# IEEE 802.1Q VLAN Workgroups

BayStack 350 switches support up to 64 VLANs with 802.1Q tagging available per port. Ports are grouped into broadcast domains by assigning them to the same VLAN. Frames received in one VLAN can only be forwarded within that VLAN, and IP Multicast frames and unknown unicast frames are flooded only to ports in the same VLAN.

Setting up virtual LANs (VLANs) is a way to segment networks to increase network capacity and performance without changing the physical network topology (Figure 1-8). With network segmentation, each switch port connects to a segment that is a single broadcast domain. When a switch port is configured to be a member of a VLAN, it is added to a group of ports (workgroup) that belong to one broadcast domain.

BayStack 350 switches allow you to assign ports to VLANs using the console, TELNET, or any generic SNMP-based network management software. You can assign different ports (and therefore the devices attached to these ports) to different broadcast domains. This feature allows network flexibility because you can reassign VLANs to accommodate network moves, additions, and changes, eliminating the need to change physical cabling.

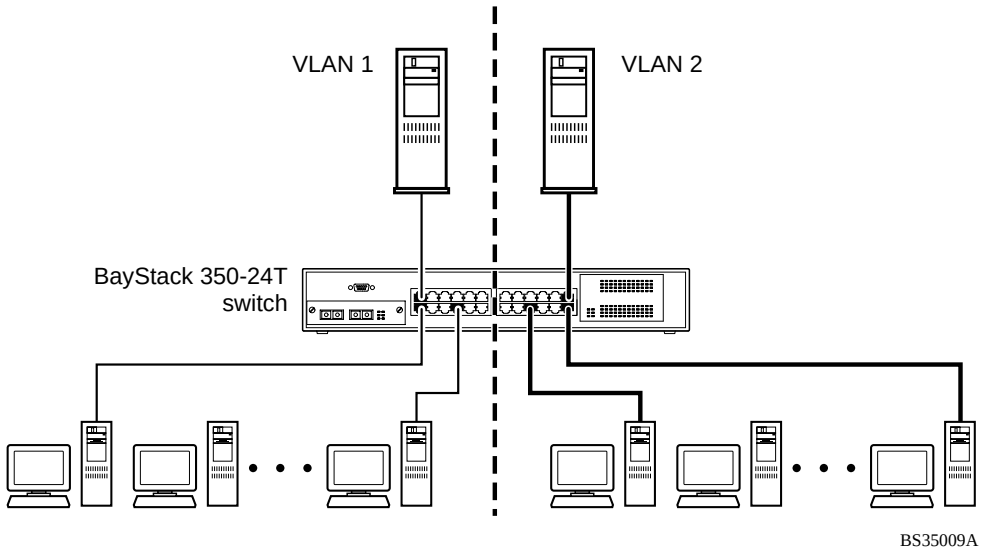


**Figure 1-8. Port-Based VLAN Example**

## IEEE 802.1Q Tagging

BayStack 350 switches operate in accordance with the IEEE 802.1Q tagging rules. Important terms used with the 802.1Q tagging feature are:

- VLAN identifier (VID) -- the 12-bit portion of the VLAN tag in the frame header that identifies an explicit VLAN.
- Port VLAN identifier (PVID) -- a classification mechanism that associates a port with a specific VLAN (see Figures 1-10 to 1-15).
- Tagged frame -- the 32-bit field (VLAN tag) in the frame header that identifies the frame as belonging to a specific VLAN. Untagged frames are marked (tagged) with this classification as they leave the switch through a port that is configured as a tagged port.
- Untagged frame -- a frame that does not carry any VLAN tagging information in the frame header.
- VLAN port members -- a set of ports that form a broadcast domain for a specific VLAN. A port can be a member of one or more VLANs.
- Untagged member -- a port that has been configured as an untagged member of a specific VLAN. When an untagged frame exits the switch through an untagged member port, the frame header remains unchanged. When a tagged frame exits the switch through an untagged member port, the tag is stripped and the tagged frame is changed to an untagged frame.
- Tagged member -- a port that has been configured as a member of a specific VLAN. When an untagged frame exits the switch through a tagged member port, the frame header is modified to include the 32-bit tag associated with the VLAN assigned to that frame. When a tagged frame exits the switch through a tagged member port, the frame header remains unchanged (original VID remains).
- User_priority -- a three-bit field in the header of a tagged frame. The field is interpreted as a binary number, therefore has a value of 0 to 7. This field allows the tagged frame to carry the user-priority across bridged LANs where the individual LAN segments may be unable to signal priority information.
- Port priority -- the priority level assigned to *untagged* frames received on a port. This value becomes the user_priority for the frame. *Tagged* packets get their user_priority from the value contained in the 802.1Q frame header.
- Unregistered packet -- a tagged frame that contains a VID where the receiving port is not a member of that VLAN.

- Filtering database identifier (FID) -- the specific filtering/forwarding database within the BayStack 350 switch that is assigned to each VLAN. The current version of software assigns *all VLANs* to the same FID. This is referred to as Shared VLAN Learning in the IEEE 802.1Q specification.

The default configuration settings for BayStack 350 switches have all ports set as untagged members of VLAN 1 with all ports configured as PVID = 1. Every VLAN is assigned a unique VLAN identifier (VID) which distinguishes it from all other VLANs. In the default configuration example shown in Figure 1-9, all incoming packets are assigned to VLAN 1 by the default port VLAN identifier (PVID =1). Untagged packets enter and leave the switch unchanged.

