchport	Displays private VLAN configuration c

Command	Purpose
show interface private-vlan mapping	Displays information about the private VL

Configuration Examples for Private VLANs

This following sections provide configuration examples for Private VLANSs:

Example: Configuring and Associating VLANs in a Private VLAN

This example shows how to configure VLAN 20 as a primary VLAN, VLAN 501 as an isolated VLAN, and VLANs 502 and 503 as community VLANs, to associate them in a private VLAN, and to verify the configuration:

```
Device# configure terminal
Device(config)# vlan 20
Device(config-vlan)# private-vlan primary
Device(config-vlan)# exit
Device(config)# vlan 501
Device(config-vlan)# private-vlan isolated
Device(config-vlan)# exit
Device(config)# vlan 502
Device(config-vlan)# private-vlan community
Device(config-vlan)# exit
Device(config)# vlan 503
Device(config-vlan)# private-vlan community
Device(config-vlan)# exit
Device(config)# vlan 20
Device(config-vlan)# private-vlan association 501-503
Device(config-vlan)# end
Device# show vlan private-vlan
Primary   Secondary      Type
--------- -------------- -----------------
20        501            isolated
20        502            community
20        503            community
```

Example: Configuring an Interface as a Host Port

This example shows how to configure an interface as a private VLAN host port, associate it with a private VLAN pair, and verify the configuration:

```
Device# configure terminal
Device(config)# interface gigabitethernet1/0/22
Device(config-if)# switchport mode private-vlan host
Device(config-if)# switchport private-vlan host-association 20 501
Device(config-if)# end
Device# show interfaces gigabitethernet1/0/22 switchport
Name: Gi1/0/22
Switchport: Enabled
Administrative Mode: private-vlan host
Operational Mode: private-vlan host
```

```
Administrative Trunking Encapsulation: negotiate
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Administrative Native VLAN tagging: enabled
Voice VLAN: none
Administrative private-vlan host-association: 20 501
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk Native VLAN tagging: enabled
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan:
20 501

<output truncated>
```

Example: Configuring an Interface as a Private VLAN Promiscuous Port

This example shows how to configure an interface as a private VLAN promiscuous port and map it to a private VLAN. The interface is a member of primary VLAN 20 and secondary VLANs 501 to 503 are mapped to it.

```
Device# configure terminal
Device(config)# interface gigabitethernet1/0/2
Device(config-if)# switchport mode private-vlan promiscuous
Device(config-if)# switchport private-vlan mapping 20 add 501-503
Device(config-if)# end
```

Use the **show vlan private-vlan** or the **show interface status** privileged EXEC command to display primary and secondary VLANs and private-VLAN ports on the device.

Example: Mapping Secondary VLANs to a Primary VLAN Interface

This example shows how to map the interfaces fo VLANs 501 and 502 to primary VLAN 10, which permits routing of secondary VLAN ingress traffic from private VLANs 501 and 502:

```
Device# configure terminal
Device(config)# interface vlan 20
Device(config-if)# private-vlan mapping 501-503
Device(config-if)# end
Device# show interfaces private-vlan mapping
Interface Secondary VLAN Type
--------- -------------- -----------------
vlan20    501            isolated
vlan20    502            community
vlan20    503            community
```

Example: Monitoring Private VLANs

This example shows output from the **show vlan private-vlan** command:

```
Device# show vlan private-vlan
Primary Secondary Type              Ports
------- --------- ----------------- ------------------------------------------
20      501       isolated          Gi1/0/22, Gi1/0/2
20      502       community         Gi1/0/2
20      503       community         Gi1/0/2
```

Where to Go Next

You can configure the following:

- VTP
- VLANs
- VLAN trunking
- VLAN Membership Policy Server (VMPS)
- Voice VLANs

Additional References

Related Documents

Related Topic	Document Title
For complete syntax and usage information for the commands used in this chapter.	*Command Reference (Catalyst 9200 Series Switches)*

Standards and RFCs

Standard/RFC	Title
RFC 1573	Evolution of the Interfaces Group of MIB-II
RFC 1757	Remote Network Monitoring Management Information Base
RFC 2021	Remote Network Monitoring Management Information Base Version 2 using SMIv2

MIBs

MIB	MIBs Link
All the supported MIBs for this release. • BRIDGE-MIB (RFC1493) • CISCO-BRIDGE-EXT-MIB • CISCO-CDP-MIB • CISCO-PAGP-MIB • CISCO-PRIVATE-VLAN-MIB • CISCO-LAG-MIB • CISCO-L2L3-INTERFACE-CONFIG-MIB • CISCO-MAC-NOTIFICATION-MIB • CISCO-STP-EXTENSIONS-MIB • CISCO-VLAN-IFTABLE-RELATIONSHIP-MIB • CISCO-VLAN-MEMBERSHIP-MIB • CISCO-VTP-MIB • IEEE8023-LAG-MIB • IF-MIB (RFC 1573) • RMON-MIB (RFC 1757) • RMON2-MIB (RFC 2021)	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Feature History for Private VLANs

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 16.9.2	Private VLANs	The private VLAN feature addresses the problem that service providers face when using VLANs: • When running the Network Essentials or Network Advantage license, the device supports up to 4094 active VLANs. If a service provider assigns one VLAN per customer, this limits the numbers of customers the service provider can support. • To enable IP routing, each VLAN is assigned a subnet address space or a block of addresses, which can result in wasting the unused IP addresses, and cause IP address management problems.
Cisco IOS XE Cupertino 17.9.1	Private VLANs	This feature was implemented on C9200CX-12P-2X2G, C9200CX-8P-2X2G, and C9200CX-12T-2X2G models of the Cisco Catalyst 9200CX Series Switches, which were introduced in this release.

Use Cisco Feature Navigator to find information about platform and software image support. To access Cisco Feature Navigator, go to https://cfnng.cisco.com/.