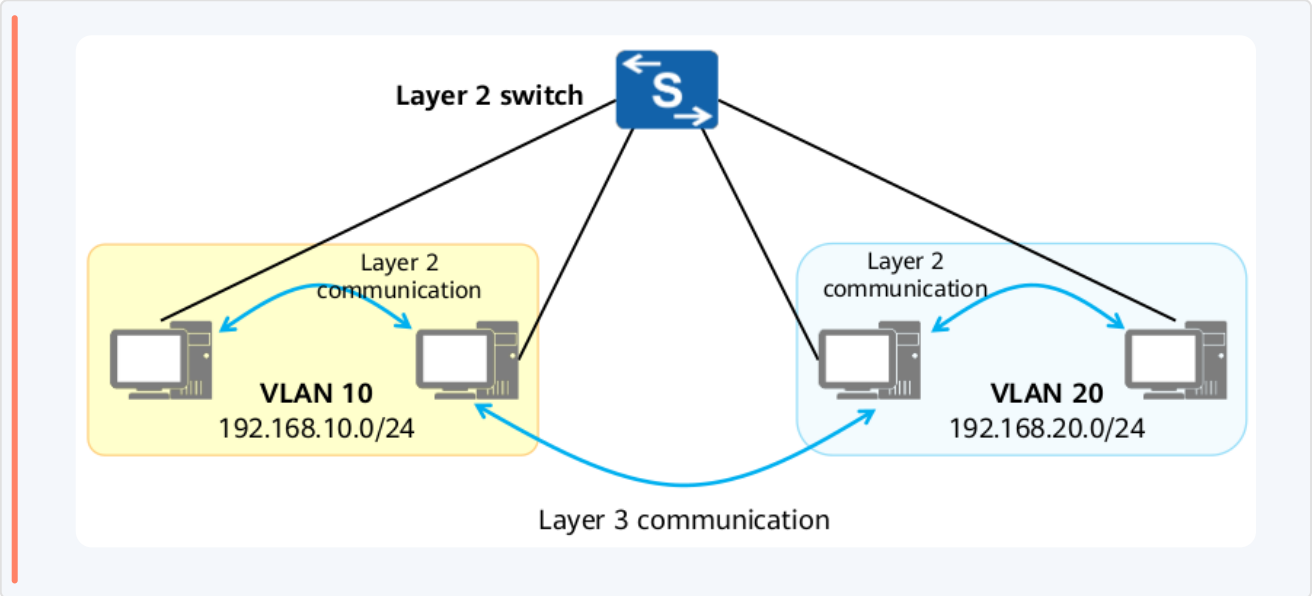
Inter-VLAN Communication

1 Inter-VLAN Communication

1.1 Background

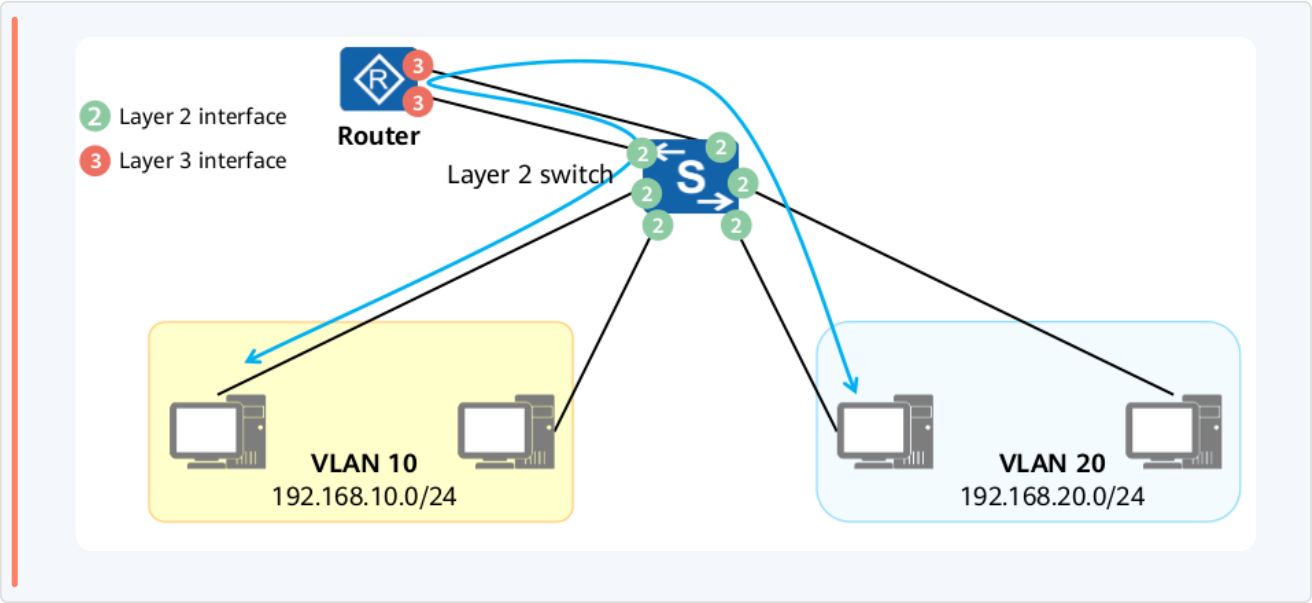
1.1.1 Layer 2 Communication

- Devices within the same VLAN and IP segment can communicate directly.
- This is called **Layer 2 communication** because it operates on the data link layer of the OSI model.
- No Layer 3 devices (routers) are required for this communication.



