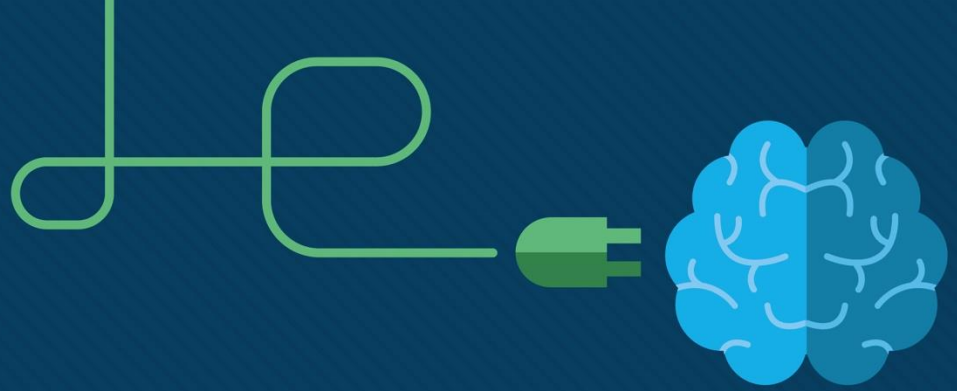


Static Routing

CCNA Routing and Switching

Routing and Switching Essentials v6.0 – Chapter 2

Sections & Objectives

- Static Routing Advantages
  - Explain how static routes are implemented in a small to medium-sized business network.
  - Explain advantages and disadvantages of static routing.
  - Explain the purpose of different types of static routes.
- Configure Static and Default Routes
  - Configure static routes to enable connectivity in a small to medium-sized business network.
  - Configure IPv4 static routes by specifying a next-hop address.
  - Configure an IPv4 default route.
  - Configure IPv6 static routes by specifying a next-hop address.
  - Configure an IPv6 default route.
  - Configure a floating static route to provide a backup connection.
  - Configure IPv4 and IPv6 static host routes that direct traffic to a specific host.

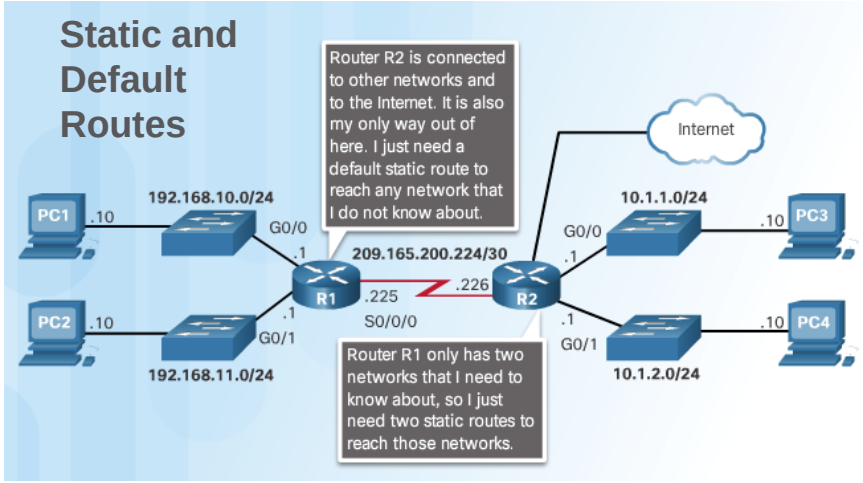
Sections & Objectives (Cont.)

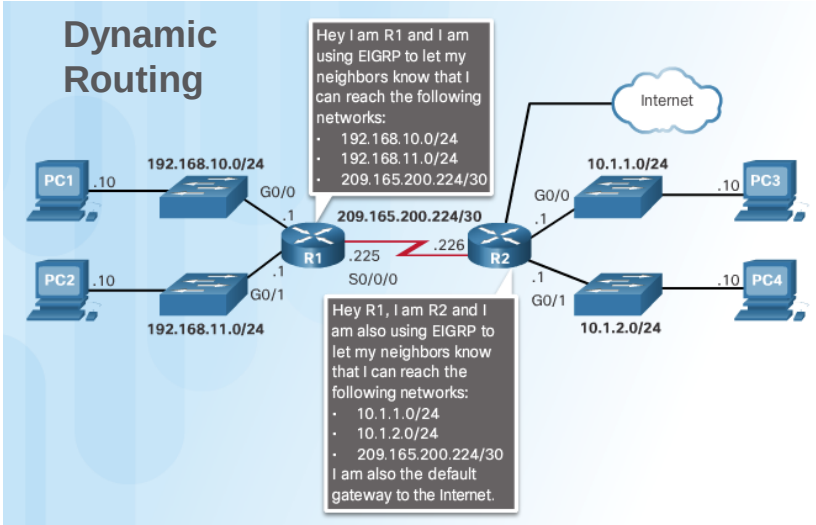
- Troubleshoot Static and Default Routes
  - Given an IP addressing scheme, configure IP address parameters on devices to provide end-to-end connectivity in a small to medium-sized business network.
  - Explain how a router processes packets when a static route is configured.
  - Troubleshoot common static and default route configuration issues.

Implement Static Routes

Reach Remote Networks

- A router learns about remote networks in two ways:
  - Manually entered into the route table using static routes
    - Static routes are not automatically updated and must be reconfigured when topology changes
  - Dynamically (Automatically) learned using a routing protocol





Why Use Static Routing?