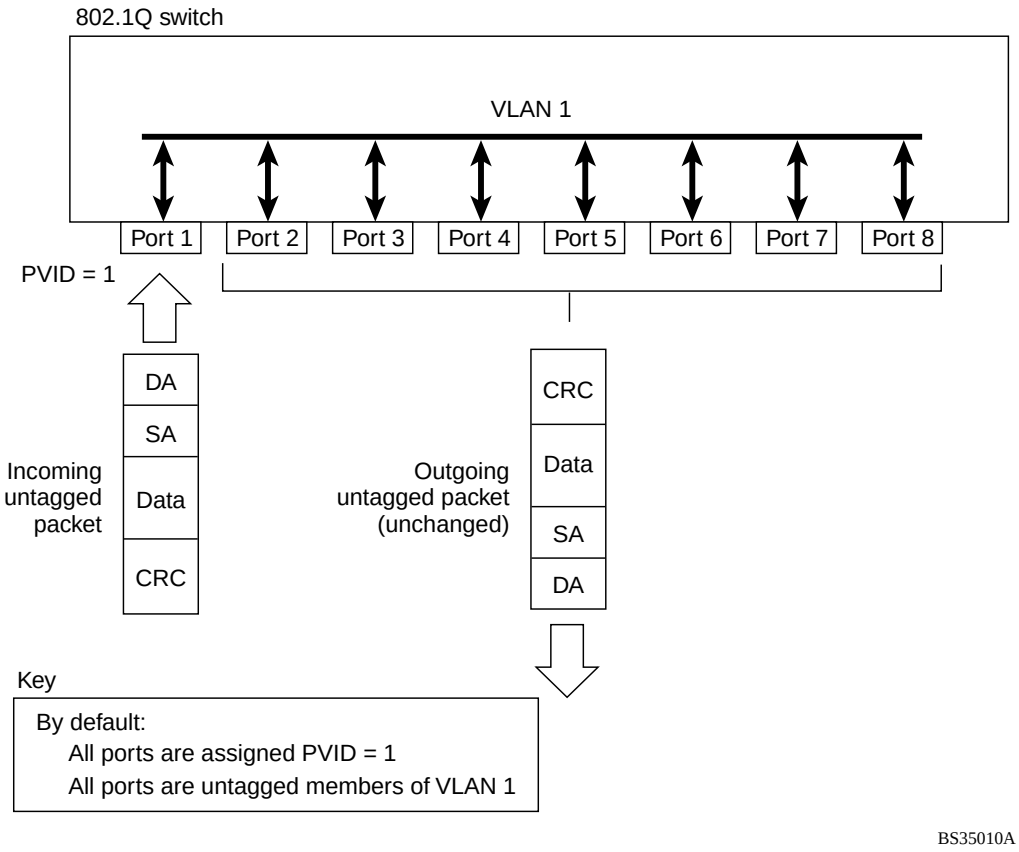


**Figure 1-9. Default VLAN Settings**

To configure VLANs, a user can reconfigure the switch ports as *tagged* or *untagged* members of specific VLANs (see Figures 1-10 to 1-15).

In Figure 1-10, untagged incoming packets are assigned directly to VLAN 2 (PVID = 2). Port 5 is configured as a *tagged* member of VLAN 2, and port 7 is configured as an *untagged* member of VLAN 2.

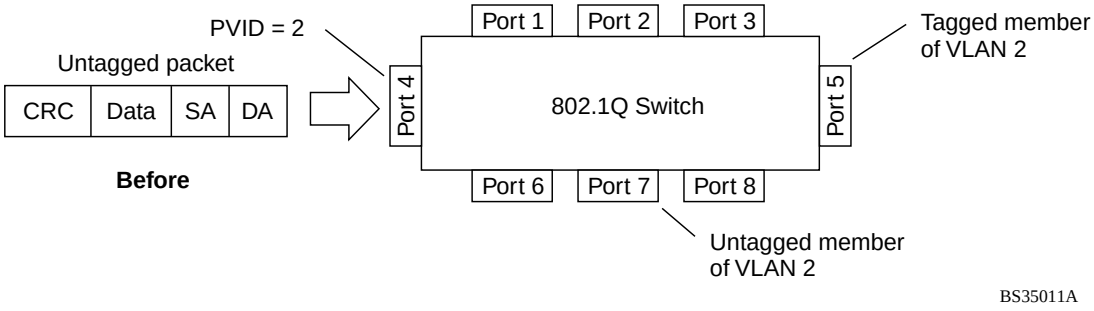


**Figure 1-10. Port-Based VLAN Assignment**

As shown in Figure 1-11, the untagged packet is marked (tagged) as it leaves the switch through port 5, which is configured as a tagged member of VLAN 2. The untagged packet remains unchanged as it leaves the switch through port 7, which is configured as an untagged member of VLAN 2.