1.1.2 Layer 3 Communication (Inter-VLAN)

- Inter-VLAN communication requires crossing between different network segments.
- This necessitates the use of **Layer 3 devices** for routing packets between VLANs.
- **Common Layer 3 devices:** routers, Layer 3 switches, firewalls, etc.



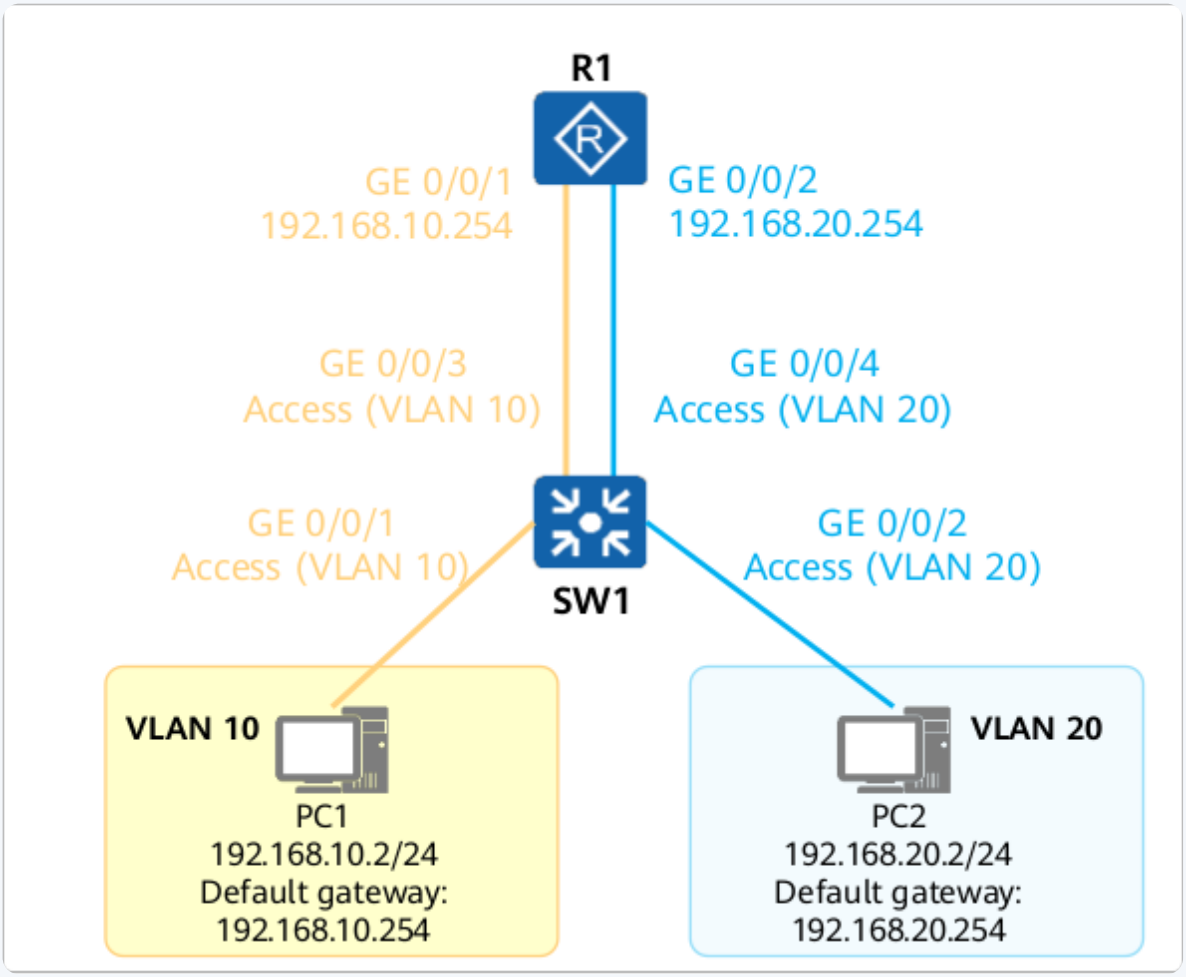
1.2 Using Routers' Physical Interfaces or Sub-interfaces to Implement Inter-VLAN Communication