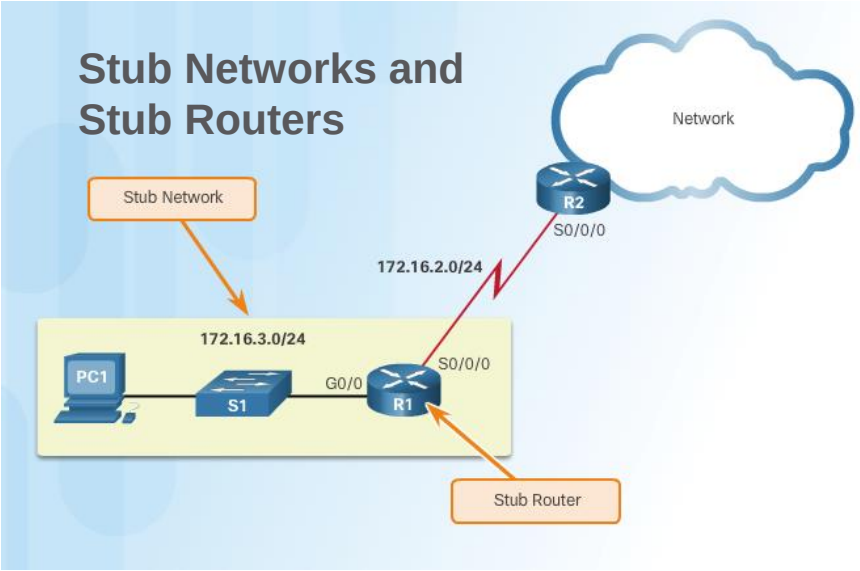
Dynamic versus Static Routing

	Dynamic Routing	Static Routing
Configuration Complexity	Generally independent of the network size	Increases with network size
Topology Changes	Automatically adapts to topology changes	Administrator intervention required
Scaling	Suitable for simple and complex topologies	Suitable for simple topologies
Security	Less secure	More secure
Resource Usage	Uses CPU, memory, link bandwith	No extra resources needed
Predictability	Route depends on the current topology	Route to destination is always the same

When to Use Static Routes

Three uses for static routes:

- Smaller networks that are not expected to grow
- Routing to and from stub networks
  - Stub network accessed by a single route and has one neighbor
  - 172.16.3.0 is a stub network
- A single default route to represent a path to any network not found in the routing table
  - Use default route on R1 to point to R2 for all other networks



Activity

Identify the Advantages and Disadvantages of Static Routing

Instruction

Determine whether the static routing descriptors are advantages or disadvantages of static routing.Click the appropriate field next to each descriptor to indicate your answers.

	Advantage	Disadvantage
Configuration complexity increases with network size.		✖
No extra resources (CPU, bandwidth, etc.) are needed.	✖	
Topology changes will affect configuration.		✖
Route path to destination is always the same.	✖	
Routing tables are small and maintenance is minimal.	✖	
No automatic updates will be made to the routing table if topology changes.		✖

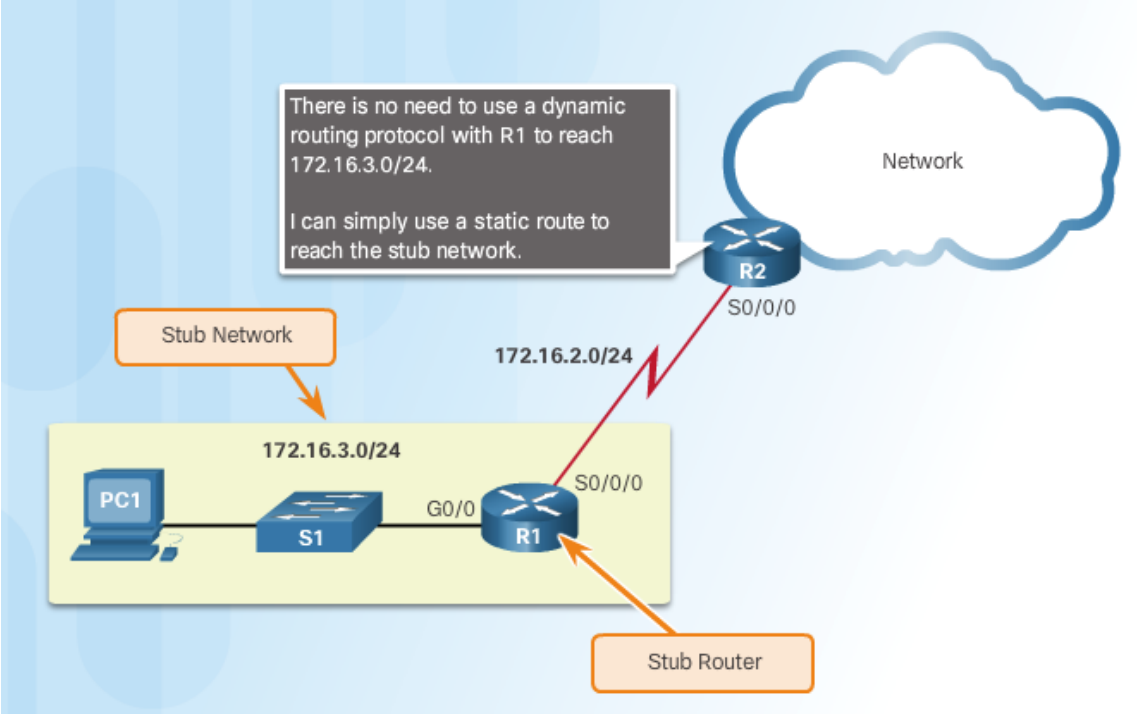
Static Route Applications

Use Static Routes To:

- Connect to a specific network
- Connect a stub router
- Summarize routing table entries which reduces size of routing advertisements
- Create a backup route in case a primary route link fails

