VLAN Principles

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Foreword

- A Virtual Local Area Network (VLAN) represents a form of administrative network that defines a logical grouping of hosts or end system devices that are not limited to a physical location, and may be defined based on a wide range of parameters that allow for a greater flexibility in the way that logical groups are defined. The application of VLAN technology has expanded to support many aspects of enterprise networking as a means of logical data flow management and isolation.

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Objectives

- Upon completion of this section, you will be able to:
  - Explain the application of VLAN tagging.
  - Describe the different port link types and characteristics.
  - Successfully establish port based VLANs.

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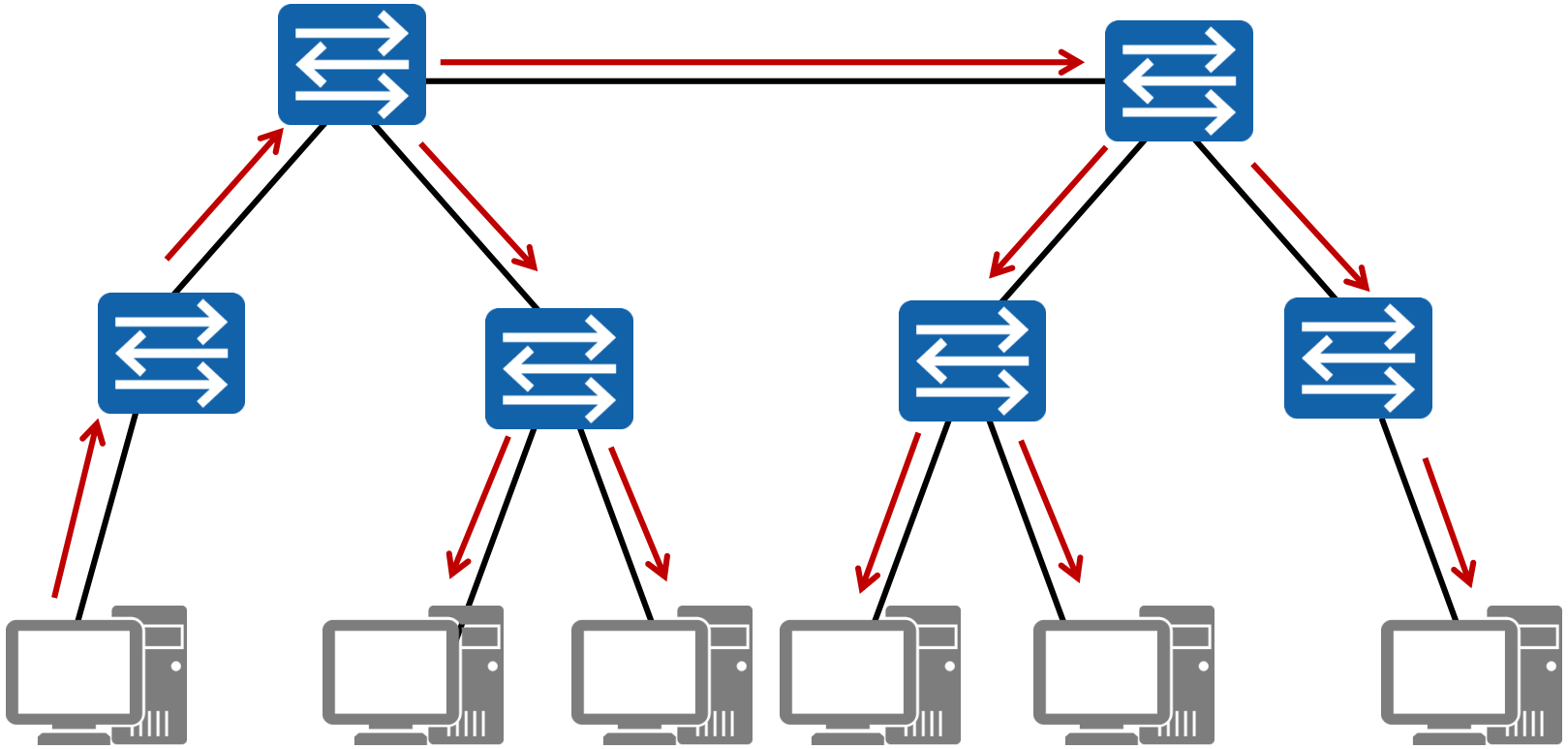
LAN Limitations



- No broadcast domain to manage expanding local networks.

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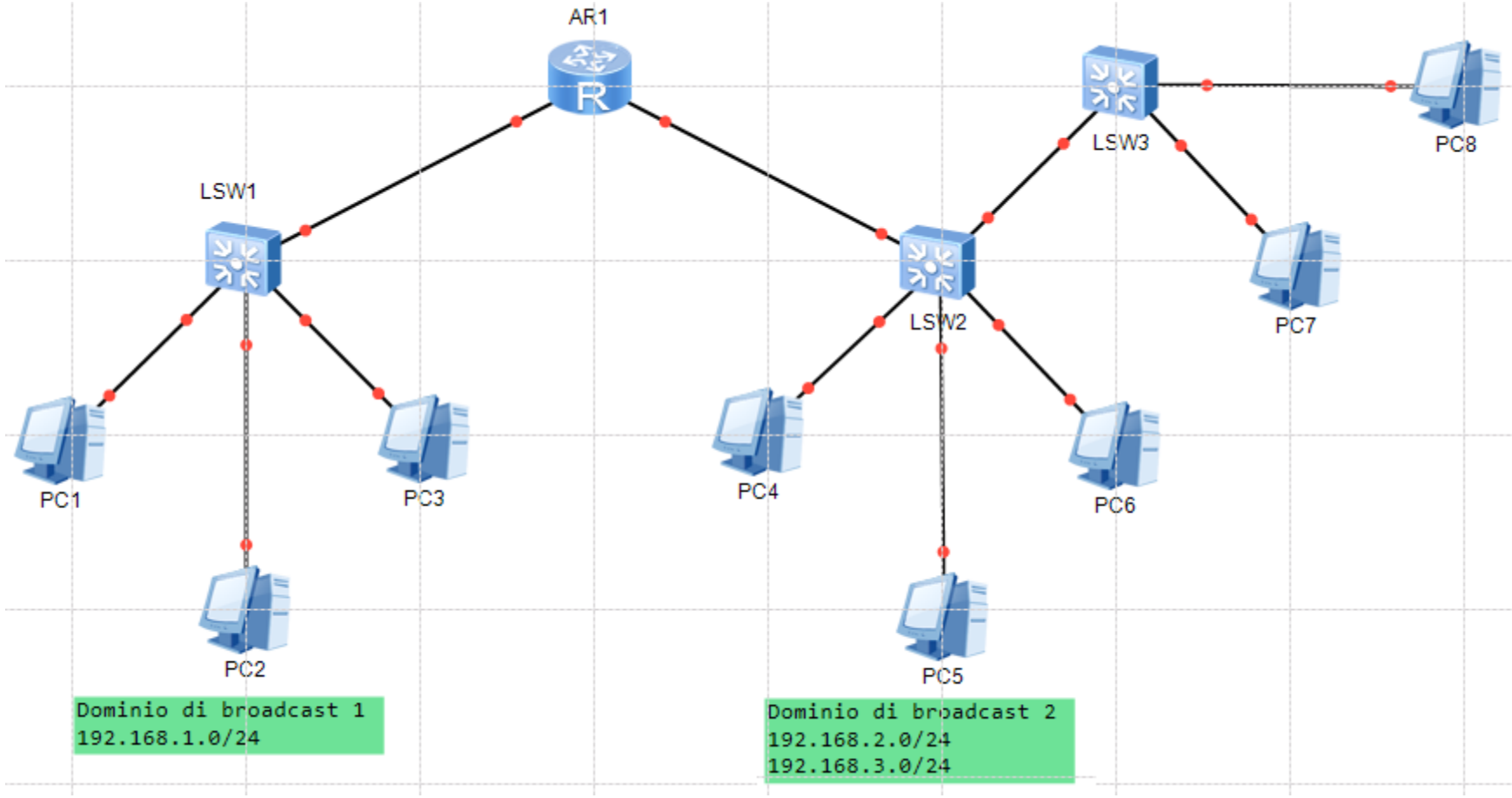
LAN Limitations – Situazione 1



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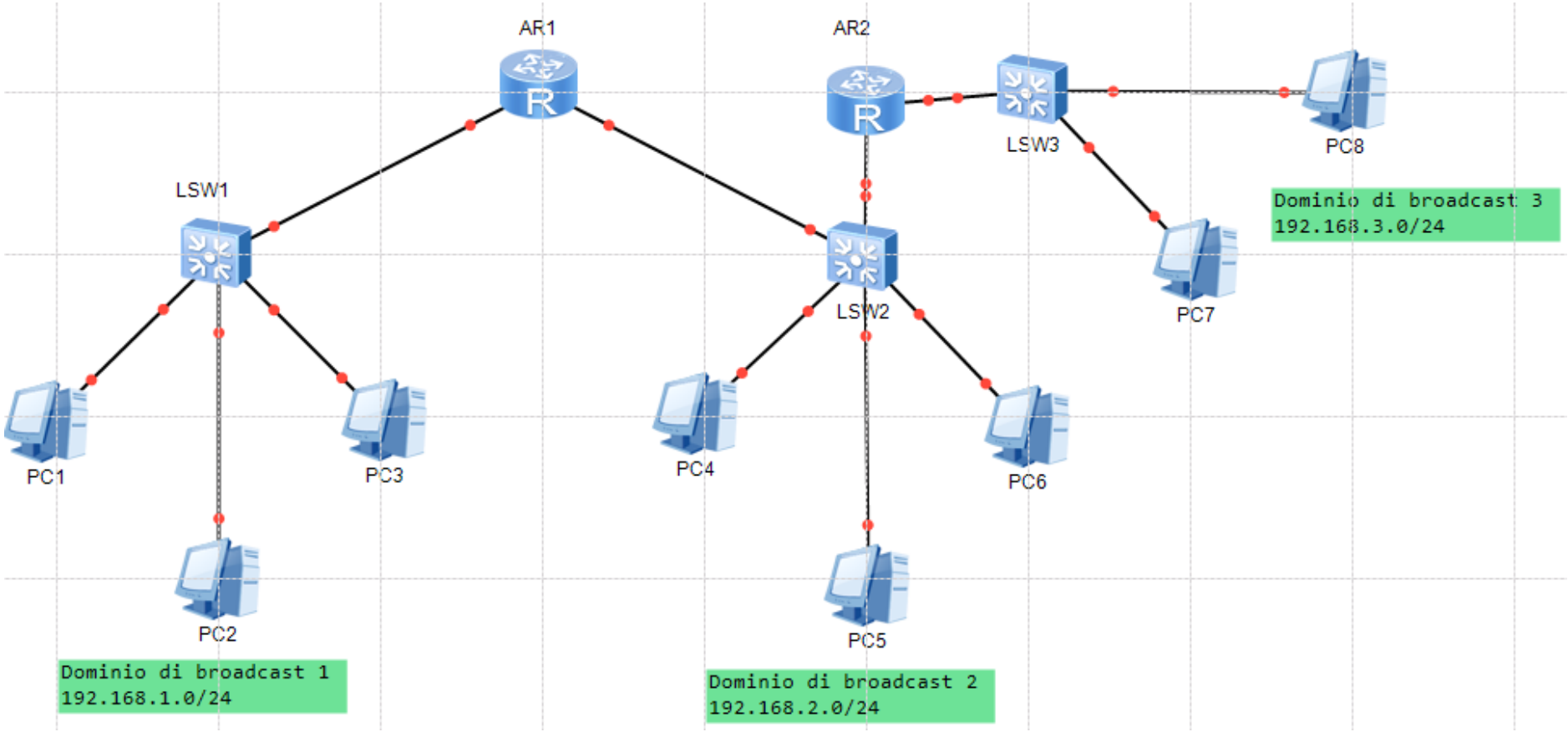
LAN Limitations – Situazione 2



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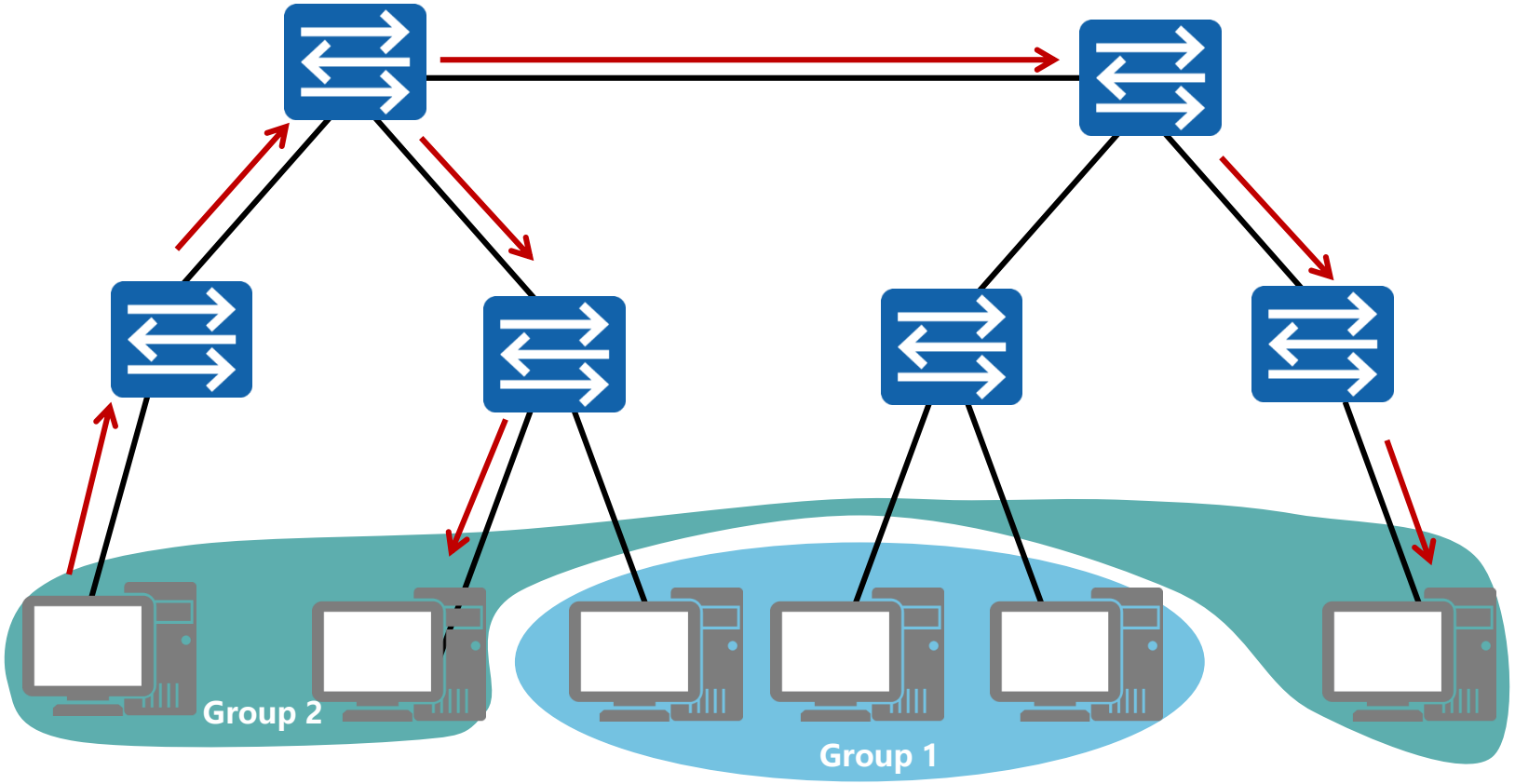
VLAN Technology



- A VLAN enables logical isolation of traffic at the data link layer.