1.2.1 Physical Interface Overview

Routers use physical interfaces to connect to different network segments and act as gateways. Each interface has its own IP address to manage traffic for specific VLANs. However, scalability is limited since one physical interface handles only one VLAN.

> The Layer 3 interfaces of the router cannot process data frames with VLAN tags. Therefore, the interfaces of the switch connected to the router

must be set to the access type.



Example

- R1 GE 0/0/1: `192.168.10.254` (VLAN 10)
- R1 GE 0/0/2: `192.168.20.254` (VLAN 20)

1.2.2 Sub-interface Overview

Sub-interfaces allow a single physical interface to manage multiple VLANs by using VLAN tags. They are Virtual interfaces that can perform Layer 3 forwarding and process tagged frames.

- **Benefits**:
  - Increased scalability

- Efficient use of physical interfaces

1.2.2.1 Sub-interface Processing Steps

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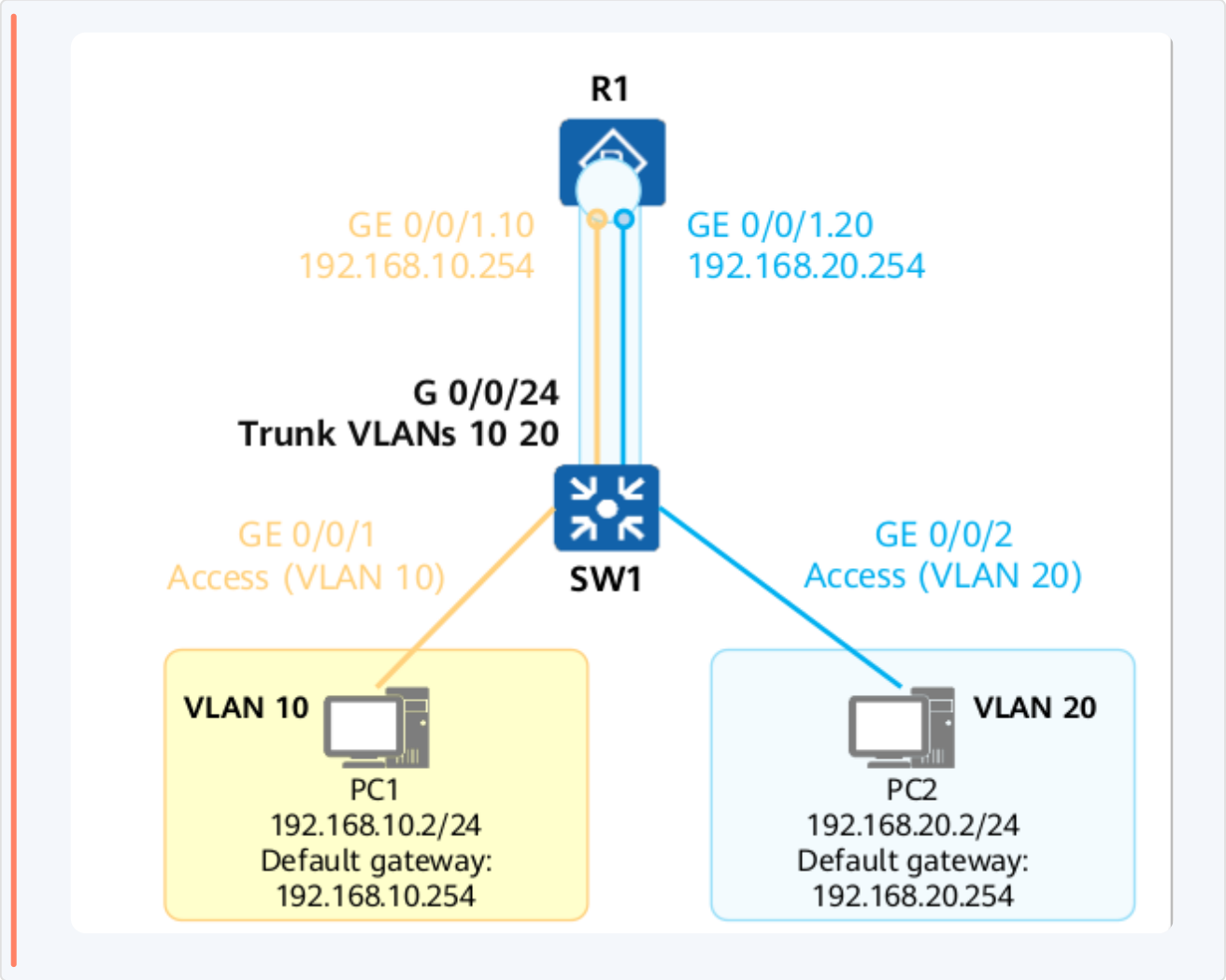
1. Connect router's physical interface to switch's trunk port.
2. Router forwards packets based on VLAN tags to appropriate sub-interface.

> - VLANs use tagging to distinguish frames on a trunk port, typically using IEEE 802.1Q to add VLAN ID and priority information to Ethernet frame headers.
> - Routers use sub-interfaces for each VLAN and logically strip the VLAN tag to make routing decisions based on Layer 3 IP addresses.
> - Routers retag frames with new VLAN IDs if they need to be sent back into a VLAN-enabled network segment after Layer 3 processing.



1.2.2.2 Configuring Sub-interfaces (Huawei CLI)

```markdown
1]interface <interface-type> <interface-number>.<sub-
terface number>
1-GigabitEthernet0/0/1.1]dot1q termination vid <vid>
[R1-GigabitEthernet0/0/1.1]ip address <IP_ADDRESS>
<SUBNET_MASK>
[R1-GigabitEthernet0/0/1.1]arp broadcast <option>
```

- **Sub-interface number:** number/VLAN ID.
- **vid:** Set the VLAN ID for tag termination.
- **option:** set ARP broadcast if needed.

> `dot1q termination vid <vid>` : This command applies the IEEE 802.1Q standard to terminate VLAN traffic from a trunk link, associating it with a specified VLAN ID on that subinterface.