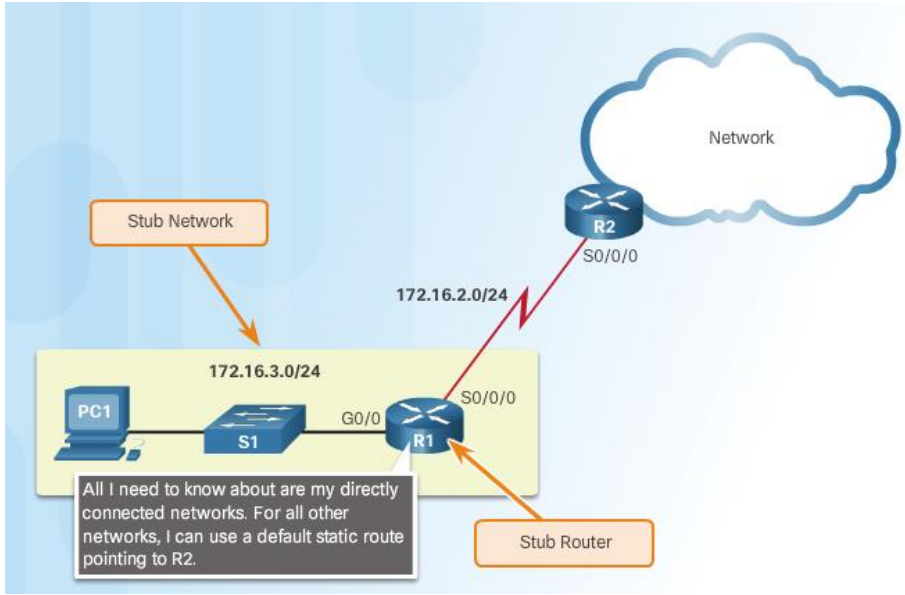
Standard Static Route

- R2 configured with a static route to reach the stub network 172.16.3.0/24



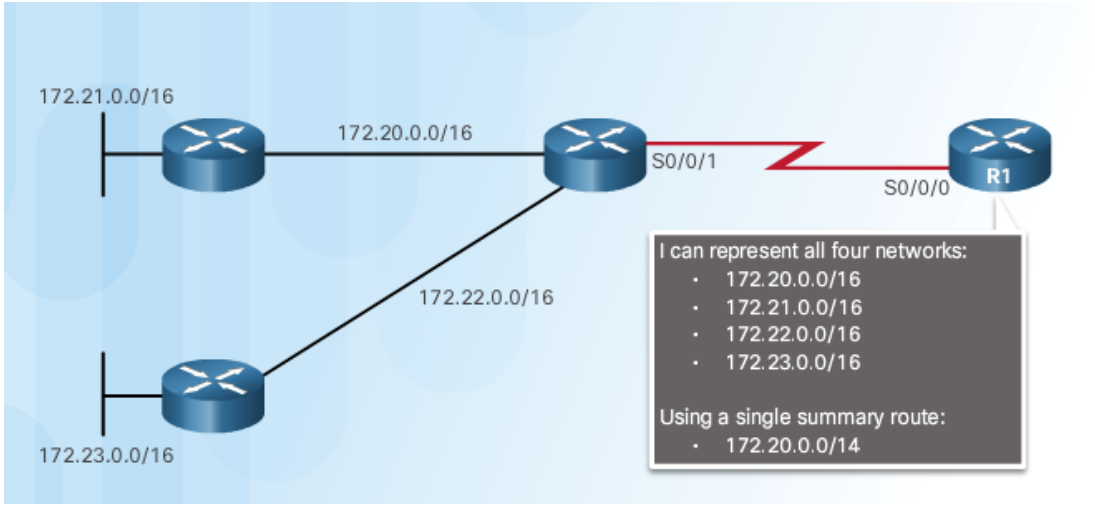
Default Static Route

- Default route matches all packets and is used when a packet does not match a specific route in the routing table
- Can be dynamically learned or statically configured
- Default Static route uses 0.0.0.0/0 as the destination IPv4 address
- Creates a Gateway of Last Resort
- Common use is when connecting a company's edge router to the ISP network
- Router has only one router to which it is connected