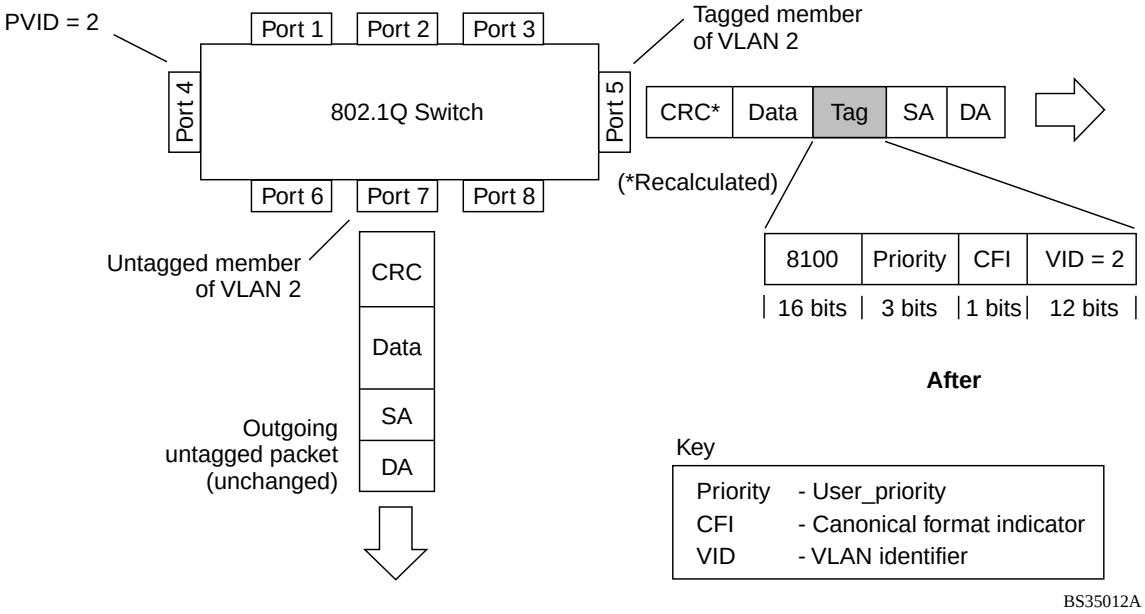


**Figure 1-11. 802.1Q Tagging (After Port-Based VLAN Assignment)**

In Figure 1-12, untagged incoming packets are assigned to VLAN 3 (IP Protocol VLAN = 3, PVID = 2). Port 5 is configured as a *tagged* member of VLAN 3, and port 7 is configured as an *untagged* member of VLAN 3.

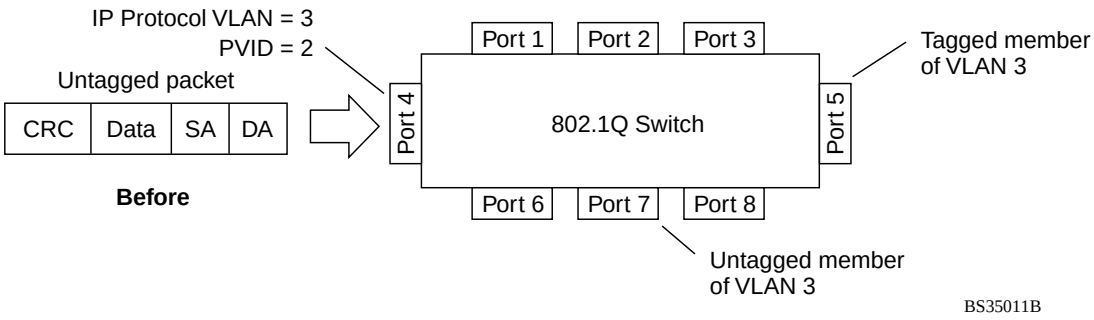


**Figure 1-12. Protocol-Based VLAN Assignment**

As shown in Figure 1-13, the untagged packet is marked (tagged) as it leaves the switch through port 5, which is configured as a tagged member of VLAN 3. The untagged packet remains unchanged as it leaves the switch through port 7, which is configured as an untagged member of VLAN 3.

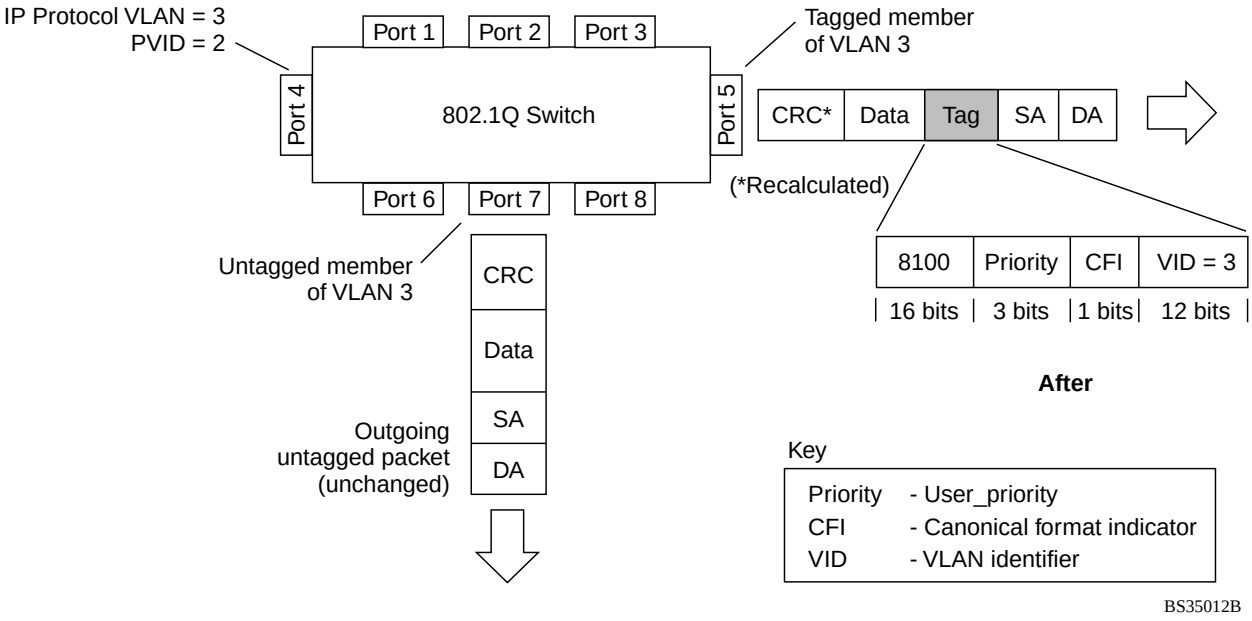


**Figure 1-13. 802.1Q Tagging (After Protocol-Based VLAN Assignment)**

In Figure 1-14, tagged incoming packets are assigned directly to VLAN 2 because of the tag assignment in the packet. Port 5 is configured as a *tagged* member of VLAN 2, and port 7 is configured as an *untagged* member of VLAN 2.