> `arp broadcast <option>` : disable/enable ARP broadcasting on the sub-interface, typically used when a host initiates communication without knowing its gateway's MAC address

1.2.3 Key Points Table

Feature	Physical Interface	Sub-interface
Layer	Layer 3	Layer 3
VLAN Support	One per interface	Multiple with tagging
Scalability	Poor (limited by number of interfaces)	Good (multiple sub-interfaces per physical port)
Tag Processing	Cannot process tagged frames	Can terminate and add tags

1.3 Using VLANIF Interfaces to Implement Inter-VLAN Communication

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1.3.1 Overview

- A **Layer 2 switch** provides **only Layer 2 switching functions**.
- A **Layer 3 switch** combines Layer 2 switching with **routing functions** through VLANIF interfaces.

1.3.1.1 VLANIF Interface

> A VLANIF interface is a virtual Layer 3 interface used for inter-VLAN routing. It can add or remove VLAN tags to facilitate communication between different VLANs.

> A frame arriving at a switch is tagged for a VLAN, routed via the VLANIF interface, decapsulated, re-encapsulated with a new VLAN tag after IP examination since routing module dont support Vlan and its workd with ip address, and sent to the destination VLAN.

> each VLANIF interface is associated with one specific VLAN ID.

1.3.2 Configuration Example

1.3.2.1 Basic Configurations

```Markdown
[SW1]interface Vlanif <vid>
[SW1-Vlanif10]ip address <ip address> <mask>
```

> The IP address of a VLANIF interface is used as the gateway IP address

1.3.2.2 Step by Step Explanation

1. PC determines if destination is on the same network segment.
2. Packet sent to switch's routing module based on MAC address.
3. Routing module performs L3 forwarding decision based on routing table.
4. Switch obtains destination MAC from ARP table and sends to switching module.

5. Switching module determines outbound interface and whether the frame needs a VLAN tag.

1.4 Layer 3 Communication Process

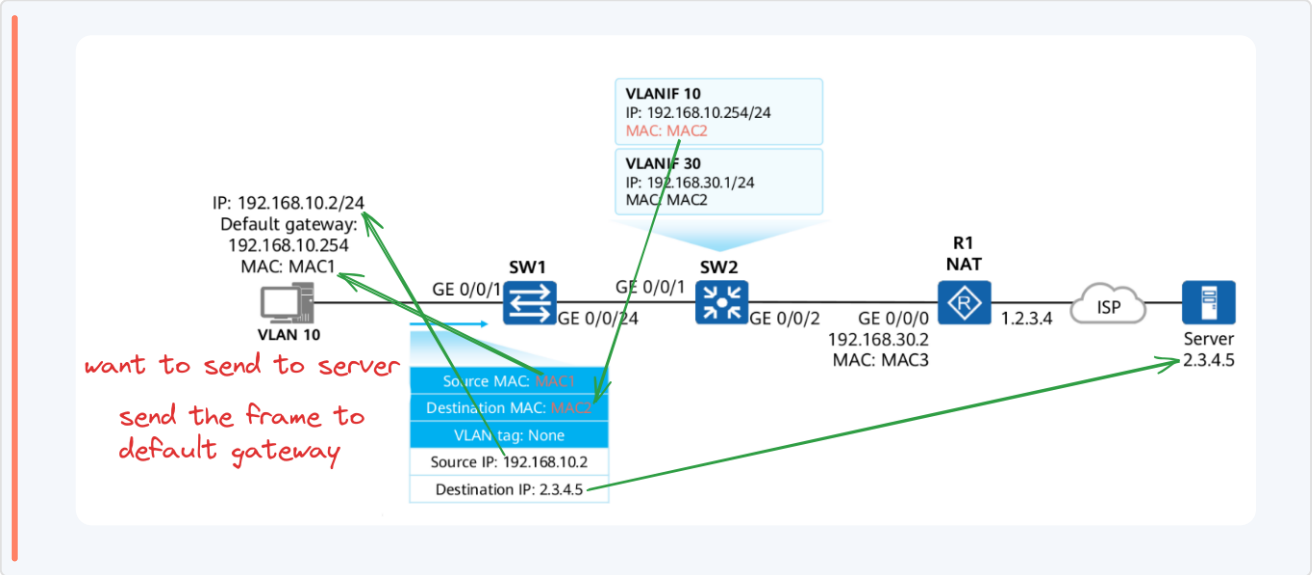
1.4.1 Communication Process from PC1 to Server