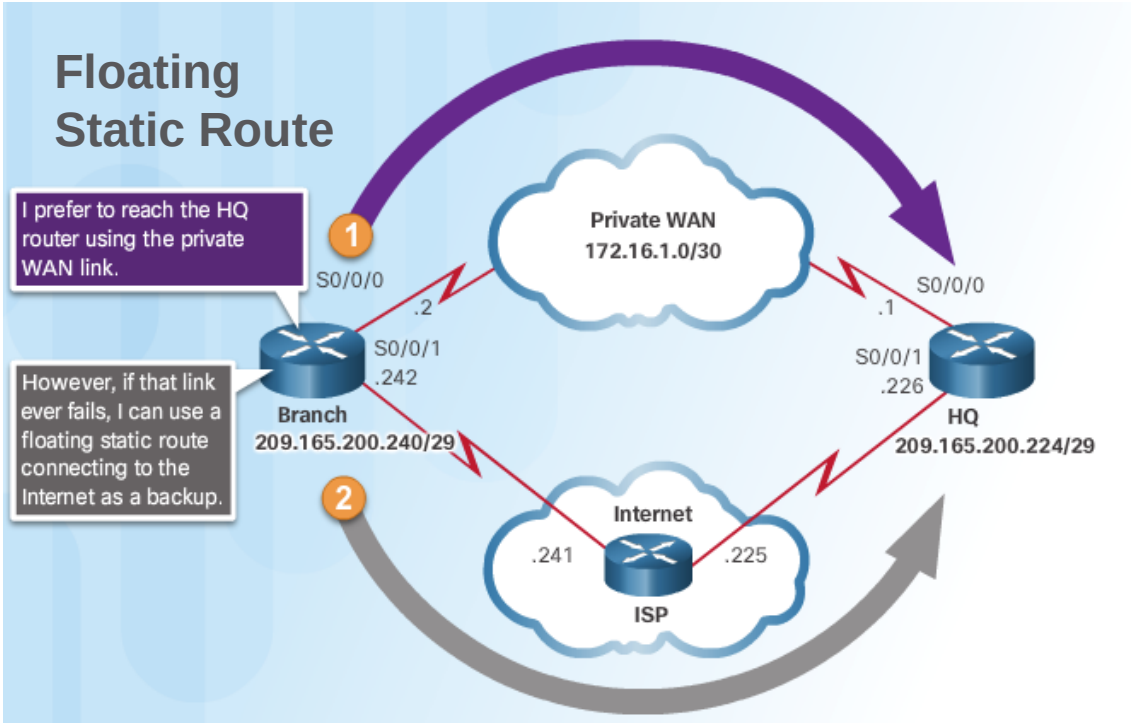
Summary Static Route

- Multiple static routes can be summarized into a single network address
  - Destination networks must be contiguous
  - Multiple static routes must use the same exit interface or next hop
  - In figure, four networks is summarized into one summary static route



Floating Static Route

- Static routes that are used to provide a backup path
- Used when primary route is not available
- Configured with a higher administrative distance (trustworthiness) than the primary route
- Example: EIGRP administrative distance equals 90. A floating static route with an AD of 91 or higher would serve as backup route and will be used if EIGRP route goes down.



Activity

Identify the Type od Static Route

Instructions

Determine the static route type based on each descriptor in the table.Click the appropriate field next to each descriptor to indicate your answers.

	Standard	Default	Floating
Backs up a route already discovered by a dynamic routing protocol.			✖
Matches all packets and sends them to a specific default gateway.		✖	
Useful when connecting to stub networks.	✖		
Configured with a higher administrative distance than the original dynamic routing protocol.			✖
Commonly used with edge routers to connect to the ISP network.		✖	

Configure Static and Default Routes

ip route Command

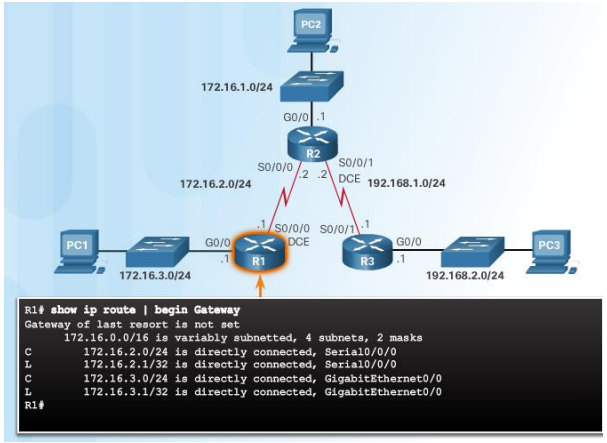
ip route Command Syntax

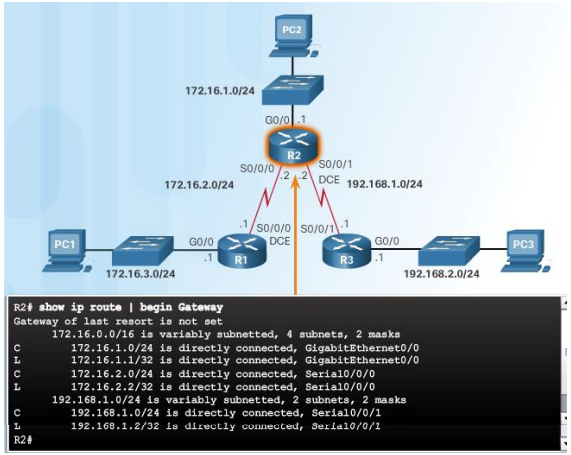
```
Router(config)# ip route network-address subnet-mask {ip-address | exit-intf}
```

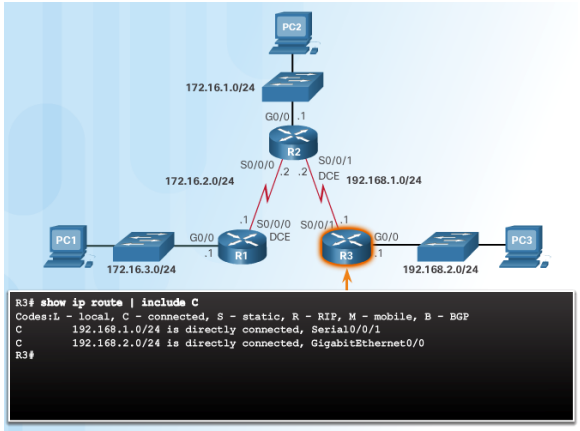
Parameter	Description
network-address	Destination network address of the remote network to be added to the routing table
subnet-mask	• Subnet mask of the remote network to be added to the routing table. • The subnet mask can be modified to summarize a group of networks.
ip-address	• Commonly referred to as the next-hop router's IP address. • Typically used when connecting to a broadcast media (i.e., Ethernet). • Commonly creates a recursive lookup
exit-intf	• Use the outgoing interface to forward packets to the destination network. • Also referred to as a directly attached static route. • Typically used when connecting in a point-to-point configuration.
distance	• (Optional) Configures an administrative distance. • Typically used to configure a floating static route.