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VLAN Technology

- Ogni VLAN è un dominio di broadcast;
- Può essere distribuito su più dispositivi fisici (switch);
- Gli switch inoltrano frames tra dispositivi nella stessa VLAN, non possono inoltrare frames tra diverse VLAN;
- I router possono inoltrare i pacchetti tra VLAN differenti;
- Tipicamente ad ogni VLAN è associata una o più subnet, VLAN diverse hanno subnet diverse.

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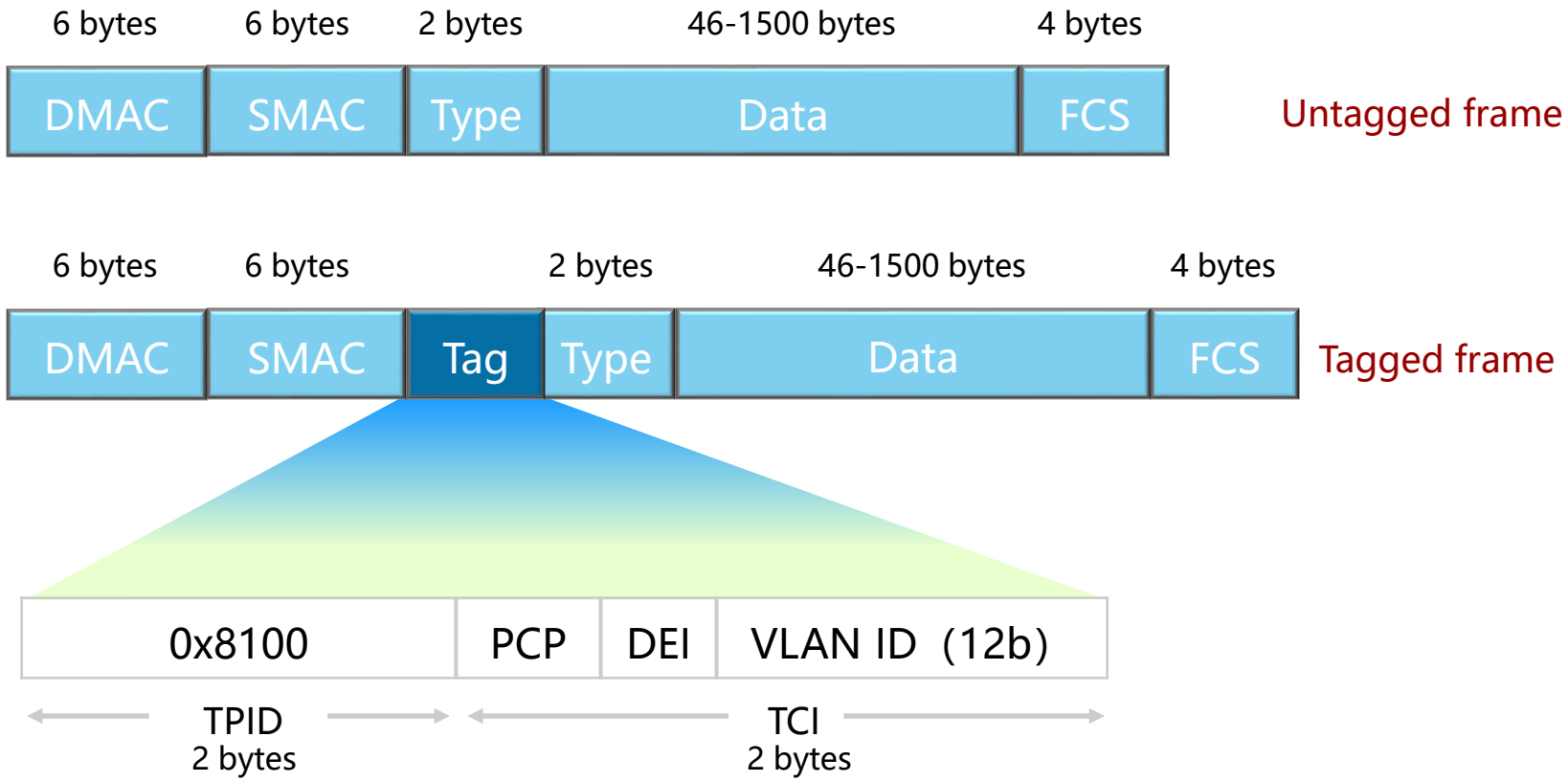
VLAN Frame Format



- A VLAN tag is inserted to distinguish frames for each VLAN.

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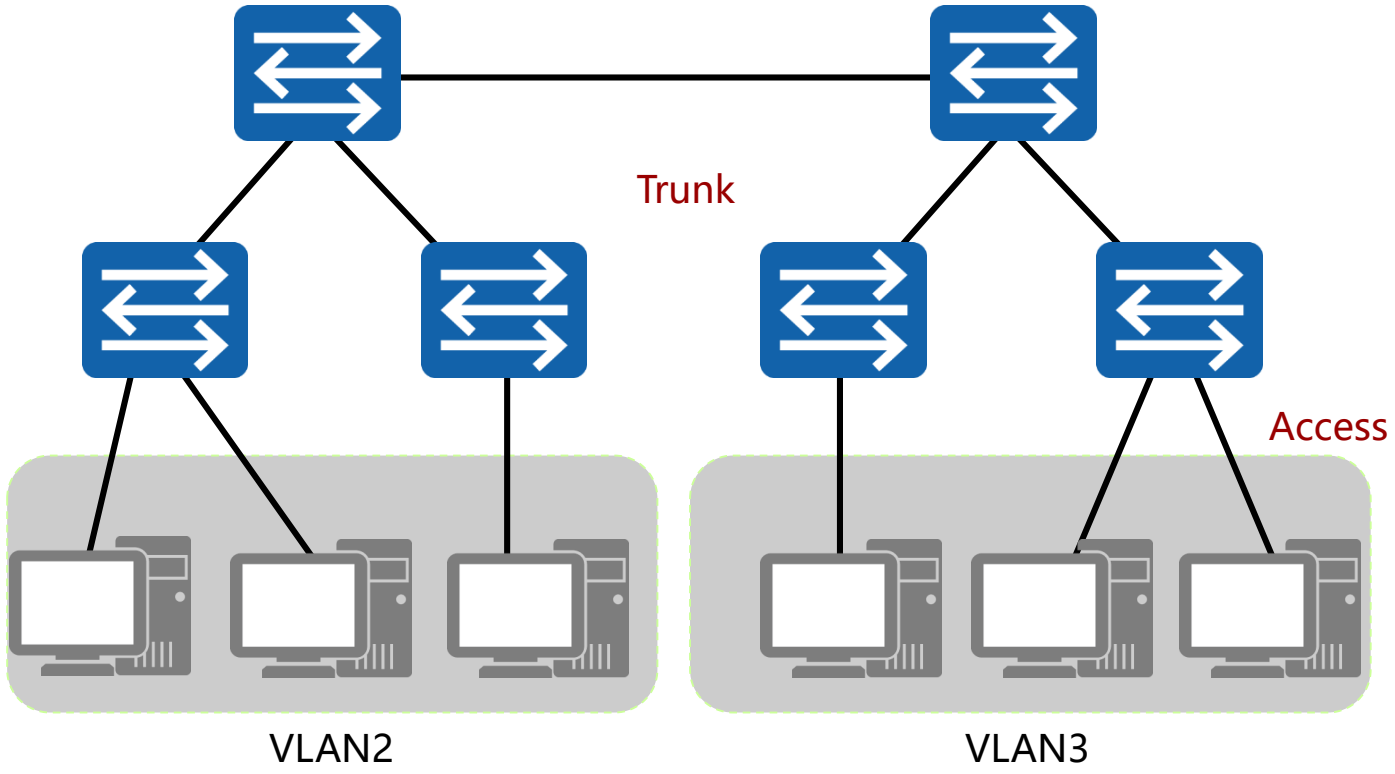
Link Types



- A trunk represents a backbone for the transmission of VLAN traffic between switches.

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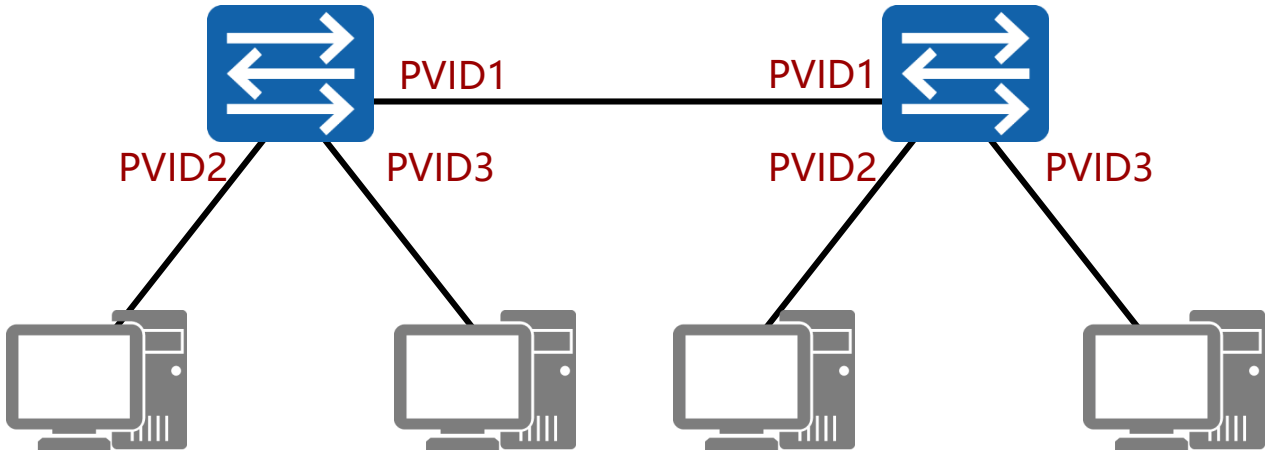
Port VLAN ID



- PVID represents the default VLAN for each interface.
- The PVID is set to VLAN 1 for all ports by default.

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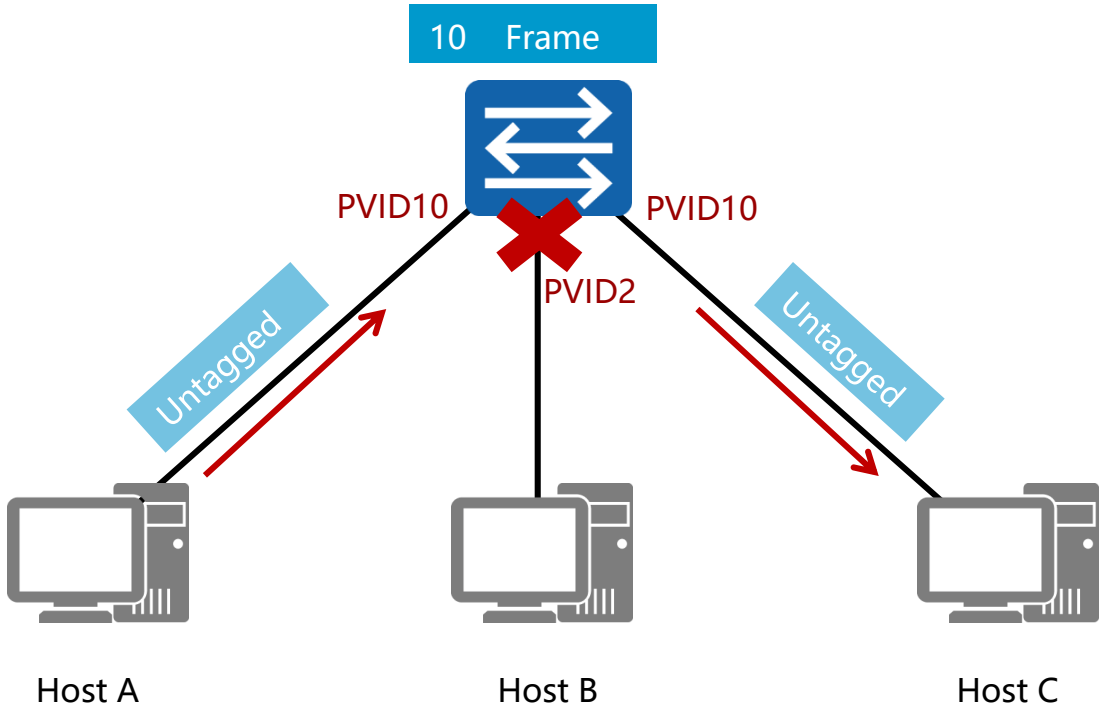
Port Types – Access



- Access ports remove VLAN tags before forwarding frames.