1.4.1.1 Step by Step Process:

1.4.1.1.1 Step 1:

PC Processing:

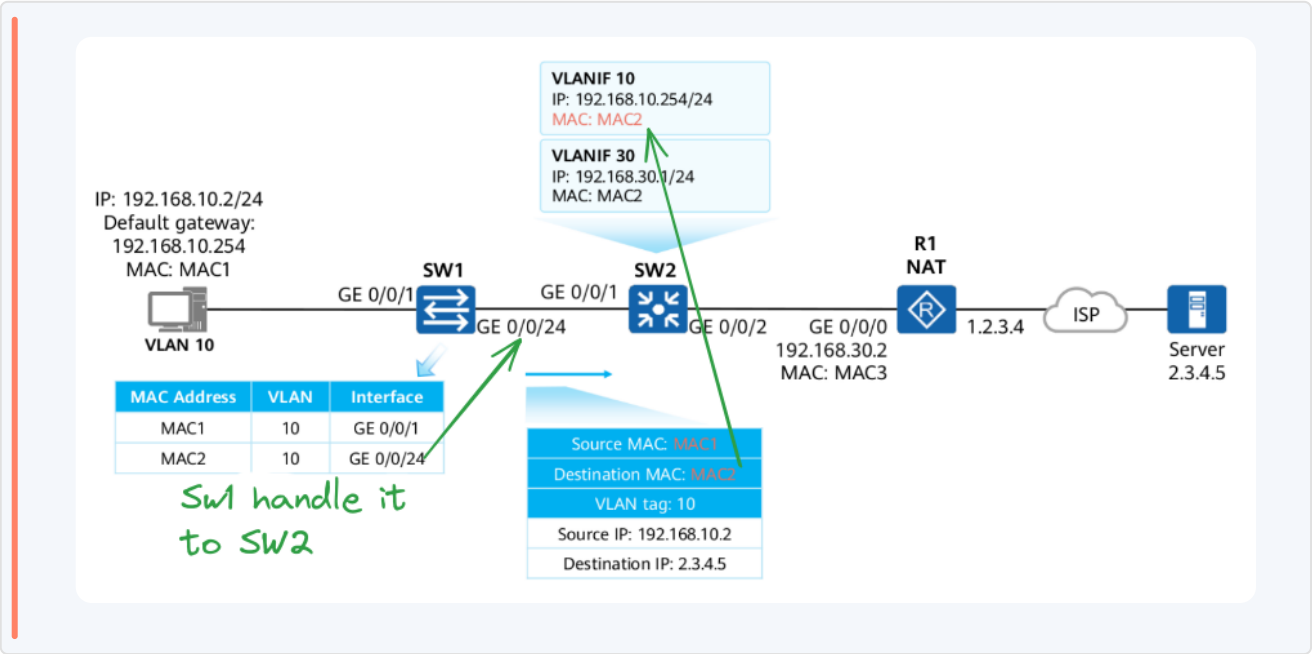
- PC checks if destination IP is local.
- Sends packet to its default gateway if not local.



1.4.1.1.2 Step 2:

SW Processing:

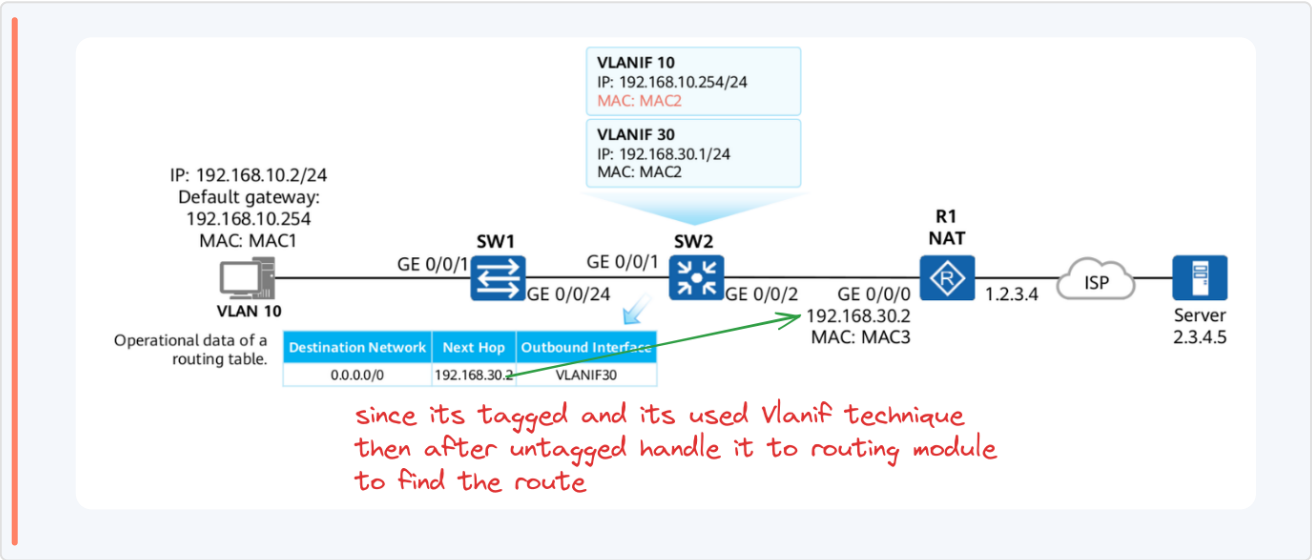
- Looks up MAC address table.
- Forwards frame based on destination MAC.



1.4.1.1.3 Step 3:

Routing Module Processing at SW:

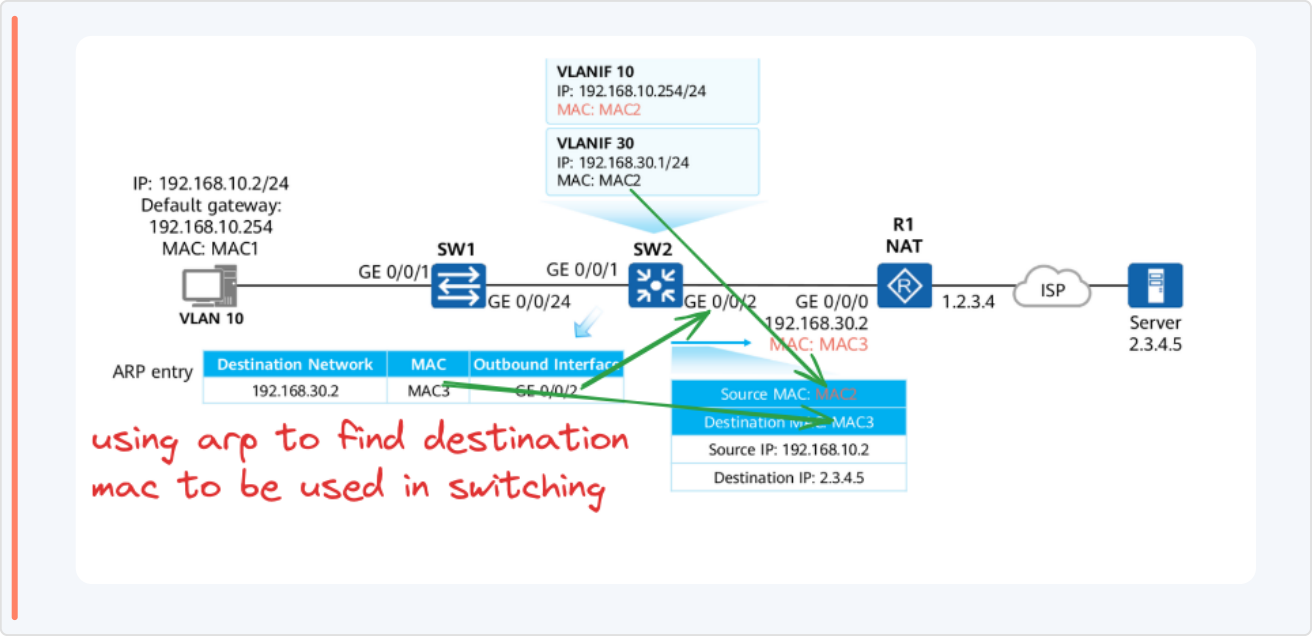
- Receives frame meant for another network.
- Checks routing table, forwards to next hop.