Next-Hop Options

- In this example, each router only has entries for directly connected network

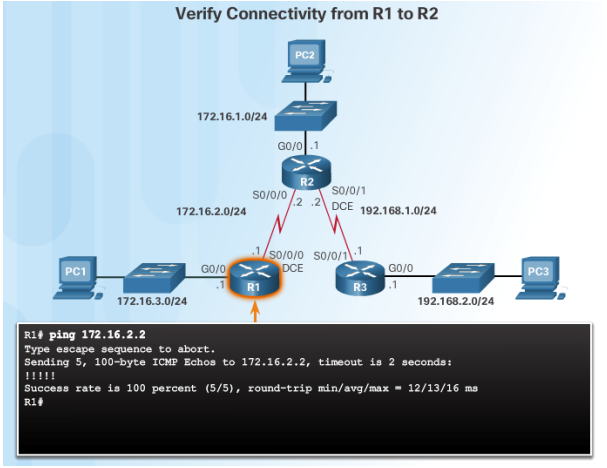


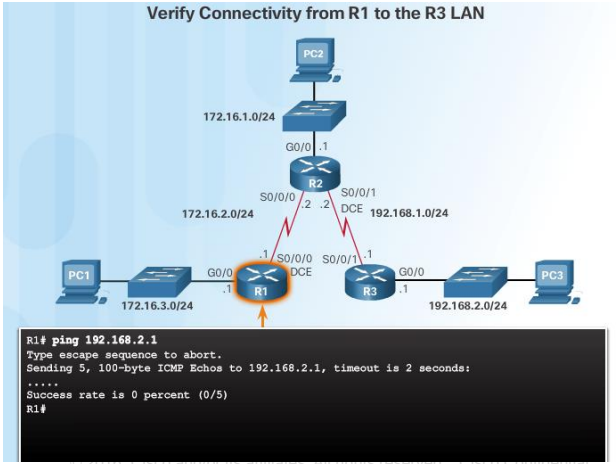




Next-Hop Options (Cont.)

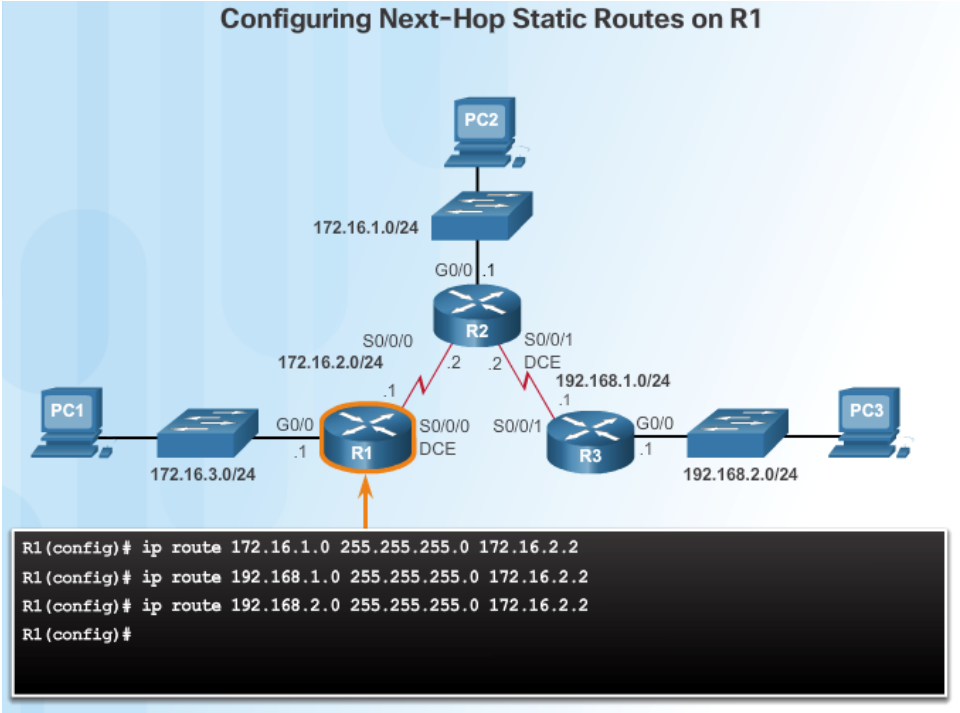
- R1 does not have an entry in its routing table for the R3 LAN network
- In a static route next-hop can be identified by
  - Next-hop IP address
  - Router exit interface
  - Next-hop IP address and exit interface