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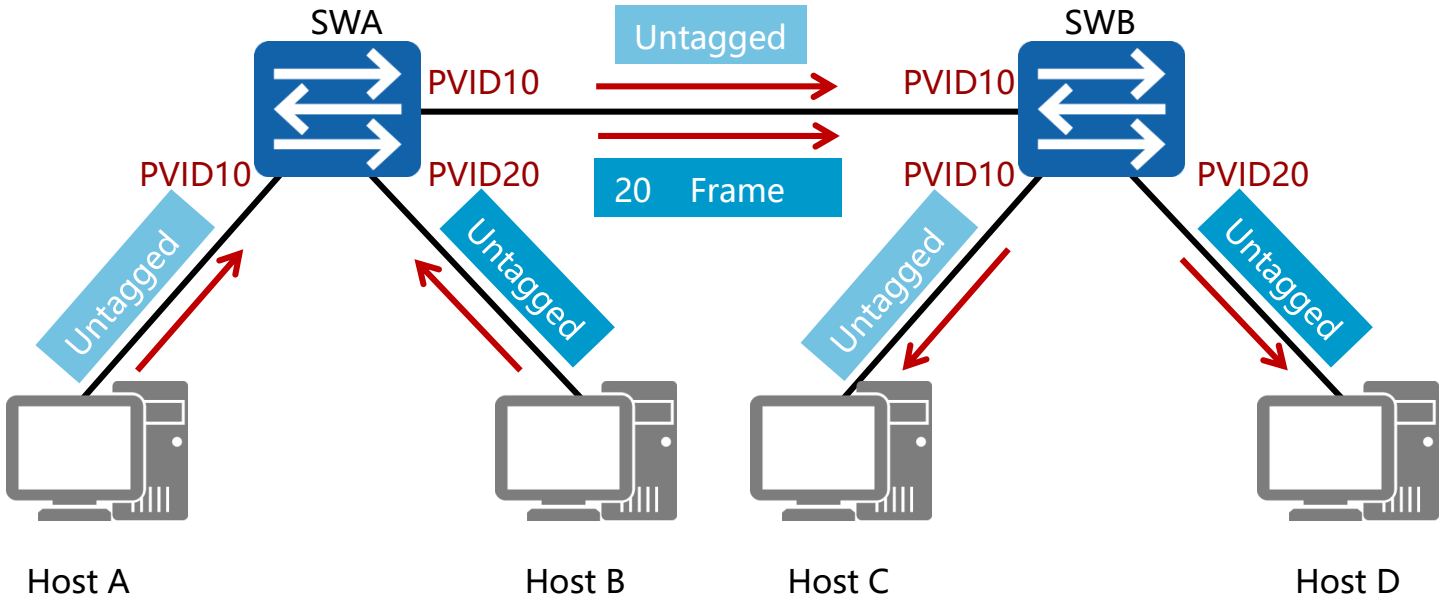
Port Types – Trunk



- Frames carried over a trunk link may be tagged or untagged.
- All VLANs must be permitted before being carried over a trunk.

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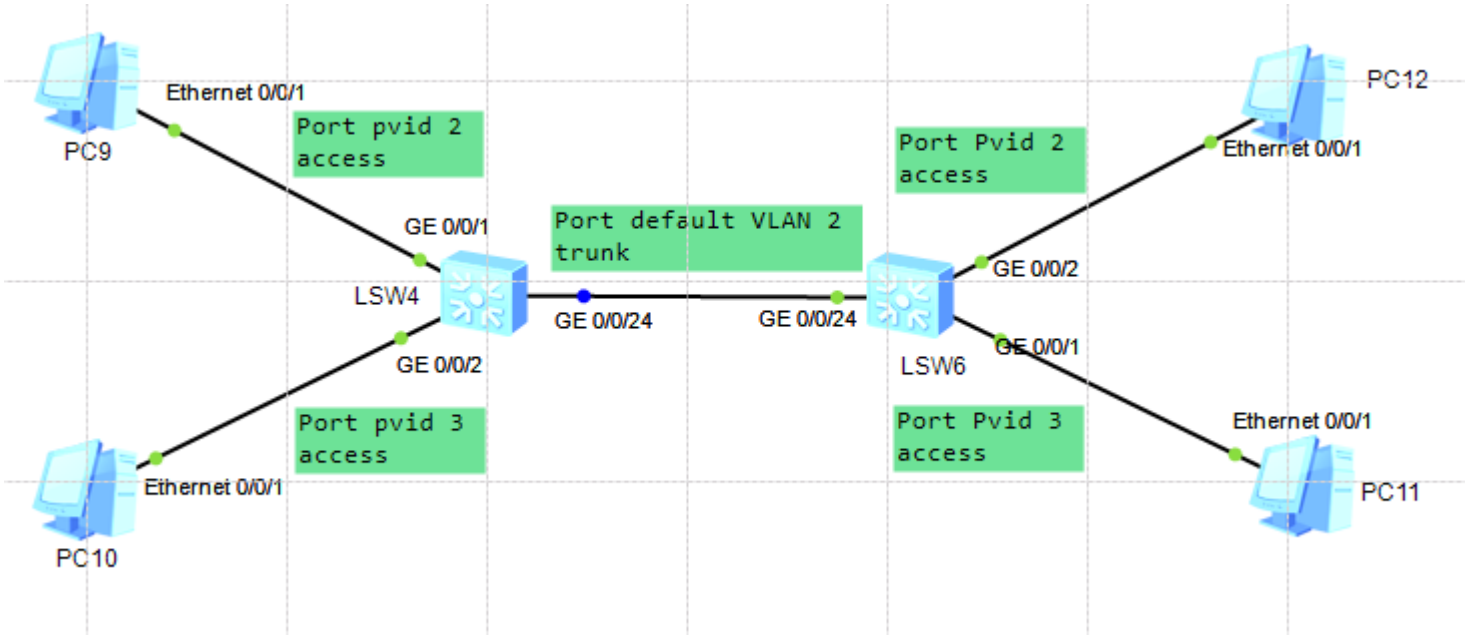
Port Types – Trunk




```
> Frame 5: 74 bytes on wire (592 bits), 74 bytes captured (592 bits) on interface 0
v Ethernet II, Src: HuaweiTe_4e:65:85 (54:89:98:4e:65:85), Dst: HuaweiTe_44:3e:cf (54:89:98:44:3e:cf)
  > Destination: HuaweiTe_44:3e:cf (54:89:98:44:3e:cf)
  > Source: HuaweiTe_4e:65:85 (54:89:98:4e:65:85)
    Type: IPv4 (0x0800)
> Internet Protocol Version 4, Src: 192.168.1.2, Dst: 192.168.1.1
> Internet Control Message Protocol
```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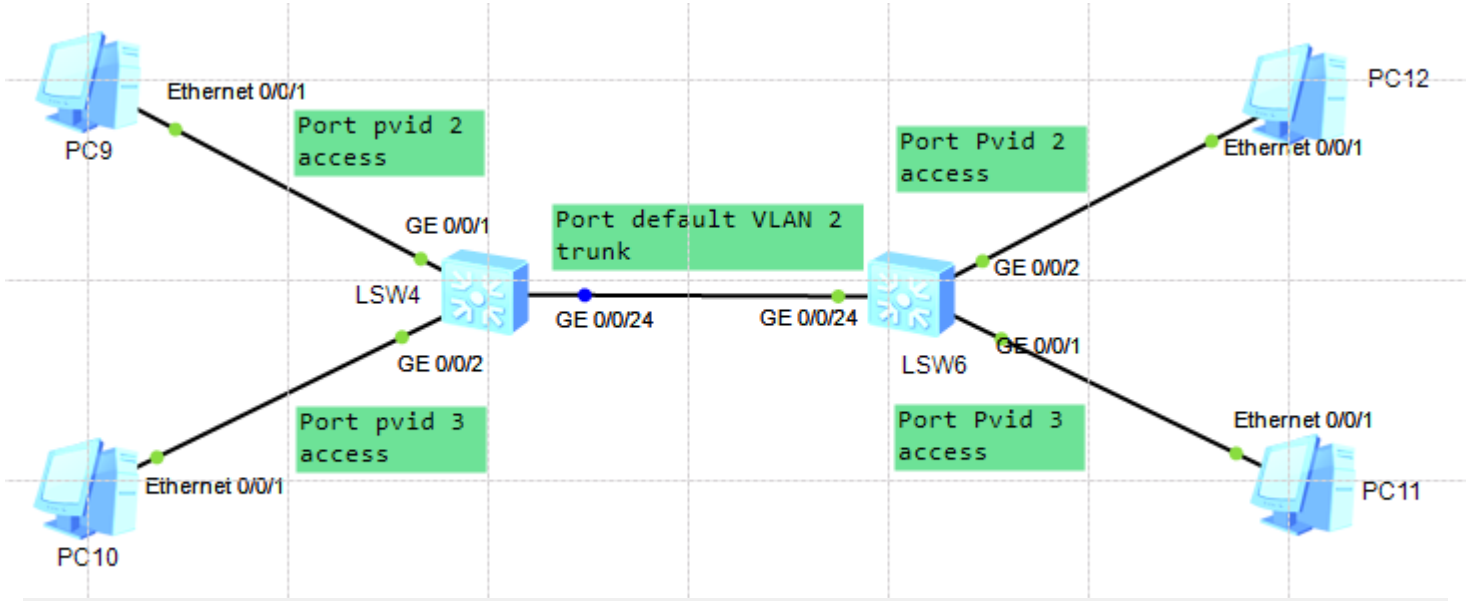
Port Types – Trunk

- Ping PC11 -> PC 10 (VLAN 3)




```
> Frame 187: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface 0
v Ethernet II, Src: HuaweiTe_91:78:e1 (54:89:98:91:78:e1), Dst: HuaweiTe_d7:2a:45 (54:89:98:d7:2a:45)
  > Destination: HuaweiTe_d7:2a:45 (54:89:98:d7:2a:45)
  > Source: HuaweiTe_91:78:e1 (54:89:98:91:78:e1)
    Type: 802.1Q Virtual LAN (0x8100)
v 802.1Q Virtual LAN, PRI: 0, CFI: 0, ID: 3
    000. .... .... .... = Priority: Best Effort (default) (0)
    ...0 .... .... .... = CFI: Canonical (0)
    .... 0000 0000 0011 = ID: 3
    Type: IPv4 (0x0800)
> Internet Protocol Version 4, Src: 192.168.2.2, Dst: 192.168.2.1
> Internet Control Message Protocol
```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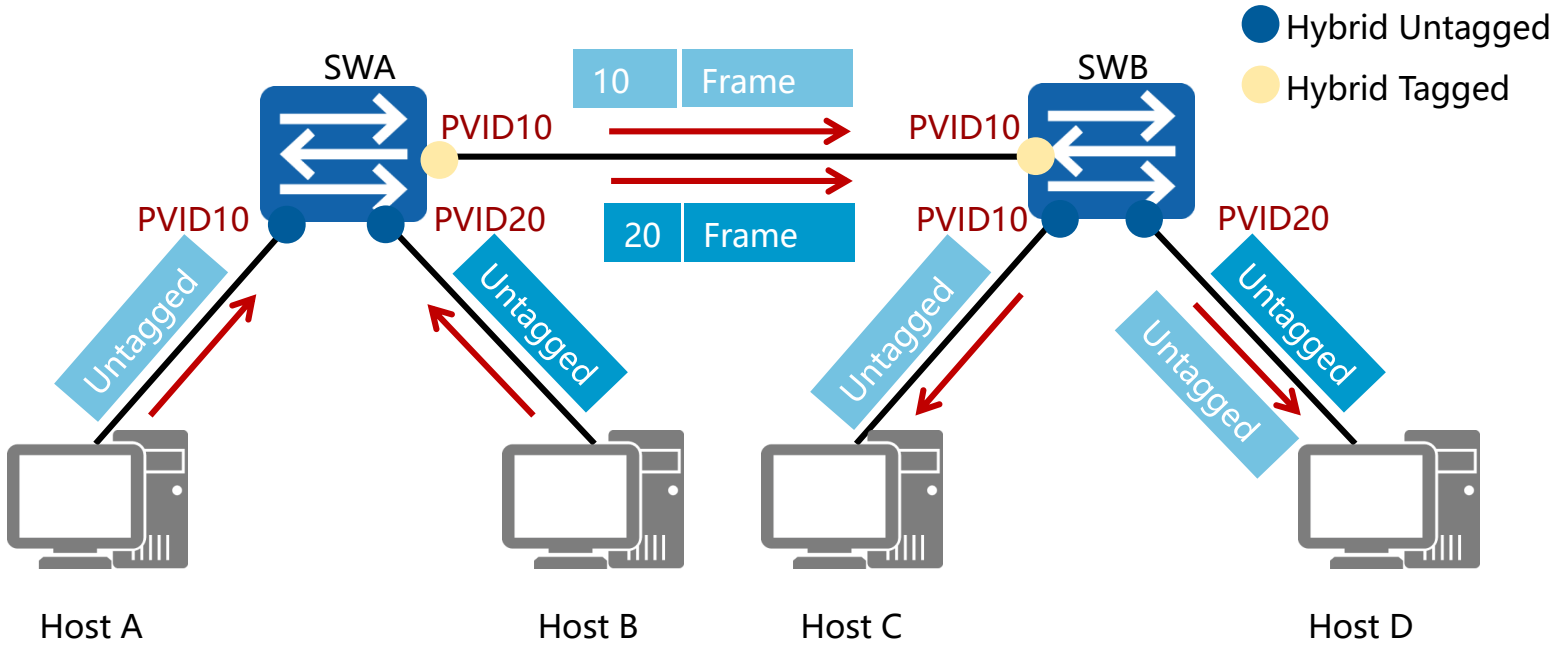
Port Types – Hybrid



- Hybrid ports are defined as either tagged or untagged.
- VLAN communication can be managed on a port by port basis.