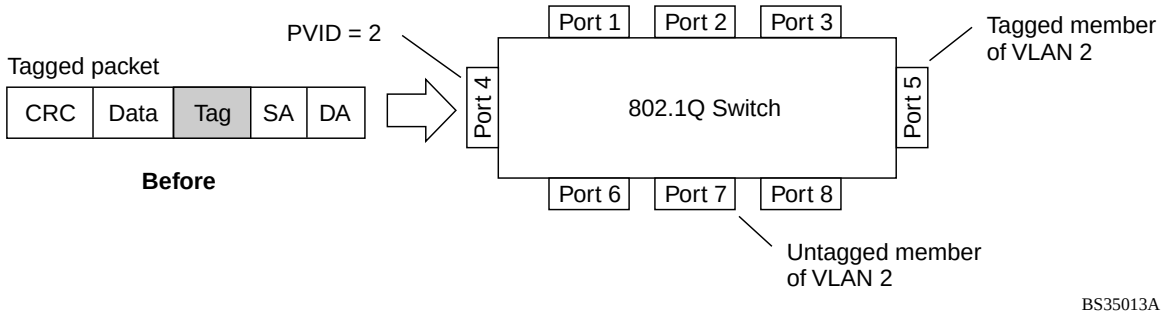


**Figure 1-14. 802.1Q Tag Assignment**

As shown in Figure 1-15, the tagged packet remains unchanged as it leaves the switch through port 5, which is configured as a tagged member of VLAN 2. However, the tagged packet is stripped (untagged) as it leaves the switch through port 7, which is configured as an untagged member of VLAN 2.

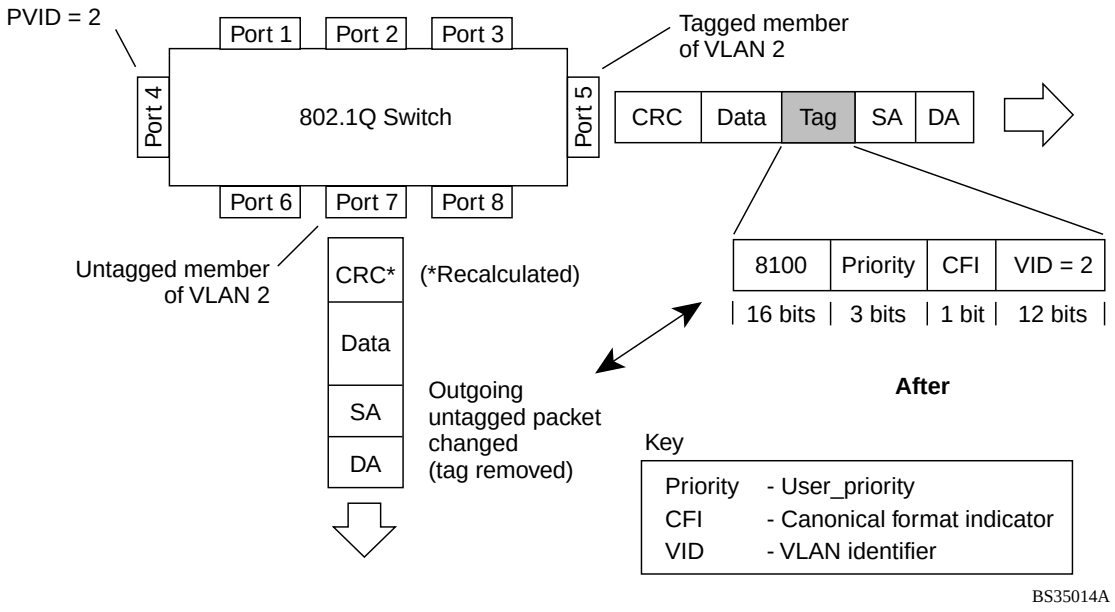


**Figure 1-15. 802.1Q Tagging (After 802.1Q Tag Assignment)**

## VLANs Spanning Multiple Switches

You can use VLANs to segment a network within a switch. When connecting multiple switches, it is possible to connect users of one VLAN with users of that same VLAN in another switch. However, the configuration guidelines depend on whether both switches support 802.1Q tagging.

With 802.1Q tagging enabled on a port for a VLAN, all frames leaving the port for that VLAN are *marked* as belonging to that specific VLAN. Users can assign specific switch ports as members of one or more VLANs that span multiple switches, without interfering with the spanning tree protocol.

### VLANs Spanning Multiple 802.1Q Tagged Switches

Figure 1-16 shows VLANs spanning two BayStack 350 switches. 802.1Q tagging is enabled on S1, port 2 and on S2, port 1 for VLAN 1 and VLAN 2. Both ports are tagged members of VLAN 1 and VLAN 2.