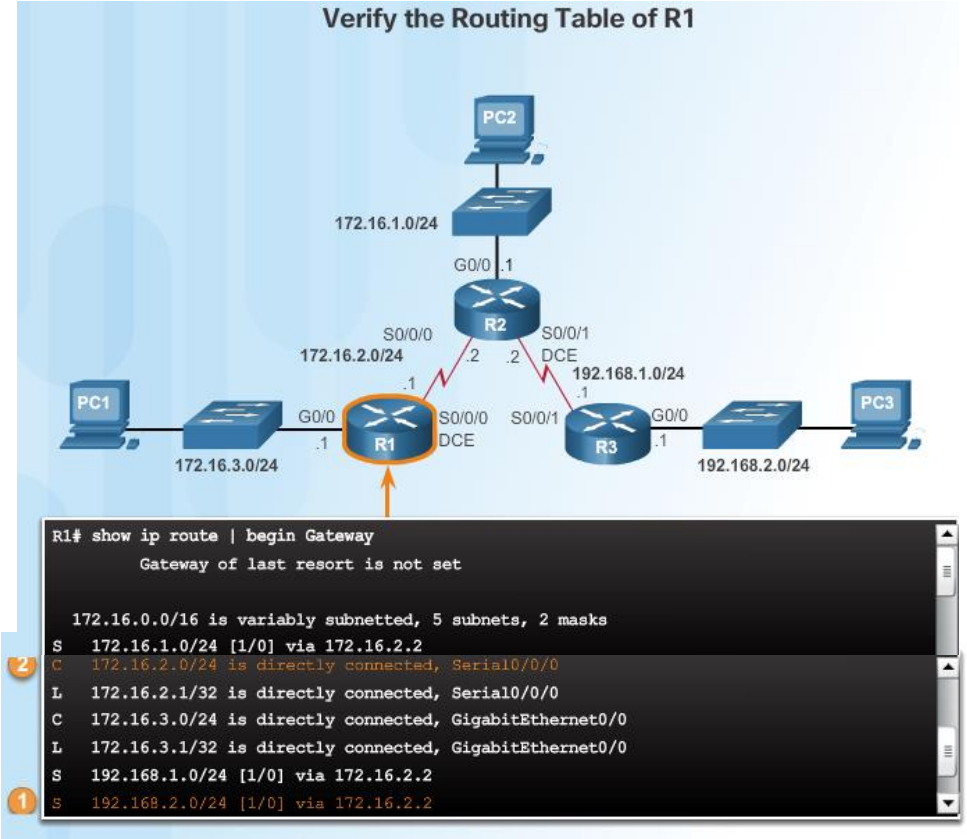
Configure a Next-Hop Static Route

- In this example, only the next-hop IP address is specified
- Before packet is forwarded the router must determine the exit interface to use (route resolvability)



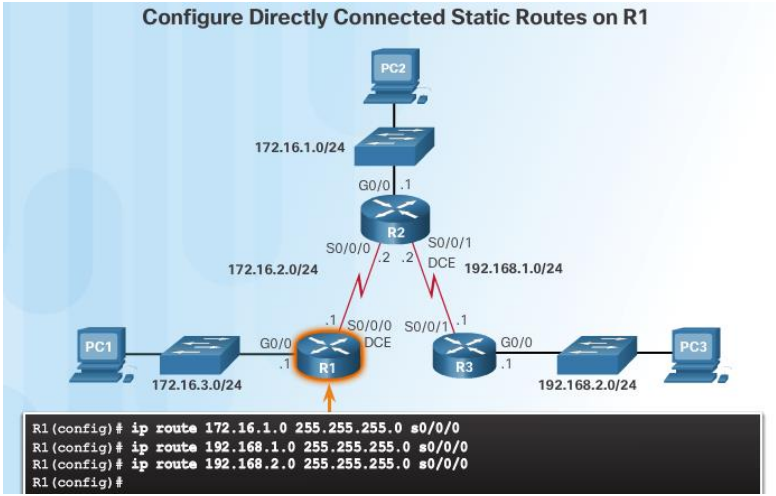
Configure a Next-Hop Static Route (Cont.)

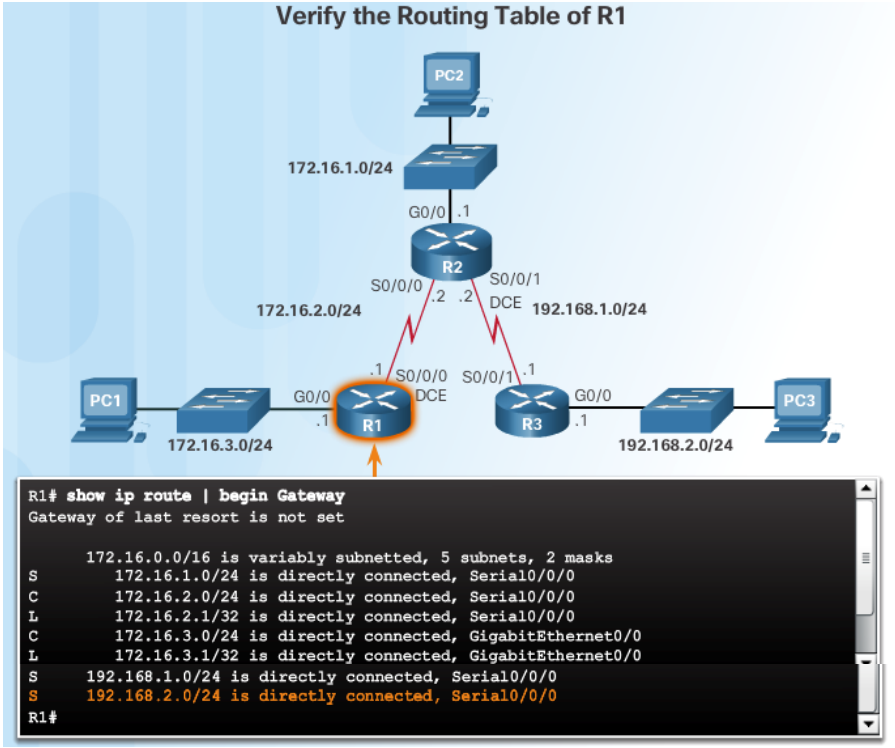
- In example, when a packet is destined for 192.168.2.0/24 network, R1:
  - Looks for match (#1) and needs to forward packets to 172.16.2.2
  - R1 must determine how to reach 172.16.2.2 first
  - Searches a second time for 172.16.2.0/24 (#2) and matches to exit interface s0/0/0
  - Takes two routing table lookups, process referred to as recursive lookup
  - If the exit interface is “down” or “administratively down” then the static route configured with next-hop will not be installed in routing table