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Port Types-Hybrid

Port Type	Untagged Frame Processing	Tagged Frame Processing	Frame Transmission	Usage
Access	Accepts an untagged frame and adds a tag with the default VLAN ID to the frame.	• Accepts the tagged frame if the frame's VLAN ID matches the default VLAN ID. • Discards the tagged frame if the frame's VLAN ID differs from the default VLAN ID.	After the PVID tag is stripped, the frame is transmitted.	An access port can belong to only one VLAN. The access interface is directly connected to a computer.
Trunk	• Adds a tag with the default VLAN ID to the untagged frame and then transmits it if the default VLAN ID is permitted by the port • Adds a tag with the default VLAN ID to the untagged frame and then discards it if the default VLAN ID is denied by the port.	• Accepts the tagged frame if the frame's VLAN ID is permitted by the port. • Discards the tagged frame if the frame's VLAN ID is denied by the port.	• If the frame's VLAN ID matches the default VLAN ID and the VLAN ID is permitted by the port, the device removes the tag and transmits the frame. • If the frame's VLAN ID differs from the default VLAN ID, but the VLAN ID is still permitted by the port, the switch will directly transmit the frame.	A trunk port allows packets of multiple VLANs to pass through. It usually connects network devices.
Hybrid			If the frame's VLAN ID is permitted by the port, the frame is transmitted. The port can be configured whether to transmit frames with tags.	A hybrid port allows packets of multiple VLANs to pass through. It can be used to connect network devices or network devices and user devices.

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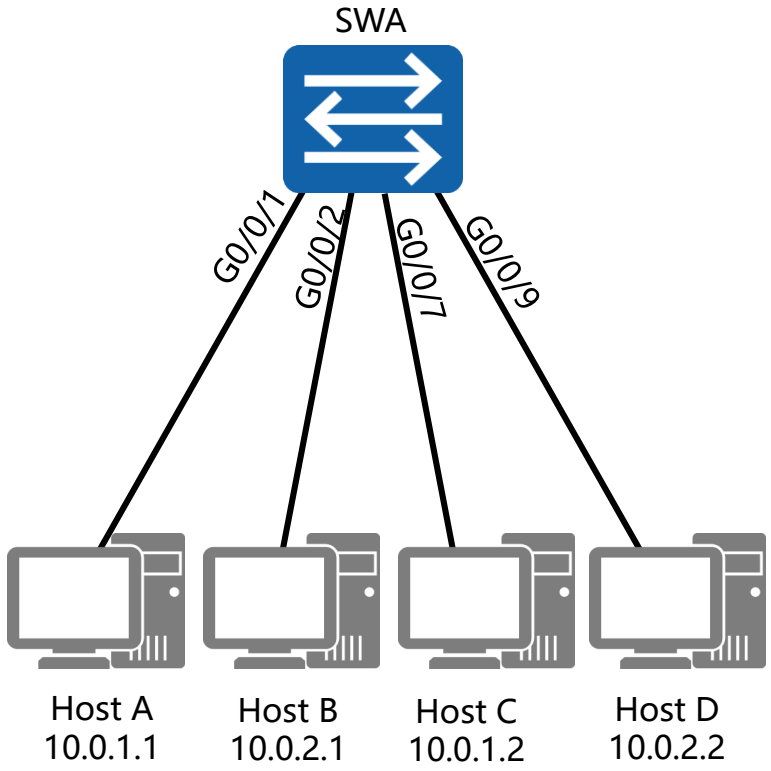
VLAN Assignment Methods



Assignment Method	VLAN 5	VLAN 10
Port based	G0/0/1, G0/0/7	G0/0/2 G0/0/9
MAC based	00-01-02-03-04-AA 00-01-02-03-04-CC	00-01-02-03-04-BB 00-01-02-03-04-DD
IP Subnet based	10.0.1.*	10.0.2.*
Protocol based	IP	IPX
Policy based	10.0.1.* + G0/0/1+ 00-01-02-03-04-AA	10.0.2.* + G0/0/2 + 00-01-02-03-04-BB

- Five methods of VLAN assignment are possible.
- Port based VLAN assignment is the default assignment method.

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VLAN Assignment Methods

VLAN Assignment Method	Advantage	Disadvantage
Port-based	This method is the most commonly used, and configuration is simple.	Configuration is not flexible. If a port needs to transmit frames of another VLAN, the port must be deleted from the original VLAN and added to the new VLAN. If a network has a large number of traveling users, the network administrator must spend more time on maintenance.
MAC address-based	VLANs do not need to be re-assigned when users travel from one place to another. This VLAN assignment method improves security and flexibility for terminal users.	A network administrator must configure MAC addresses associated with VLANs on the switch. If the network has many terminals, it will take a long time for the administrator to configure the MAC addresses.
IP subnet-based	IP subnet-based and protocol-based VLAN assignment are both network layer-based VLAN assignment. Network layer-based VLAN assignment greatly reduces workload of manual configurations and allows users to easily join a VLAN, move from one VLAN to another, or leave a VLAN.	The switch needs to parse the source IP addresses of packets and convert them into MAC addresses. This slows down switch response.
Protocol-based		The switch needs to analyze protocol address formats and convert between them. This slows down switch response.

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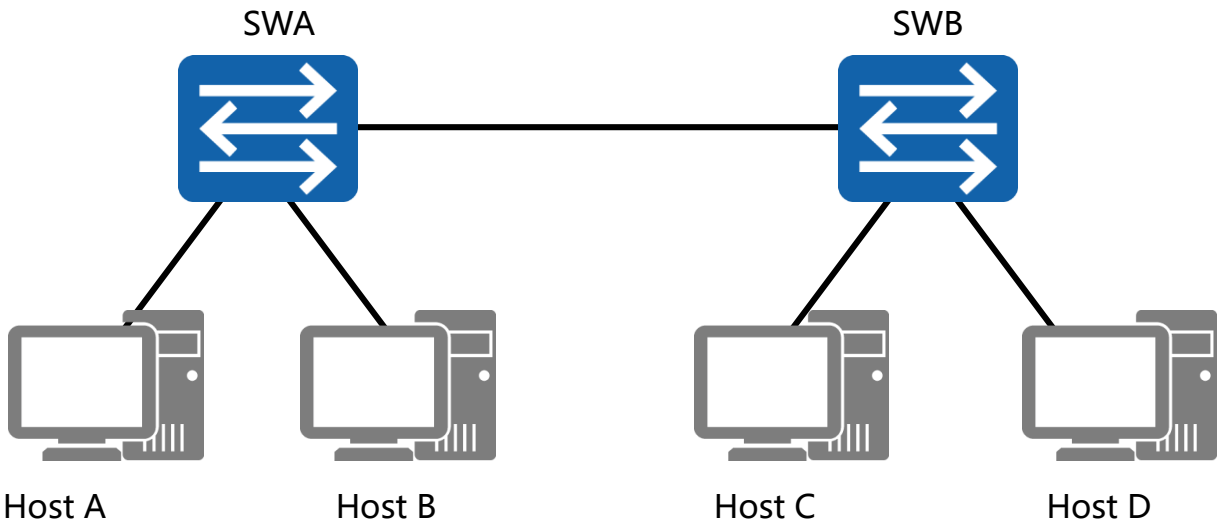
Creating VLANs




```
[SWA]vlan 10
[SWA-vlan10]quit
[SWA]vlan batch 2 to 3
Info: This operation may take a few seconds. Please wait for a
moment...done.
```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Creating VLANs

```
[SWA]display vlan
The total number of vlans is : 4
--------------------------------------------------------------
U:Up; D:Down; TG:Tagged; UT:Untagged; MP:Vlan-mapping;
ST:Vlan-stacking; #: ProtocolTransparent-vlan; *:Management-
vlan;
--------------------------------------------------------------
VID  Type    Ports
--------------------------------------------------------------
1    common  UT:GE0/0/1(U) ……
2    common
3    common
10   common
……
```


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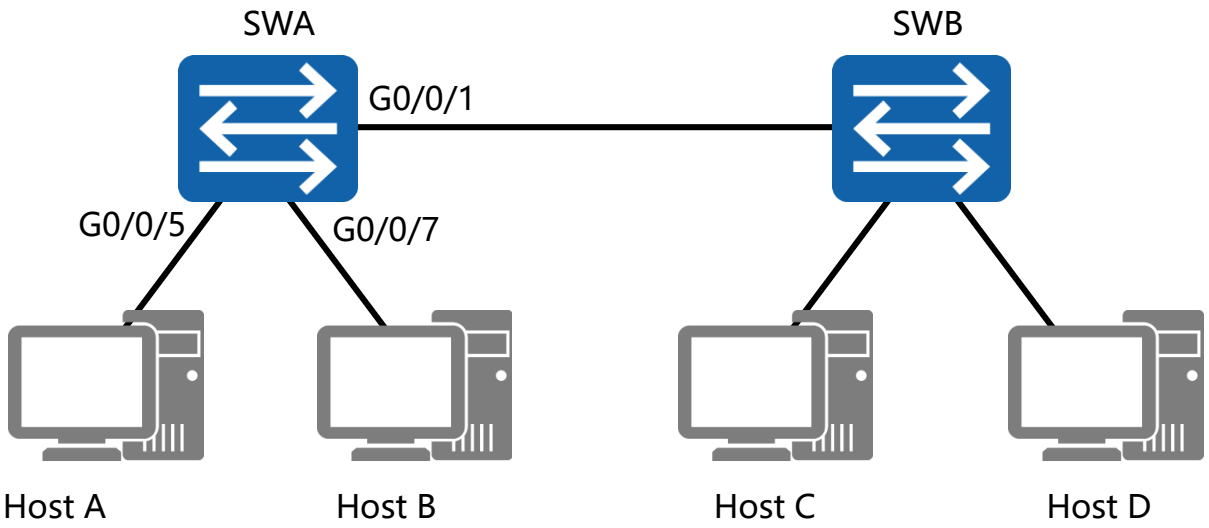
Setting the Port Link Type




```
[SWA]interface GigabitEthernet 0/0/1
[SWA-GigabitEthernet0/0/1]port link-type trunk
[SWA-GigabitEthernet0/0/1]quit
[SWA]interface GigabitEthernet 0/0/5
[SWA-GigabitEthernet0/0/5]port link-type access
```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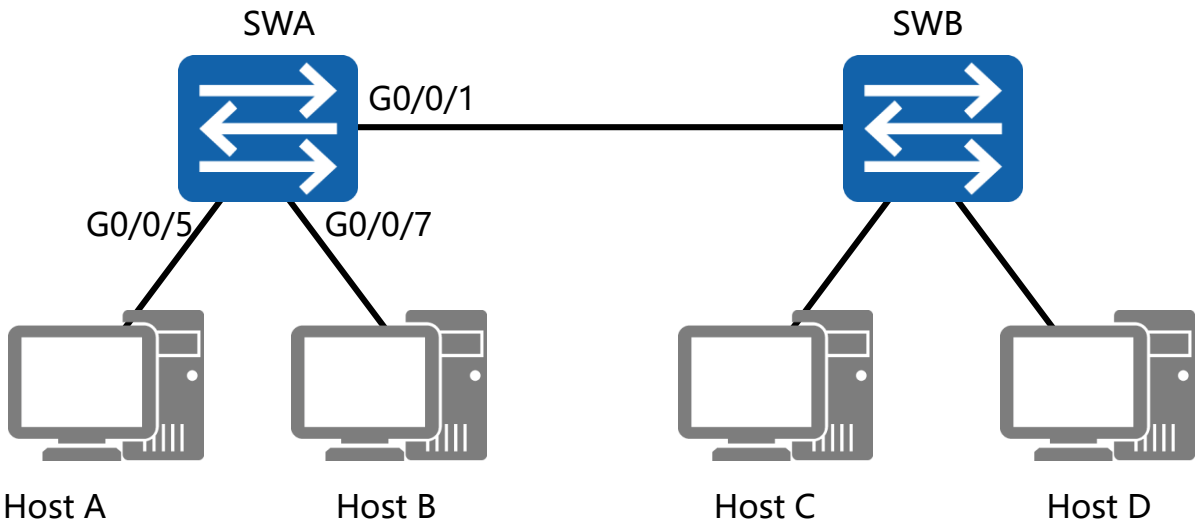
Assigning Ports to VLANs




```
[SWA]vlan 2
[SWA-vlan2]port GigabitEthernet 0/0/7
[SWA-vlan2]quit
[SWA]interface GigabitEthernet 0/0/5
[SWA-GigabitEthernet0/0/5]port link-type access
[SWA-GigabitEthernet0/0/5]port default vlan 3
```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Verifying VLAN Assignment

```
[SWA]display vlan
The total number of vlans is : 4
--------------------------------------------------------------
U:Up; D:Down; TG:Tagged; UT:Untagged; MP:Vlan-mapping;
ST:Vlan-stacking; #: ProtocolTransparent-vlan; *:Management-
vlan;
--------------------------------------------------------------
VID  Type    Ports
--------------------------------------------------------------
1    common  UT:GE0/0/1(U) ……
2    common  UT:GE0/0/7(D)
3    common  UT:GE0/0/5(U)
10   common
……
```