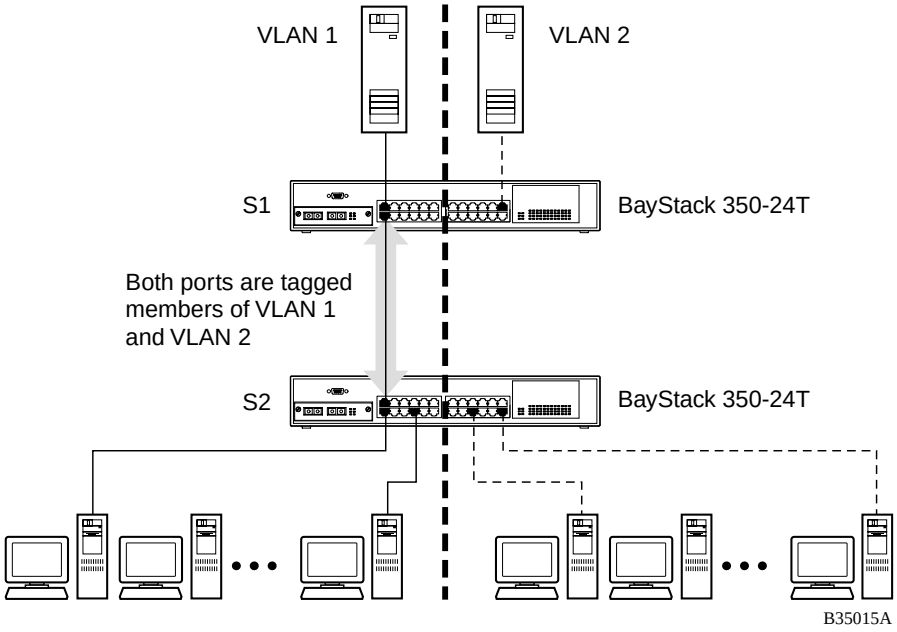


**Figure 1-16. VLANs Spanning Multiple 802.1Q Tagged Switches**

Because there is only one link between the two switches, the Spanning Tree Protocol (STP) treats this configuration as any other switch-to-switch connection. For this configuration to work properly, both switches must support the 802.1Q tagging protocol.

### VLANs Spanning Multiple Untagged Switches

Figure 1-17 shows VLANs spanning multiple untagged switches. In this configuration switch S2 does not support 802.1Q tagging and you must use a single switch port on each switch for each VLAN.

For this configuration to work properly, you must set spanning tree participation to Disabled (the STP is not supported across multiple LANs).

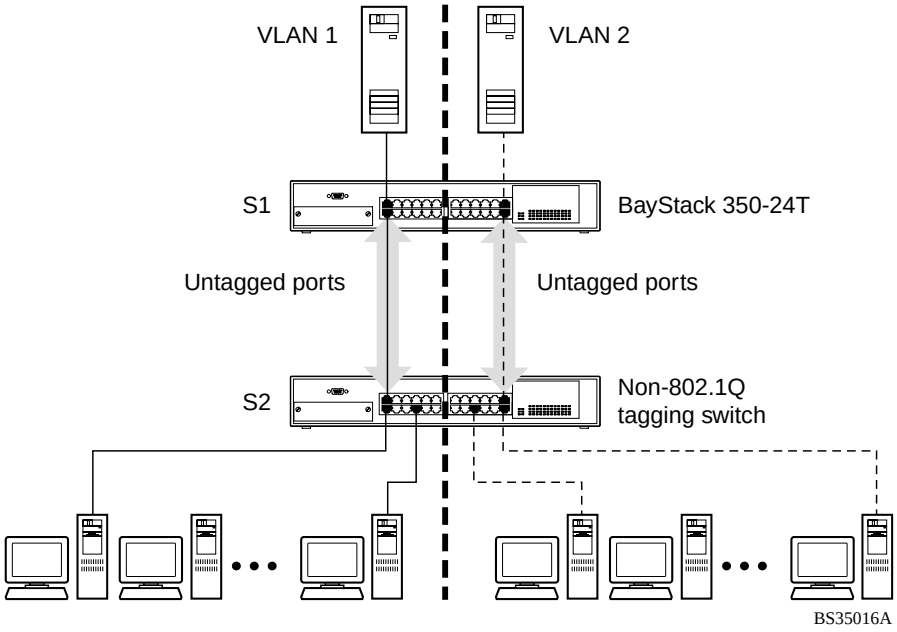


**Figure 1-17. VLANs Spanning Multiple Untagged Switches**

When the STP is enabled on these switches, only one link between each pair of switches will be forwarding traffic. Because each port belongs to only one VLAN at a time, connectivity on the other VLAN is lost. Exercise care when configuring the switches to ensure that the VLAN configuration does not conflict with spanning tree configuration.

To connect multiple VLANs across switches with redundant links, the STP must be disabled on all participating switch ports. Figure 1-18 shows possible consequences of enabling the STP when using VLANs between untagged (non-802.1Q tagged) switches.