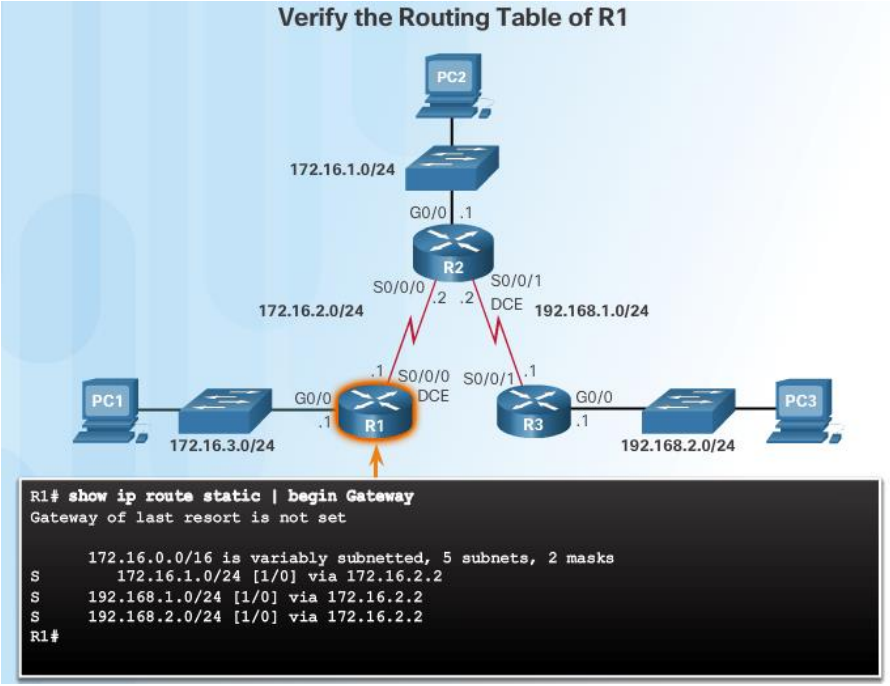
Configure a Directly Connected Static Route

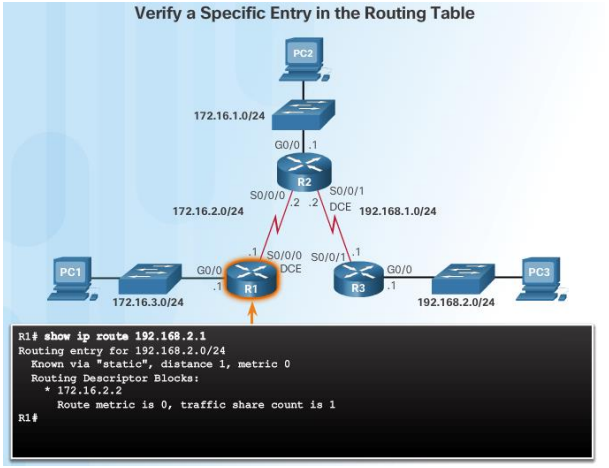
- Use the exit interface to specify next-hop so no other lookups are required
- Administrative distance of static route is 1

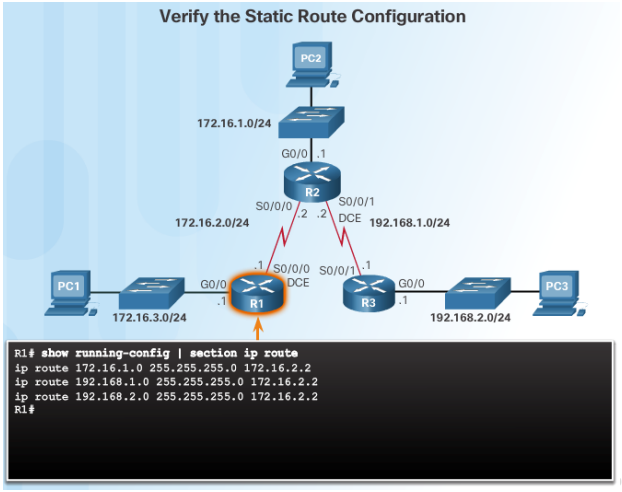




Verify a Static Route

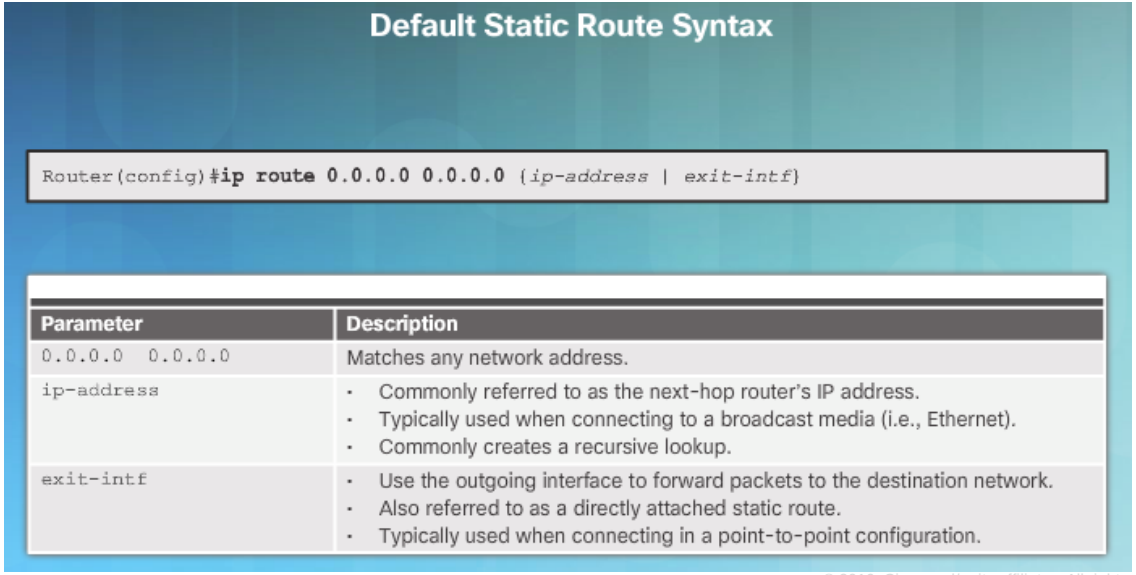






Default Static Route

- Default static routes are commonly used when connecting:
  - An edge router to a service provider network
  - A stub router (a router with only one upstream neighbor router)
- Default route is used when no other routes in the routing table match the destination IP