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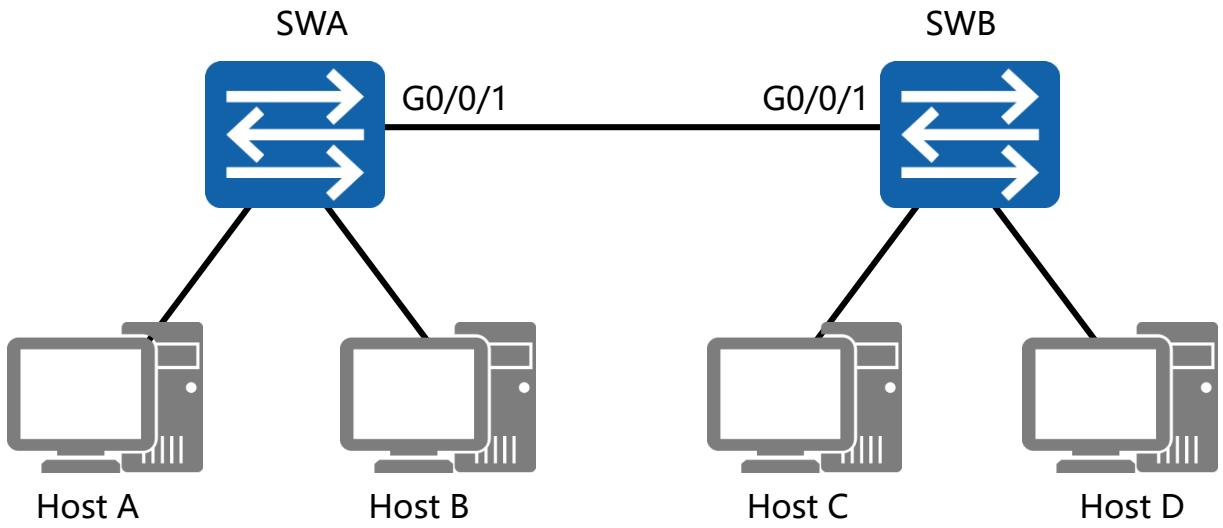
Forwarding Over the Trunk




```
[SWA-GigabitEthernet0/0/1]port link-type trunk
[SWA-GigabitEthernet0/0/1]port trunk pvid vlan 10
[SWA-GigabitEthernet0/0/1]port trunk allow-pass vlan 2 3
```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Forwarding Over the Trunk

```
[SWA]display vlan
The total number of vlans is : 4
--------------------------------------------------------------
U:Up; D:Down; TG:Tagged; UT:Untagged; MP:Vlan-mapping;
ST:Vlan-stacking; #: ProtocolTransparent-vlan; *:Management-
vlan;
--------------------------------------------------------------
VID  Type    Ports
--------------------------------------------------------------
1    common  UT:GE0/0/1(U) ……
2    common  UT:GE0/0/7(D) TG:GE0/0/1(U)
3    common  UT:GE0/0/5(U) TG:GE0/0/1(U)
10   common
……
```


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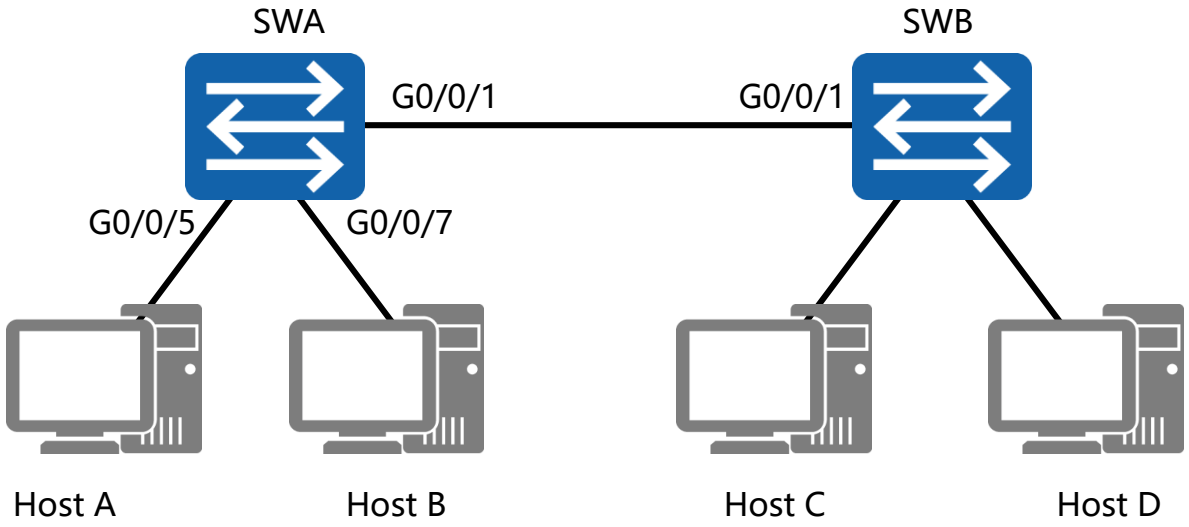
Configuring Hybrid Ports




```
[SWA-GigabitEthernet0/0/5]port link-type hybrid
[SWA-GigabitEthernet0/0/5]port hybrid pvid vlan 3
[SWA-GigabitEthernet0/0/5]port hybrid untagged vlan 3

[SWA-GigabitEthernet0/0/7]port link-type hybrid
[SWA-GigabitEthernet0/0/7]port hybrid pvid vlan 2
[SWA-GigabitEthernet0/0/7]port hybrid untagged vlan 2
```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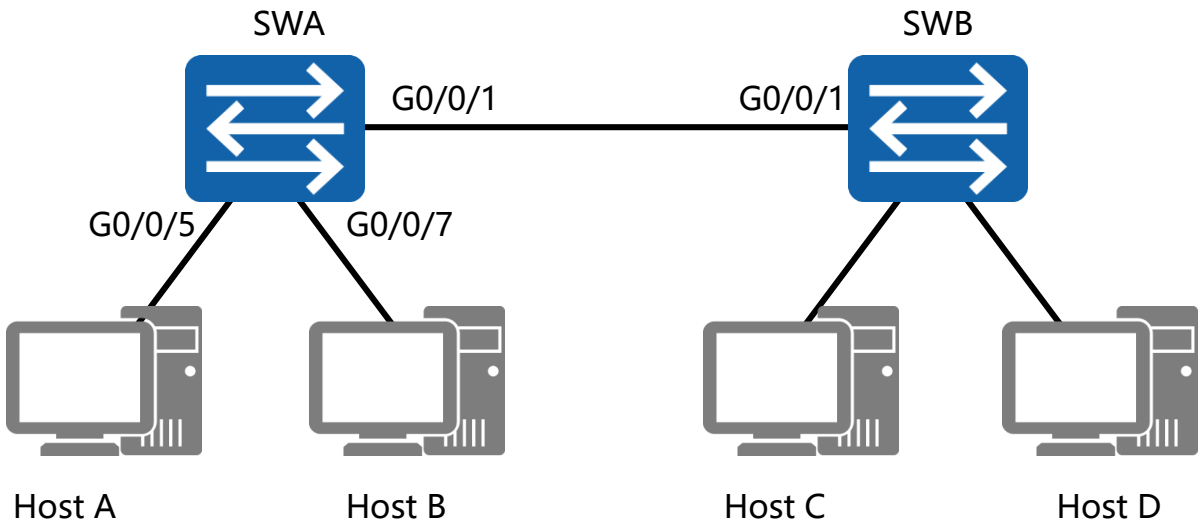
Configuring Hybrid Ports




```
[SWA-GigabitEthernet0/0/1]port link-type hybrid
[SWA-GigabitEthernet0/0/1]port hybrid tagged vlan 2 to 3
```

- Trunk links using the hybrid port link-type must enable tagging of VLAN frames before forwarding.

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Configuring Hybrid Ports


```
[Huawei-GigabitEthernet0/0/2]dis thi
#
interface GigabitEthernet0/0/2
 port hybrid pvid vlan 2
 port hybrid tagged vlan 4
#
return
[Huawei-GigabitEthernet0/0/2]
```

```
> Frame 73: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface 0
> Ethernet II, Src: HuaweiTe_21:07:ed (54:89:98:21:07:ed), Dst: HuaweiTe_20:33:6e (54:89:98:20:33:6e)
v 802.1Q Virtual LAN, PRI: 0, CFI: 0, ID: 4
    000. .... .... .... = Priority: Best Effort (default) (0)
    ...0 .... .... .... = CFI: Canonical (0)
    .... 0000 0000 0100 = ID: 4
    Type: IPv4 (0x0800)
> Internet Protocol Version 4, Src: 192.168.3.2, Dst: 192.168.3.1
> Internet Control Message Protocol
```


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Configuration Validation

```
[SWA]display vlan
The total number of vlans is : 4
--------------------------------------------------------------
U:Up; D:Down; TG:Tagged; UT:Untagged; MP:Vlan-mapping; ST:Vlan-
stacking; #: ProtocolTransparent-vlan; *:Management-vlan;
--------------------------------------------------------------
VID  Type    Ports
--------------------------------------------------------------
1    common  UT:GE0/0/1(U) ……
2    common  UT:GE0/0/7(D)
             TG:GE0/0/1(U)
3    common  UT:GE0/0/5(U)
             TG:GE0/0/1(U)
10   common
……
```


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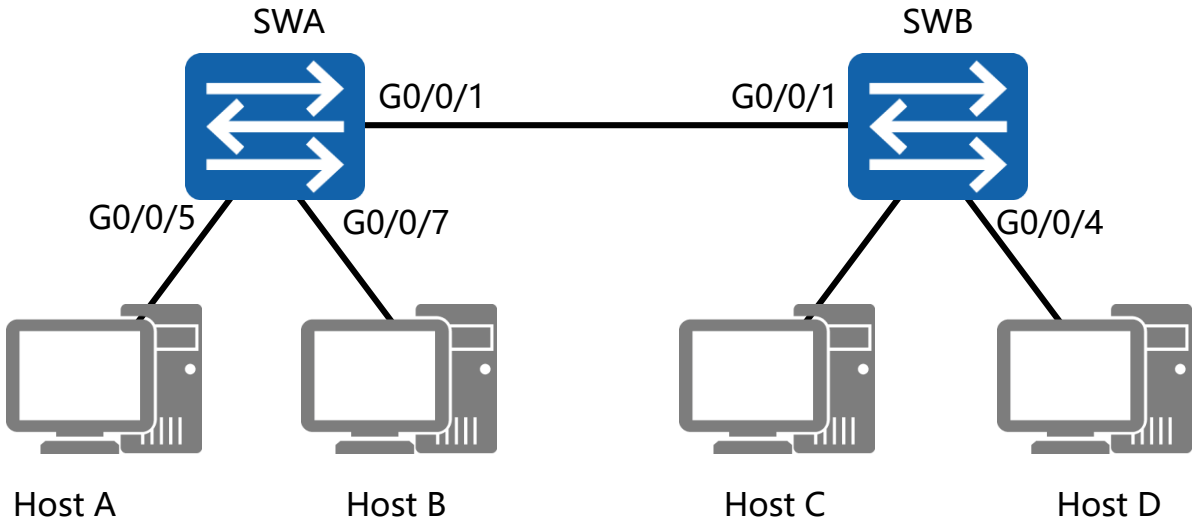
Configuring Hybrid Ports




```
[SWB-GigabitEthernet0/0/4]port link-type hybrid
[SWB-GigabitEthernet0/0/4]port hybrid pvid vlan 3
[SWB-GigabitEthernet0/0/4]port hybrid untagged vlan 2 to 3
```

- Hybrid ports can be configured to receive VLAN traffic from multiple VLANs by simply removing the tag at the port interface.

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Configuration Validation

```
[SWB]display vlan
The total number of vlans is : 3
--------------------------------------------------------------
U:Up; D:Down; TG:Tagged; UT:Untagged; MP:Vlan-mapping; ST:Vlan-
stacking; #: ProtocolTransparent-vlan; *:Management-vlan;
--------------------------------------------------------------
VID  Type    Ports
--------------------------------------------------------------
1    common  UT:GE0/0/1(U) ……
2    common  UT:GE0/0/4(U)
3    common  UT:GE0/0/4(U)
4   ……
```


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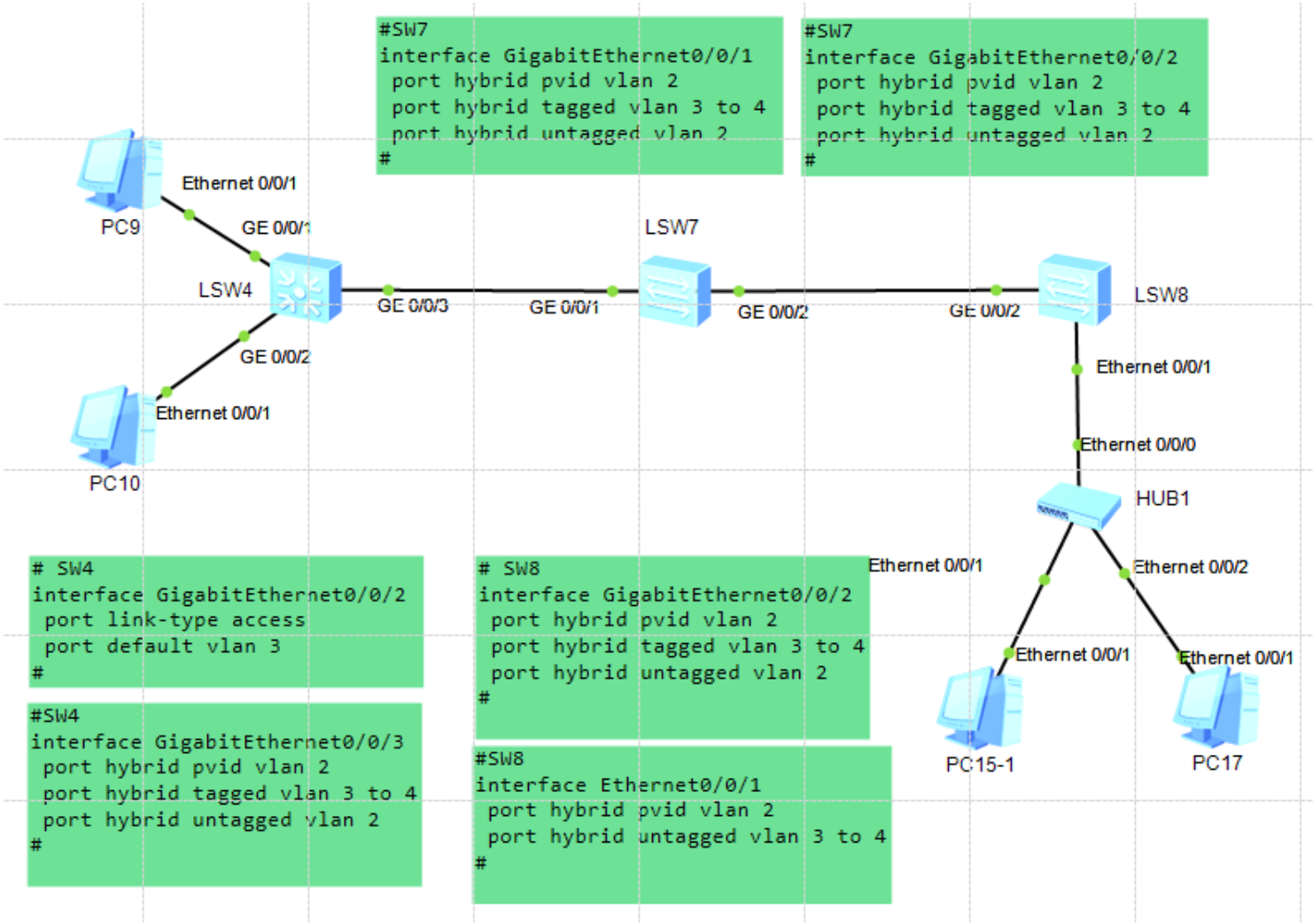
Configuring Hybrid Ports - Ping pc10-17