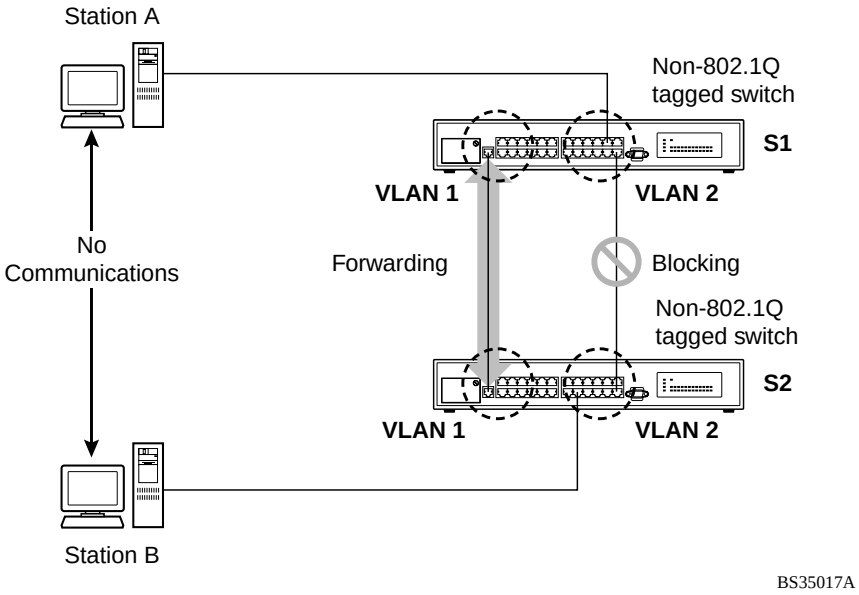


**Figure 1-18. Possible Problems with VLANs and Spanning Tree Protocol**

As shown in Figure 1-18, with STP enabled, only one connection between S1 and S2 is forwarding at any time. Communications failure occurs between VLAN 2 of S1 and VLAN 2 of S2, blocking communications between Stations A and B.

The link connecting VLAN 1 on switches S1 and S2 is selected as the forwarding link based on port speed, duplex mode, and port priority. Because the other link connecting VLAN 2 is placed into Blocking mode, stations on VLAN 2 in switch S1 cannot communicate with stations in VLAN 2 on switch S2. With multiple links only one link will be forwarding.

## Shared Servers

BayStack 350 switches allow ports to exist in multiple VLANs for shared resources, such as servers, printers, and switch-to-switch connections. It is also possible to have resources exist in multiple VLANs on one switch as shown in Figure 1-19.

In this example, clients on different broadcast domains share resources. The broadcasts from ports configured in VLAN 3 can be seen by all VLAN port members of VLAN 3.

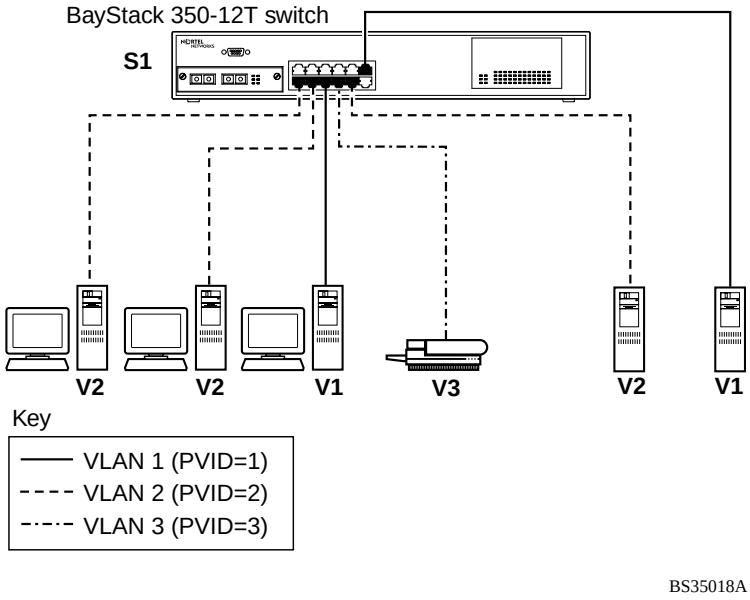


**Figure 1-19. Multiple VLANs Sharing Resources**

In the above configuration,all of the switch ports are set to participate as VLAN port members. This allows the switch to establish the appropriate broadcast domains within the switch (see Figure 1-20).

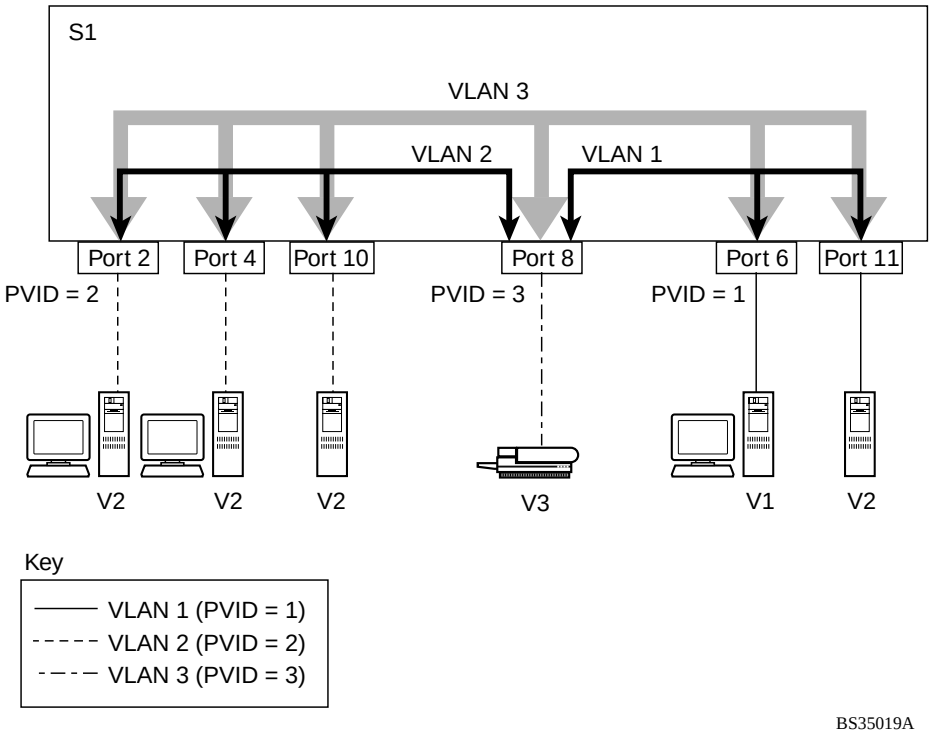


**Figure 1-20. VLAN Broadcast Domains Within the Switch**

For example, to create a broadcast domain for each VLAN shown in Figure 1-20, configure each VLAN with a port membership, and each port with the appropriate PVID/VLAN association:

- Ports 8, 6, and 11 are untagged members of VLAN 1.