1.4.1.1.4 Step 4:

SW Processing:

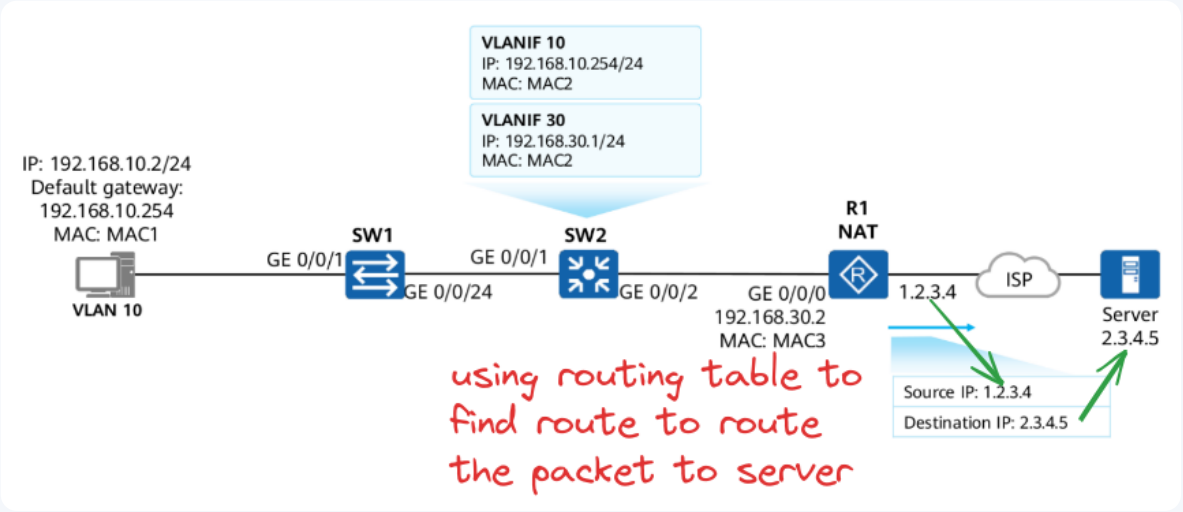
- After finding the MAC address switch Prepares Packet for Outbound interface



1.4.1.1.5 Step5:

R Router NAT Processing:

- Checks the destination IP address and finds that it is not a local IP address.
- Searches the routing table, finds a default matching route, and forwards the packet
- Performs NAT on packets leaving intranet.



1.4.2 Comparison between Layer 2 and Layer 3 interfaces

Aspect	Layer 2 Interface	Layer 3 Interface
IP Address Configuration	Cannot be assigned an IP address.	Can be assigned an IP address.
MAC Address Presence	Doesn't have a MAC address.	Has a MAC address.
Data Handling	Uses MAC table to forward or flood frames.	Uses routing table to forward packets or discards them.
Typical Devices	Found on Layer 2 switches.	Found on routers and Layer 3 switches.
Broadcast Domain Isolation	Does not isolate; floods broadcasts.	Isolates; terminates broadcasts without flooding.

> In Huawei networking devices, physical interfaces with IP addresses also have MAC addresses for Layer 2 communication, except for logical or virtual interfaces like loopbacks or tunnels that don't handle Ethernet frames.