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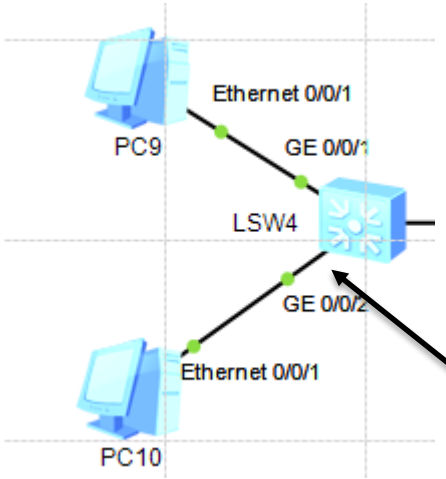
Configuring Hybrid Ports - Ping pc10-17




```
# SW4
interface GigabitEthernet0/0/2
 port link-type access
 port default vlan 3
#
```

```
#SW4
interface GigabitEthernet0/0/3
 port hybrid pvid vlan 2
 port hybrid tagged vlan 3 to 4
 port hybrid untagged vlan 2
#
```

```
> Frame 13: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface 0
> Ethernet II, Src: HuaweiTe_d7:2a:45 (54:89:98:d7:2a:45), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
> Address Resolution Protocol (request)
```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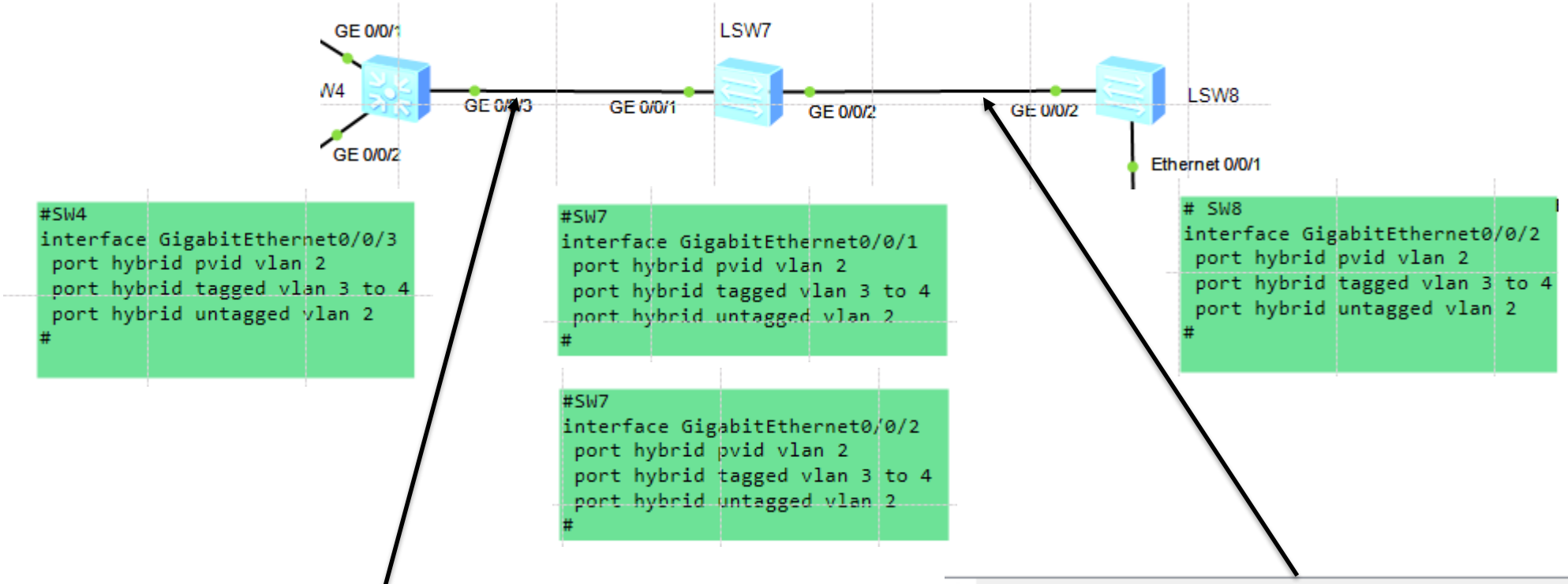
Configuring Hybrid Ports - Ping pc10-17




```
> Frame 5: 64 bytes on wire (512 bits), 64 bytes captured (512 bits) on interface 0
> Ethernet II, Src: HuaweiTe_d7:2a:45 (54:89:98:d7:2a:45), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
v 802.1Q Virtual LAN, PRI: 0, CFI: 0, ID: 3
    000. .... .... .... = Priority: Best Effort (default) (0)
    ...0 .... .... .... = CFI: Canonical (0)
    .... 0000 0000 0011 = ID: 3
    Type: ARP (0x0806)
    Padding: 00000000000000000000000000000000
    Trailer: 00000000
> Address Resolution Protocol (request)
```

```
> Frame 6: 64 bytes on wire (512 bits), 64 bytes captured (512
> Ethernet II, Src: HuaweiTe_d7:2a:45 (54:89:98:d7:2a:45), Dst:
v 802.1Q Virtual LAN, PRI: 0, CFI: 0, ID: 3
    000. .... .... .... = Priority: Best Effort (default) (0)
    ...0 .... .... .... = CFI: Canonical (0)
    .... 0000 0000 0011 = ID: 3
    Type: ARP (0x0806)
    Padding: 00000000000000000000000000000000
    Trailer: 00000000
> Address Resolution Protocol (request)
```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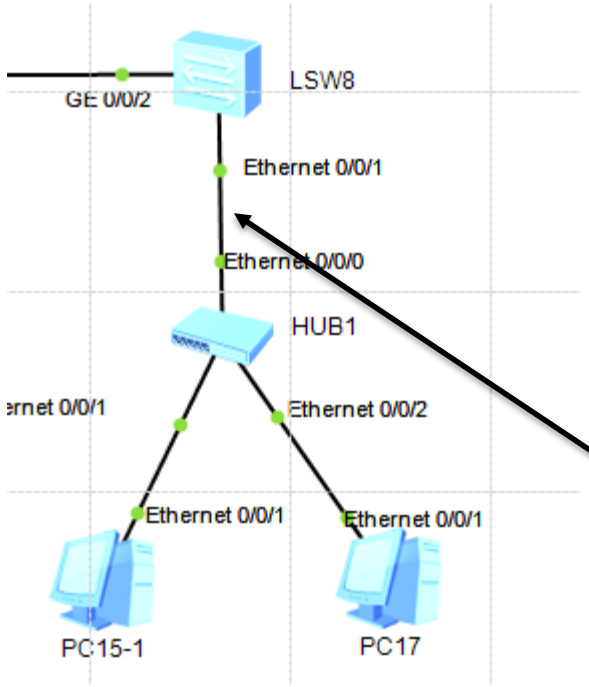
Configuring Hybrid Ports – Ping pc10-17




```
#SW8
interface Ethernet0/0/1
 port hybrid pvid vlan 2
 port hybrid untagged vlan 3 to 4
#
```

```
> Frame 7: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface 0
v Ethernet II, Src: HuaweiTe_d7:2a:45 (54:89:98:d7:2a:45), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
  > Destination: Broadcast (ff:ff:ff:ff:ff:ff)
  > Source: HuaweiTe_d7:2a:45 (54:89:98:d7:2a:45)
    Type: ARP (0x0806)
    Padding: 000000000000000000000000000000000000
> Address Resolution Protocol (request)
```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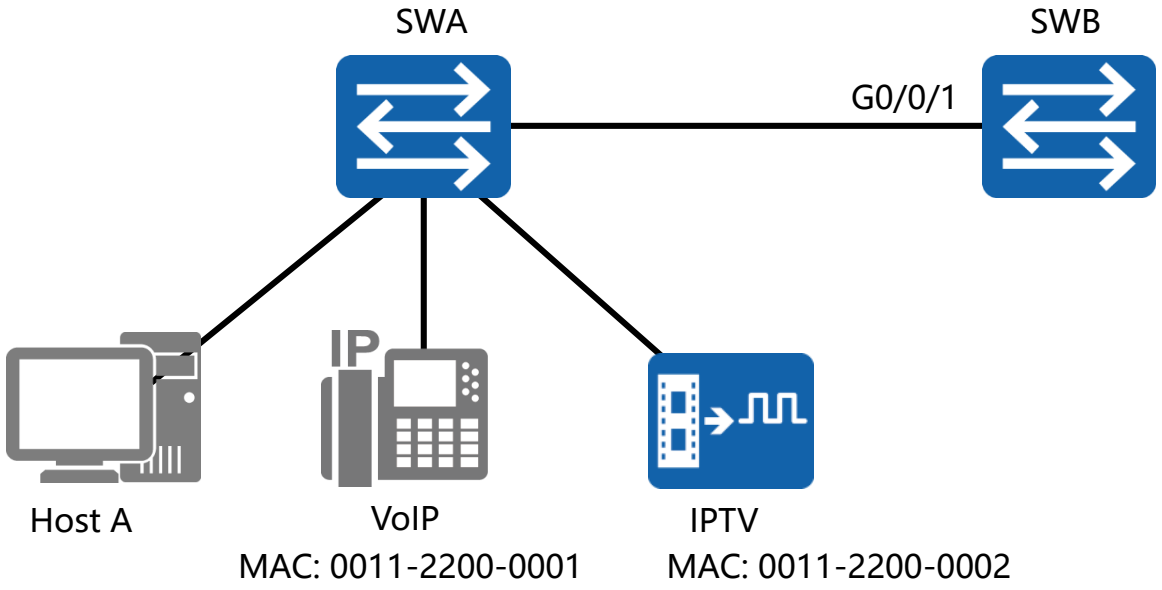
Voice VLAN Application



- Voice VLANs are used to distinguish, isolate and prioritize voice traffic over service traffic as a means of quality assurance.

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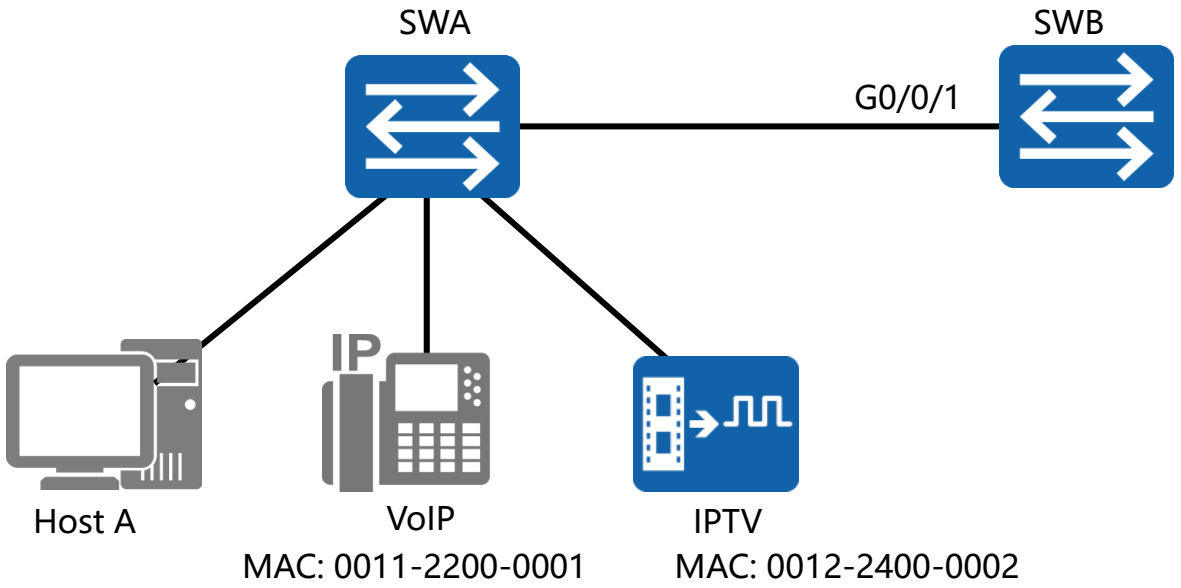
Voice VLAN Configuration




```
[SWB]vlan 2
[SWB-vlan2]interface GigabitEthernet 0/0/1
[SWB-GigabitEthernet0/0/1]voice-vlan 2 enable
[SWB-GigabitEthernet0/0/1]voice-vlan mode auto
[SWB-GigabitEthernet0/0/1]quit
[SWB]voice-vlan mac-address 0011-2200-0000 mask ffff-ff00-0000
```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Configuration Validation

```
[SWB]display voice-vlan status
Voice VLAN Configurations:
------------------------------------------------------------
Voice VLAN ID             : 2
Voice VLAN status         : Enable
Voice VLAN aging time     : 1440(minutes)
Voice VLAN 8021p remark   : 6
Voice VLAN dscp remark    : 46
------------------------------------------------------------
Port Information:
------------------------------------------------------------
Port                      Add-Mode   Security-Mode   Legacy
------------------------------------------------------------
GigabitEthernet0/0/1      Auto       Security        Disable
```