  The PVID/VLAN association for ports 6 and 11 is: PVID = 1.

- Ports 2, 4, 10, and 8 are untagged members of VLAN 2.

  The PVID/VLAN association for ports 2, 4, and 10 is: PVID = 2.

- Ports 2, 4, 10, 8, 6, and 11 are untagged members of VLAN 3.

  The PVID/VLAN association for port 8 is: PVID = 3.

The following steps show how to use the VLAN configuration screens to configure the VLAN 3 broadcast domain shown in Figure 1-20.

To configure the VLAN port membership for VLAN 1:

1. **Select Switch Configuration from the BayStack 350-12T Main Menu (or press w).**
2. **From the Switch Configuration Menu, select VLAN Configuration (or press v).**
3. **From the VLAN Configuration Menu select VLAN Configuration (or press v).**

   The default VLAN Configuration screen opens (Figure 1-21):

```
                        VLAN Configuration

  Create VLAN:      [    1 ]              VLAN Type:         [   Port-Based   ]
  Delete VLAN:      [      ]              Protocol Id (PID): [      None      ]
  VLAN Name:        [ VLAN #1 ]           User-Defined PID:  [ 0x0000 ]
  Management VLAN:  [ Yes ]               VLAN State:        [     Active     ]

                Port Membership
            1-6        7-12
           ------     ------


 Unit #1   UUUUUU     UUUUUU









KEY: T = Tagged Port Member, U = Untagged Port Member, - = Not a Member of VLAN
Use space bar to display choices, press <Return> or <Enter> to select choice.
Press Ctrl-R to return to previous menu.  Press Ctrl-C to return to Main Menu.
```

**Figure 1-21. Default VLAN Configuration Screen Example**

The VLAN Configuration screen settings shown in Figure 1-21 are default settings with all switch ports classified as *untagged* members of VLAN 1.

Figure 1-22 shows the VLAN Configuration screen after it is configured to support the VLAN 3 broadcast domain shown in Figure 1-20 (VLAN Name is optional).

Ports 2, 4, 6, 8, 10, and 11 are now untagged members of VLAN 3 as shown in Figure 1-20 on page 1-30.

```
                        VLAN Configuration

  Create VLAN:      [    3 ]              VLAN Type:          [   Port-Based   ]
  Delete VLAN:      [      ]              Protocol Id (PID):  [      None      ]
  VLAN Name:        [ Mary's VLAN ]       User-Defined PID:   [ 0x0000 ]
  Management VLAN:  [ Yes ]               VLAN State:         [     Active     ]

                 Port Membership
            1-6        7-12
           ------     ------


 Unit #1   -U-U-U     -U-UU-









KEY: T = Tagged Port Member, U = Untagged Port Member, - = Not a Member of VLAN
Use space bar to display choices, press <Return> or <Enter> to select choice.
Press Ctrl-R to return to previous menu.  Press Ctrl-C to return to Main Menu.
```

**Figure 1-22. VLAN Configuration Screen Example**

To configure the PVID (port VLAN identifier) for Port 8:

1. **From the VLAN Configuration screen, press [Ctrl]-R to return to the VLAN Configuration Menu.**
2. **From the VLAN Configuration Menu, select VLAN Port Configuration (or press c).**

   The default VLAN Port Configuration screen opens (Figure 1-23).

The VLAN Port Configuration screen settings shown in Figure 1-23 are default settings.

```
                    VLAN Port Configuration


              Port:                              [  1  ]
              Filter Tagged Frames:              [ No  ]
              Filter Untagged Frames:            [ No  ]
              Filter Unregistered Frames:        [ No  ]
              Port Name:                         [  ]
              PVID:                              [  1  ]
              Port Priority:                     [  0  ]
              Tagging:                           [Untagged Access]









Use space bar to display choices, press <Return> or <Enter> to select choice.
Press Ctrl-R to return to previous menu.  Press Ctrl-C to return to Main Menu.
```

**Figure 1-23. Default VLAN Port Configuration Screen Example**

Figure 1-24 shows the VLAN Port Configuration screen after it is configured to support the PVID assignment for port 8, as shown in Figure 1-20 (Port Name is optional).

The PVID/VLAN association for VLAN 3 is now PVID = 3.

```
                        VLAN Port Configuration


                Port:                          [  8  ]
               Filter Tagged Frames:           [ No  ]
                Filter Untagged Frames:        [ No  ]
                Filter Unregistered Frames:    [ No  ]
               Port Name:                      [ Molly's port ]
               PVID:                           [   3 ]
                Port Priority:                 [ 0 ]
                Tagging:                       [ Untagged Access ]









Use space bar to display choices, press <Return> or <Enter> to select choice.
Press Ctrl-R to return to previous menu.  Press Ctrl-C to return to Main Menu.
```

**Figure 1-24. VLAN Port Configuration Screen Example**

## VLAN Workgroup Summary

This section summarizes the VLAN workgroup examples discussed in the previous sections of this chapter.

As shown in Figure 1-25, switch S1 (a BayStack 350 switch) is configured with multiple VLANs:

- Ports 1, 6, 11, and 12 are in VLAN 1.
- Ports 2, 3, 4, 7, and 10 are in VLAN 2.
- Port 8 is in VLAN 3.

Because S4 does not support 802.1Q tagging, a single switch port on each switch must be used for each VLAN (see “VLANs Spanning Multiple Untagged Switches” on page 1-27).

The connection to S2 requires only one link between the switches because S1 and S2 are both BayStack 350 switches that support 802.1Q tagging (see "VLANs Spanning Multiple 802.1Q Tagged Switches" on page 1-26).

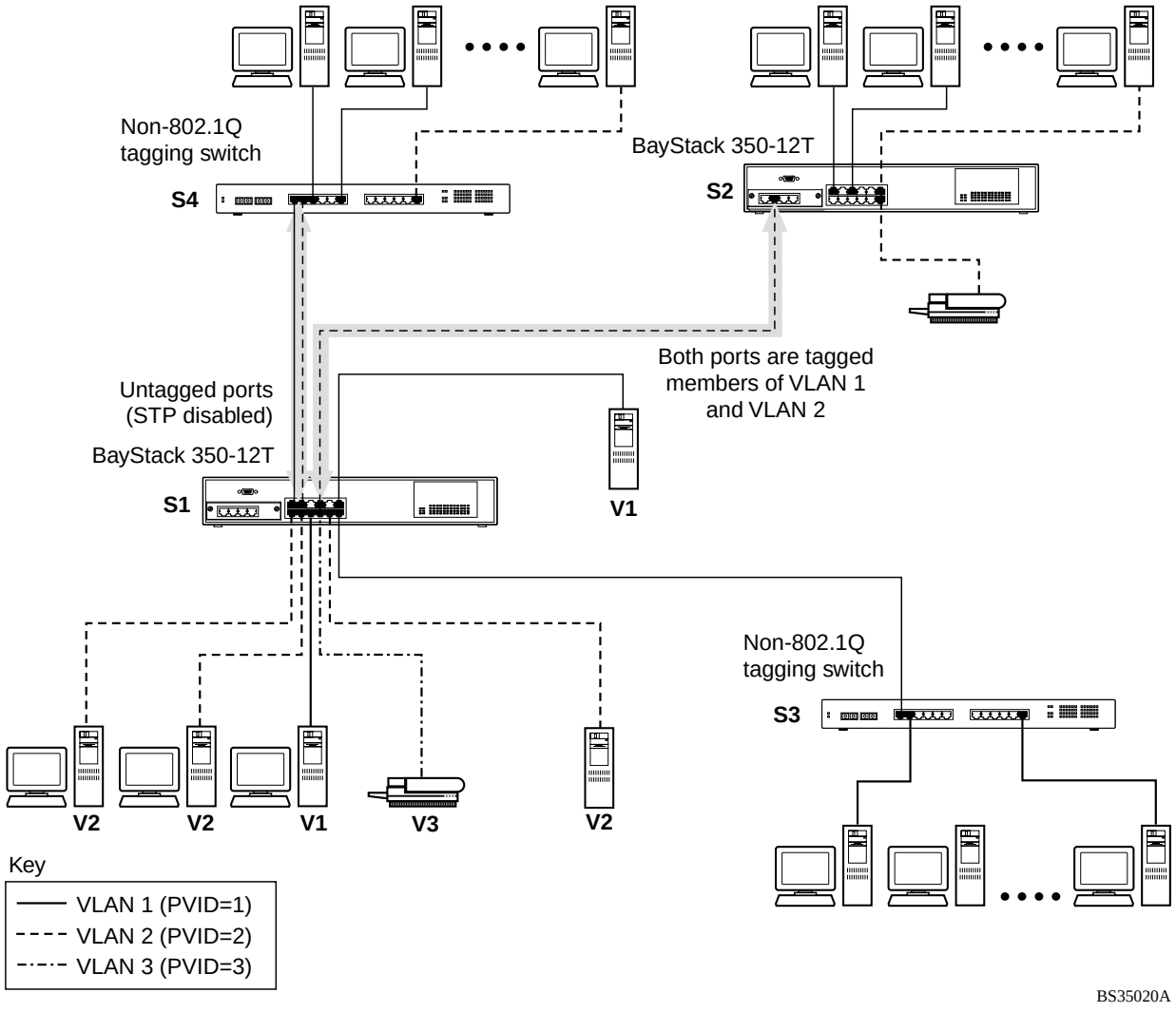


**Figure 1-25. VLAN Configuration Spanning Multiple Switches**

## VLAN Configuration Rules

VLANs operate according to specific configuration rules. When creating VLANs, consider the following rules that determine how the configured VLAN reacts in any network topology:

- All ports that are involved in port mirroring must have memberships in the same VLANs. If a port is configured for port mirroring, the port's VLAN membership cannot be changed.
- If a port is a trunk group member, all trunk members are added or deleted from the VLAN.
- All ports involved in trunking and port mirroring must have the same VLAN configuration. If a port is on a trunk with a mirroring port, the VLAN configuration cannot be changed.
- VLANs are not dependent on rate limiting settings.
- If a port is an IGMP member on any VLAN, and is removed from a VLAN, the port's IGMP membership is also removed.
- If a port is added to a different VLAN, and it is already configured as a static router port, the port is configured as an IGMP member on that specific VLAN.

For more information about configuring VLANs, see "VLAN Configuration Menu" on page 3-20.

See also Appendix D, "Quick Steps to Features" for configuration flowcharts that can help you use this feature.