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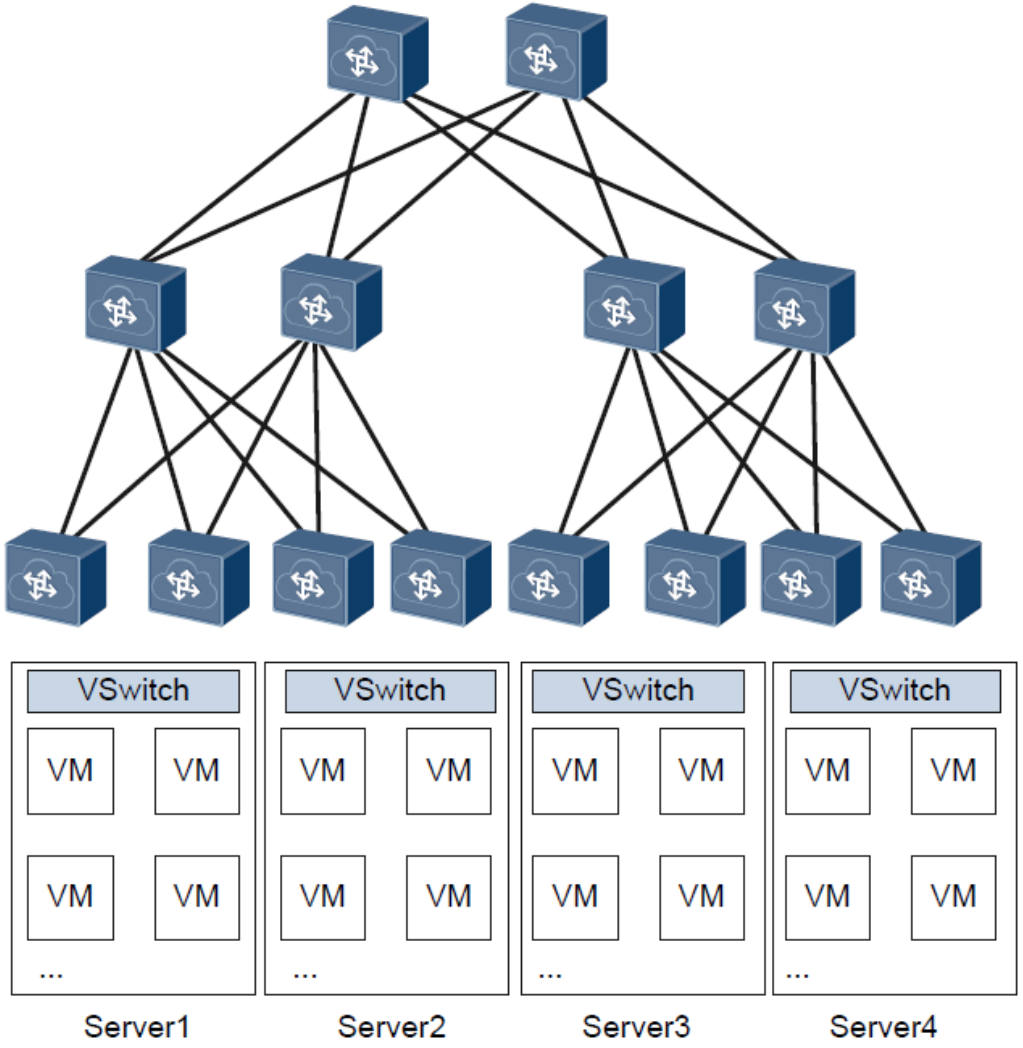
VxLAN



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VxLAN

- Tecnologia molto importante utilizzata in ambito DCN (Data Center Network) ;
- Consente di superare il limite delle 4096 VLAN realizzabili con la 802.1Q;
- Utilizzata per realizzare complessi scenari Layer 2 in ambito DC quando sono utilizzate le tecnologie di virtualizzazione.

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VxLAN

Caratteristiche principali:

- Supporta 16M segmenti VxLAN;
- Consente di ridurre le dimensioni dei domini di broadcast:
  - Riduzione delle dimensioni delle tabelle ARP;
- Consente di estendere una rete L2 incapsulando MAC in UDP;
- Disaccoppia la rete fisica da quella virtuale, semplificando la gestione della rete.
- Viene definite come “Network Virtualization over Layer 3 (NVo3)”.

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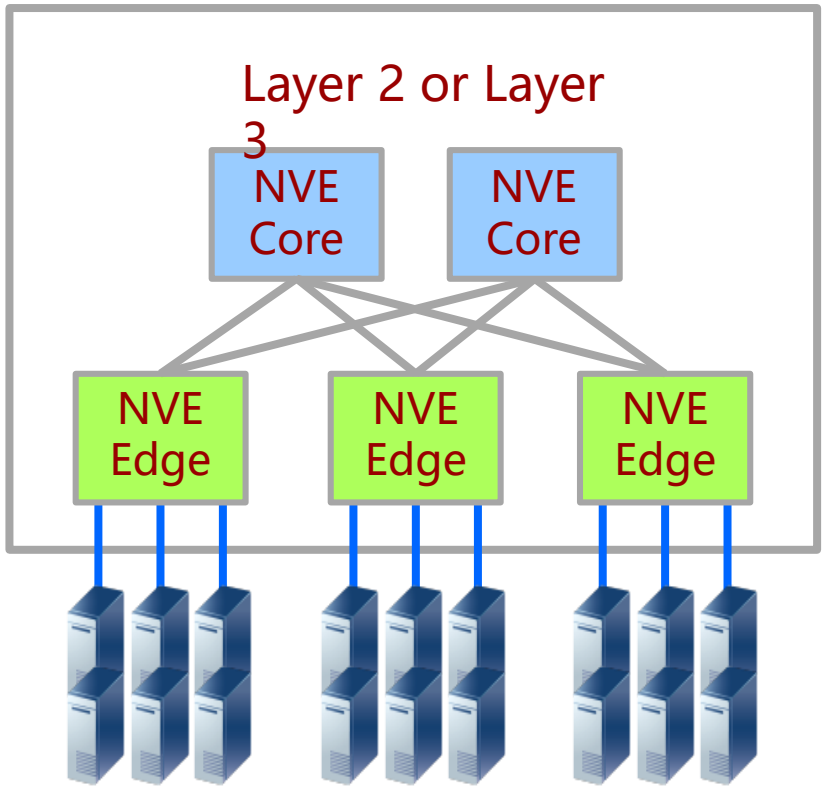
NVO3 and VxLAN Overview



NVO3

NVO3 (Network Virtualization over Layer 3) is a general term for IP overlay network virtualization technology based on Layer 3. The famous NVO3 virtualization technology examples include, VxLAN, NVGRE and STT.

VXLAN

VXLAN is a Network Virtualization over Layer 3 (NVo3) technology that uses MAC in User Datagram Protocol (MAC-in-UDP) to encapsulate packets.

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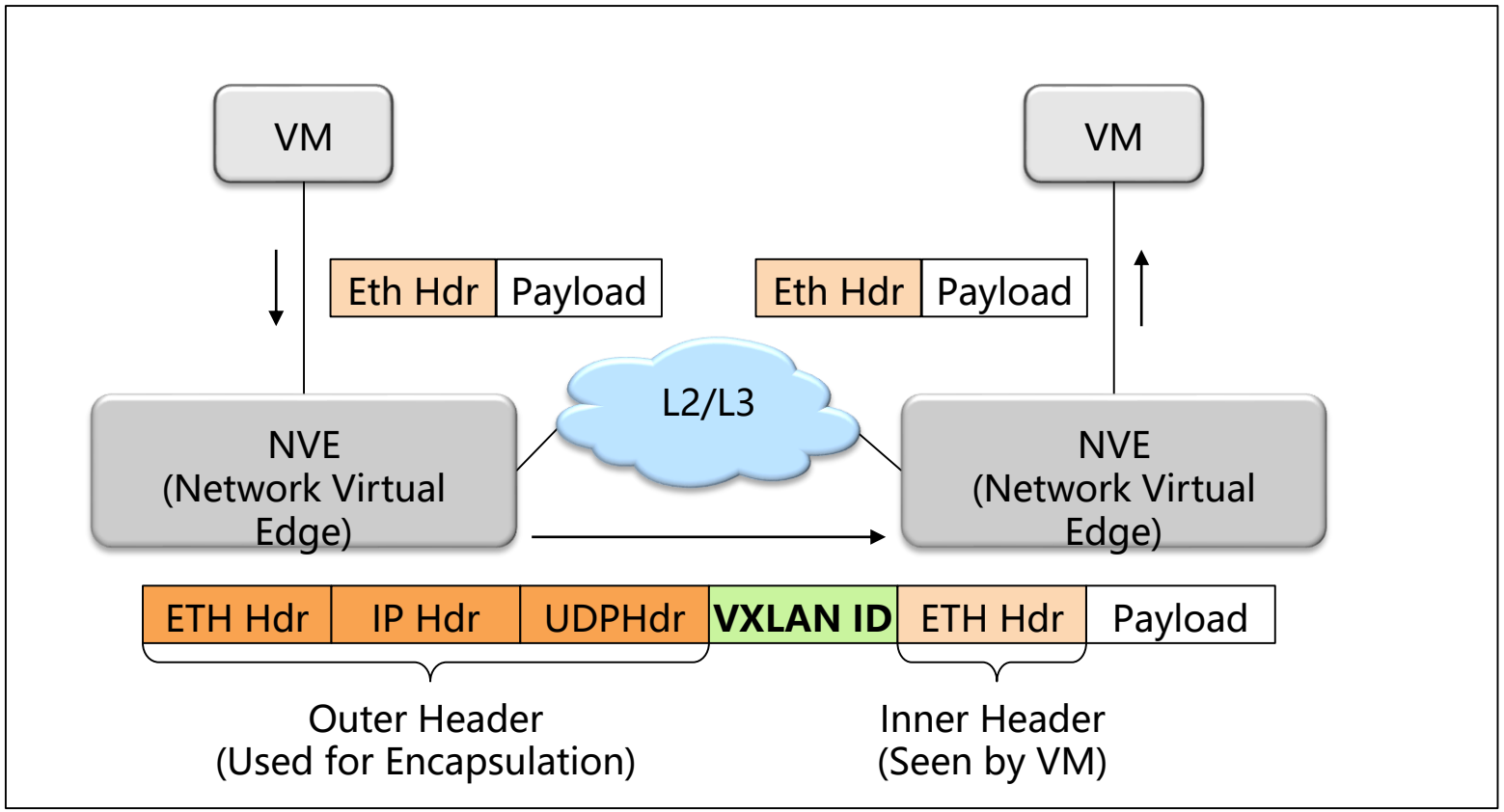
VxLAN Overview



VxLAN Encapsulation Brief Process

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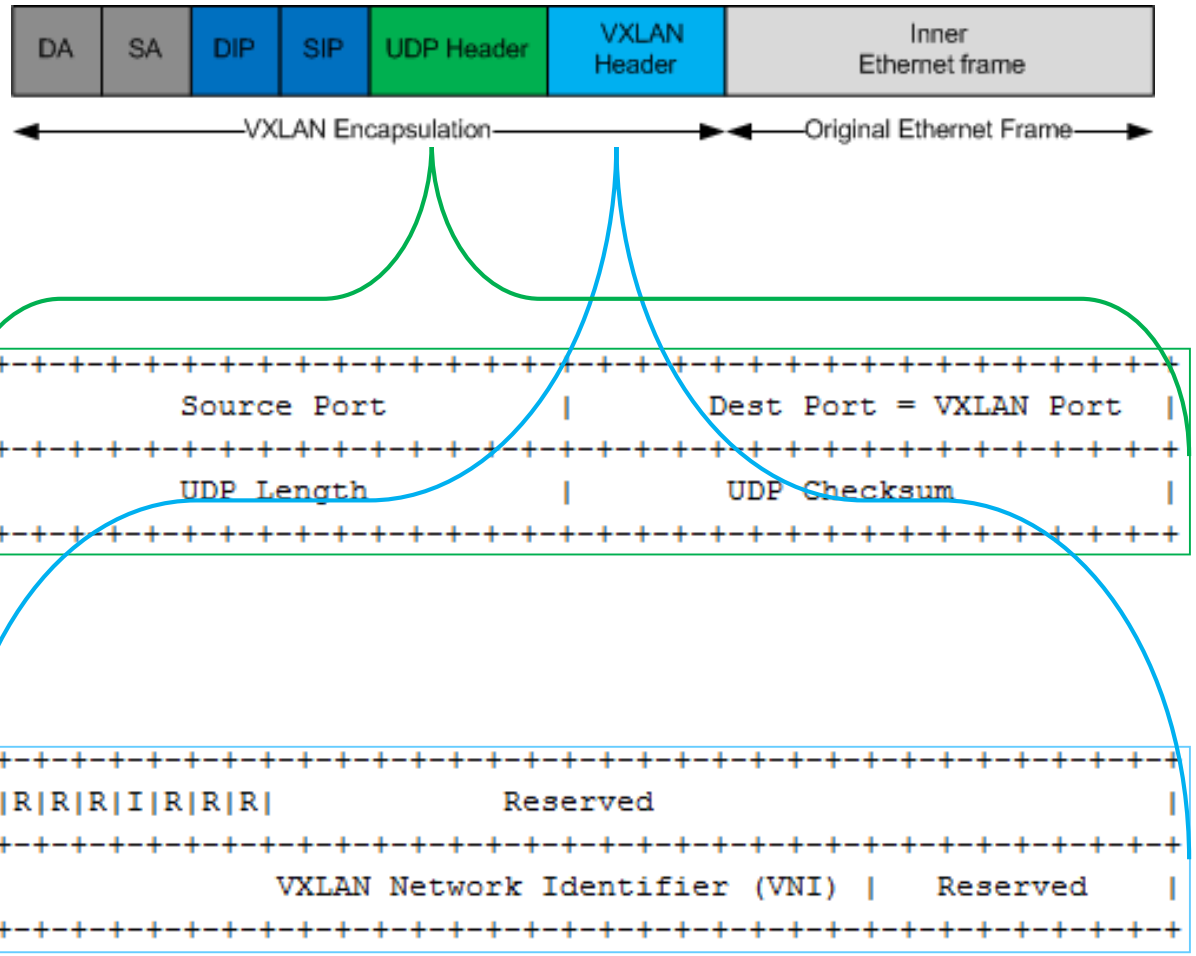
VxLAN Packet Format



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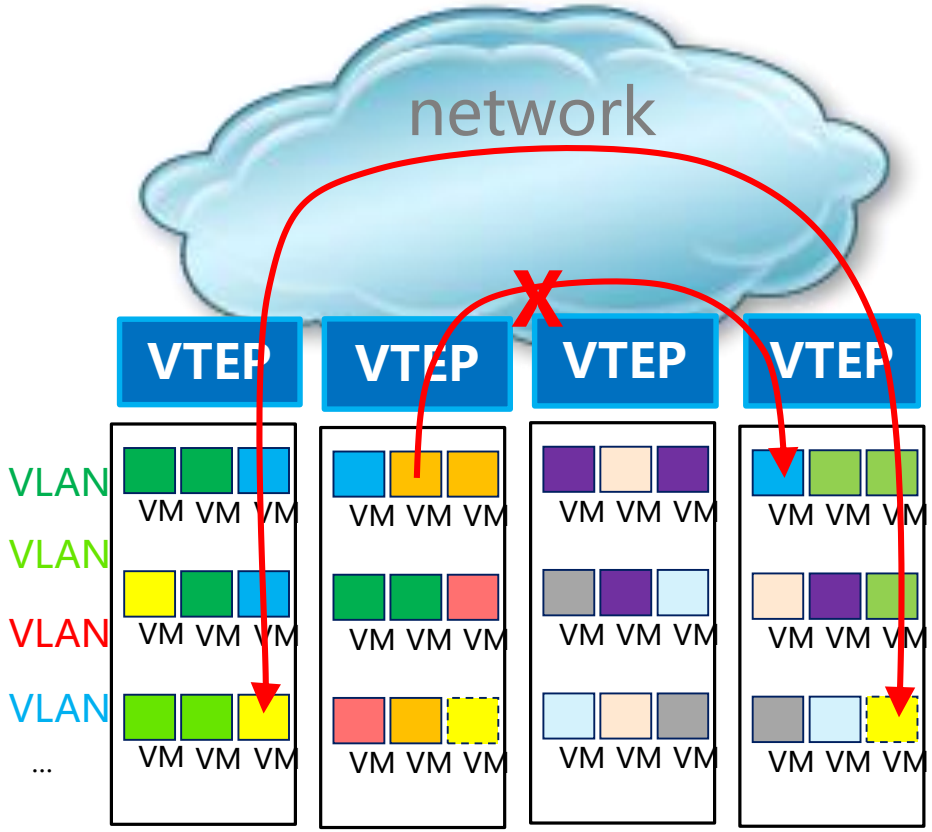
VxLAN Concepts - VNI

- **VNI-** A VXLAN segment identifier similar to a VLAN ID. VMs on different VXLAN segments cannot communicate directly at Layer 2.



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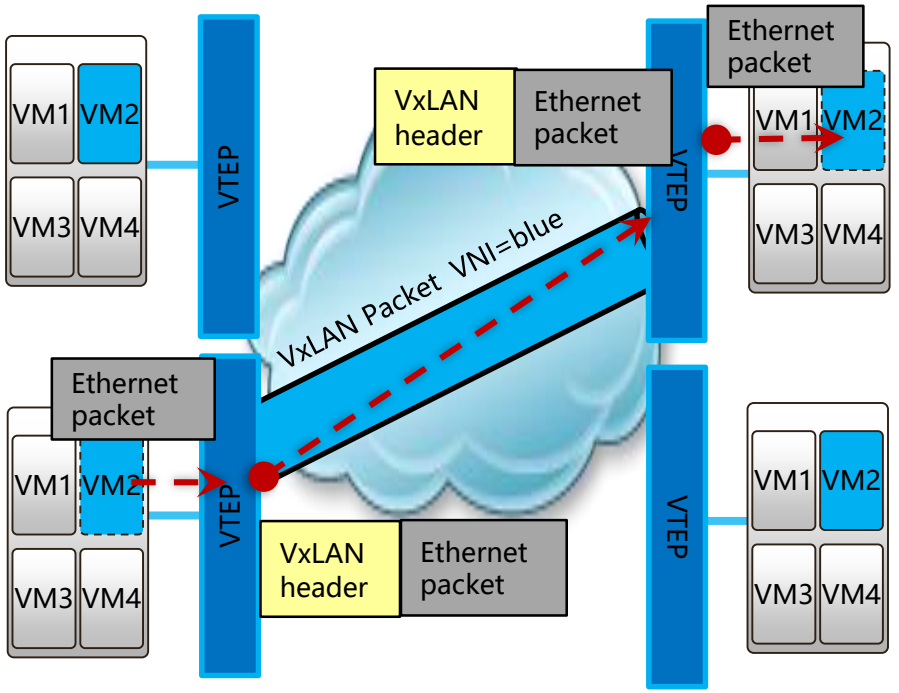
VxLAN Concepts - VTEP

- **VTEP -**A VXLAN tunnel endpoint that encapsulates and decapsulates VXLAN packets. It is represented by an NVE. VTEP can be realized on physical switches (hardware overlay scenario) or logical vSwithes (software overlay scenario).



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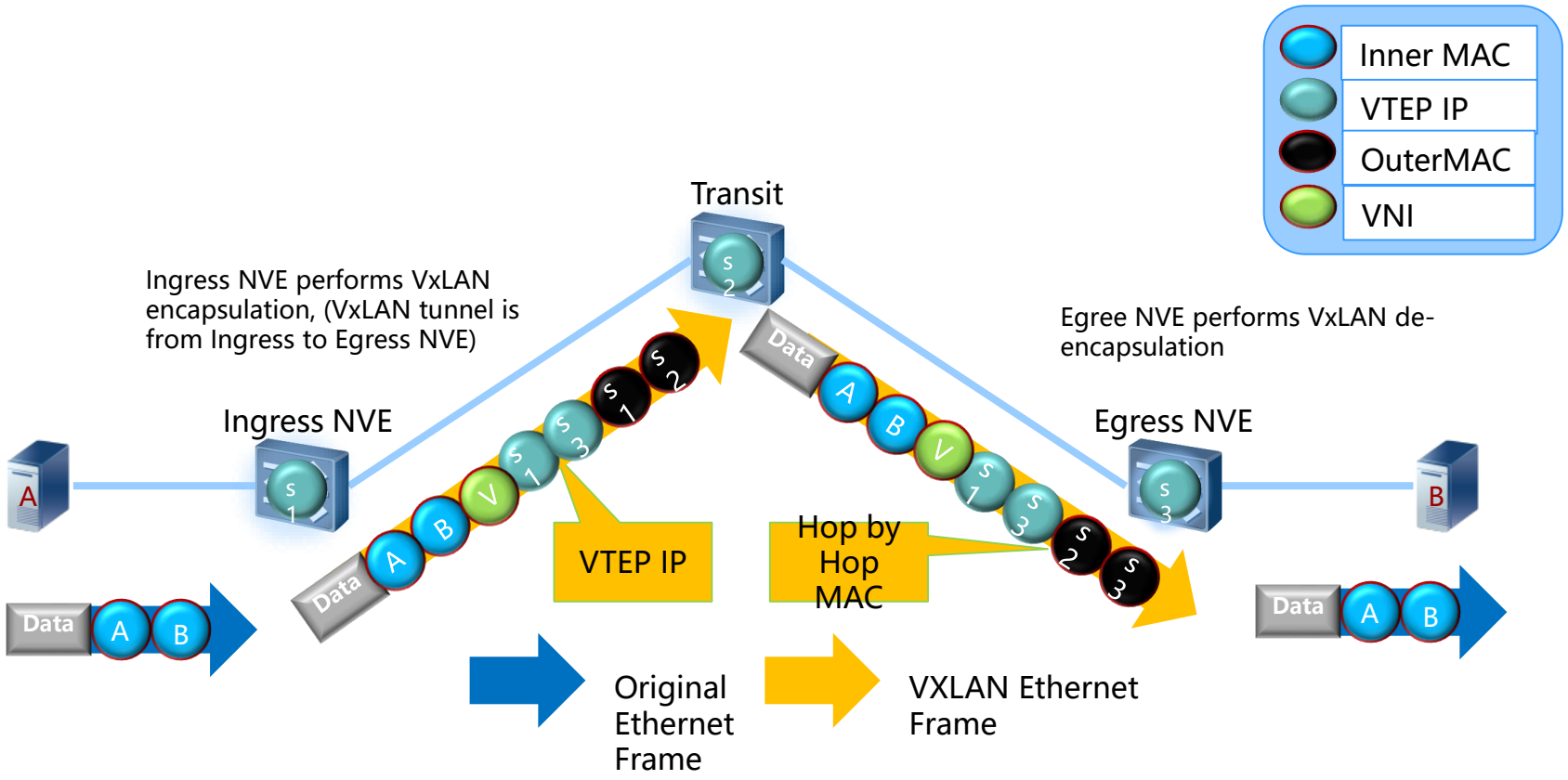
VxLAN Packet Encapsulation Process



The Layer 2 Ethernet frame can be sent through IP network transparently on top of L3 IP network; VxLAN network is similar to Bridge Fabric for end terminal.

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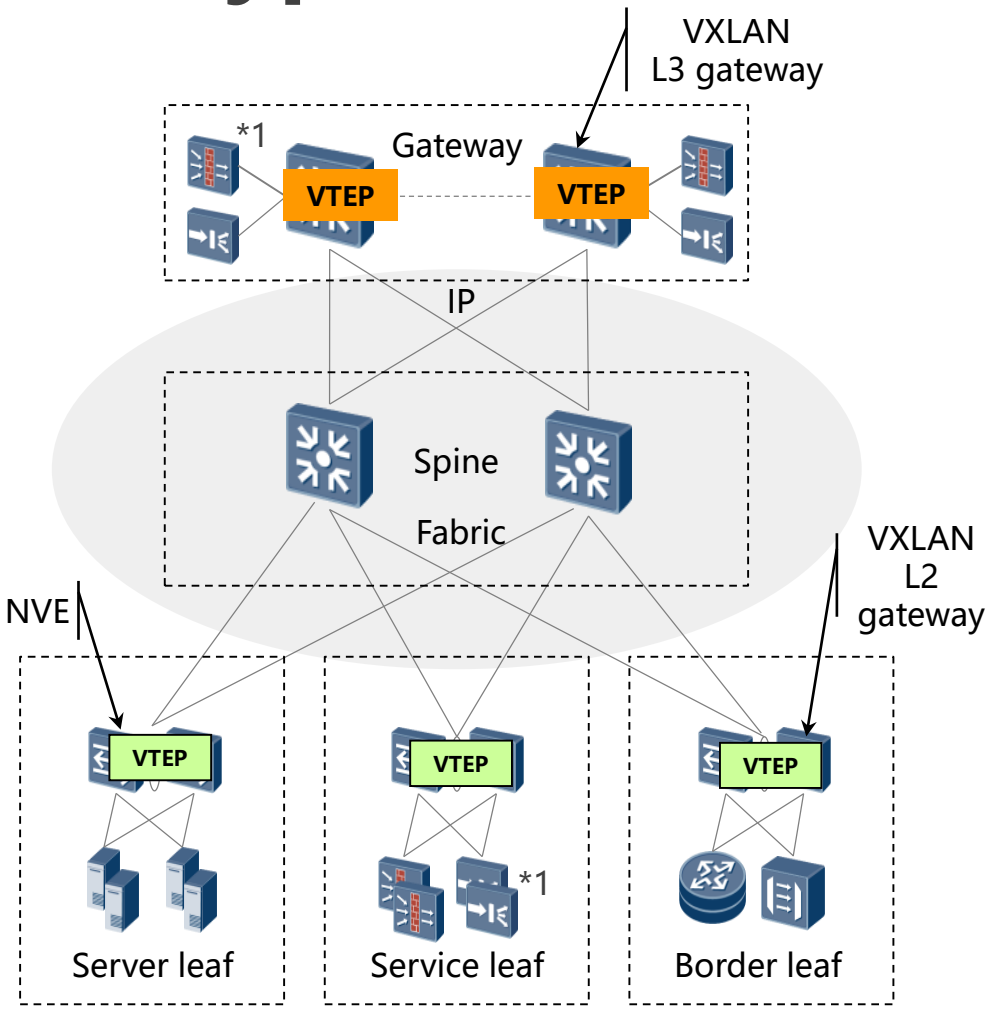
VxLAN Typical Network



*1: L4-L7 value-added service devices can be connected to gateways in bypass mode or connect to the VXLAN fabric network thought service leaf nodes.

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Summary

- If a trunk link has a PVID of 5 and the command port trunk allow-pass vlan 2 3 is used, which VLAN traffic will be carried over the trunk?
- What action will be taken by an access port with a PVID of 2 when receiving an untagged frame?

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