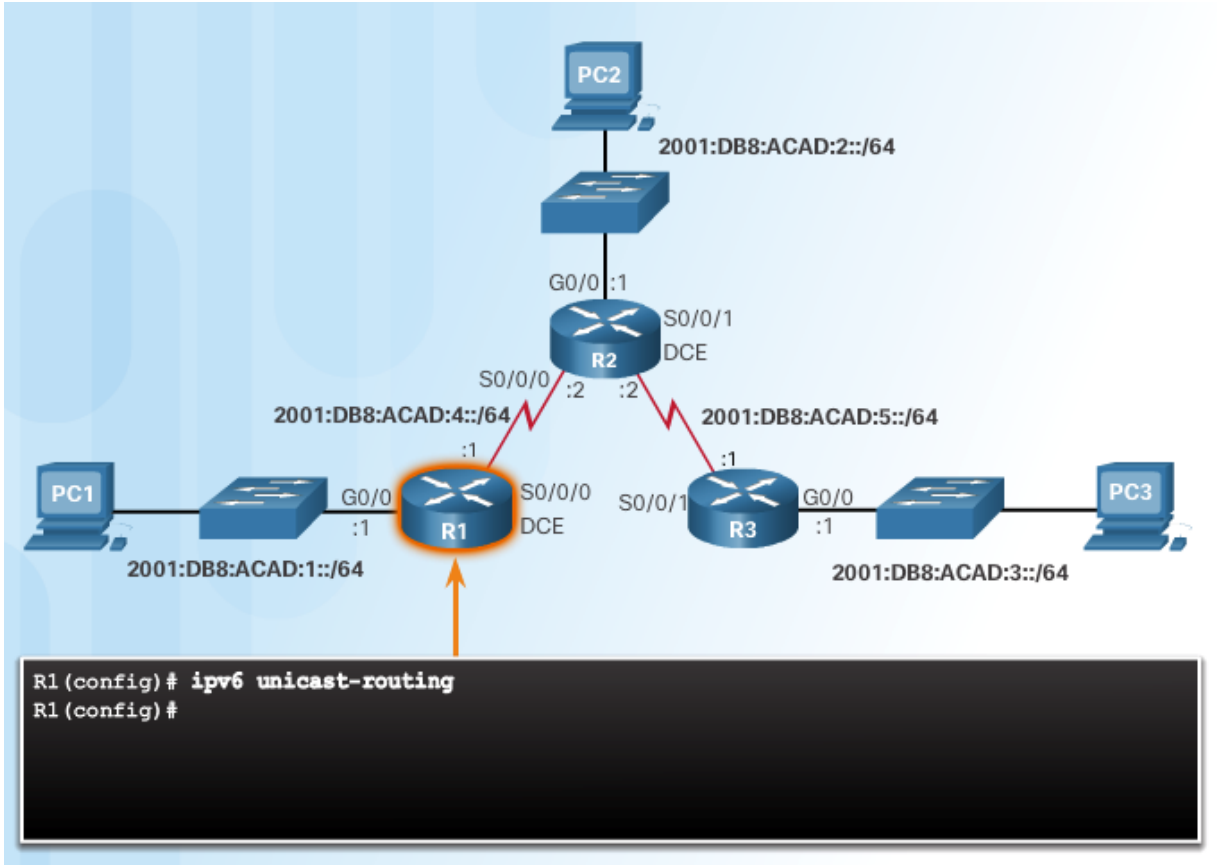
The ipv6 route Command

```
Router(config)# ipv6 route ipv6-prefix/prefix-length {ipv6-address | exit-intf}
```

Parameter	Description
ipv6-prefix	Destination network address of the remote network to be added to the routing table.
prefix-length	Prefix length of the remote network to be added to the routing table.
ipv6-address	• Commonly referred to as the next-hop router's IP address. • Typically used when connecting to a broadcast media (i.e., Ethernet). • Commonly creates a recursive lookup.
exit-intf	• Use the outgoing interface to forward packets to the destination network. • Also referred to as a directly attached static route. • Typically used when connecting in a point-to-point configuration.

The ipv6 route Command (Cont.)

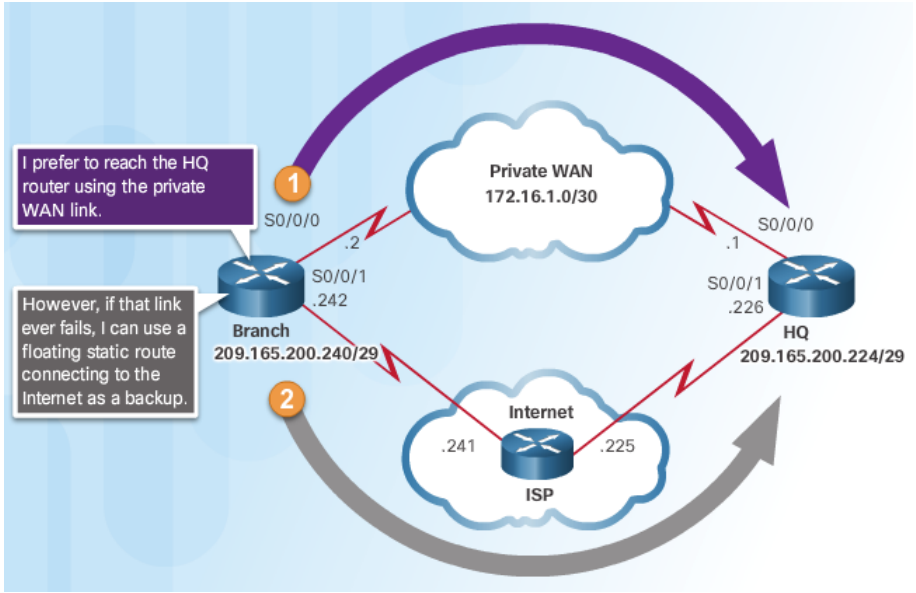
- **ipv6 unicast-routing** enables the router to forward IPv6 packets



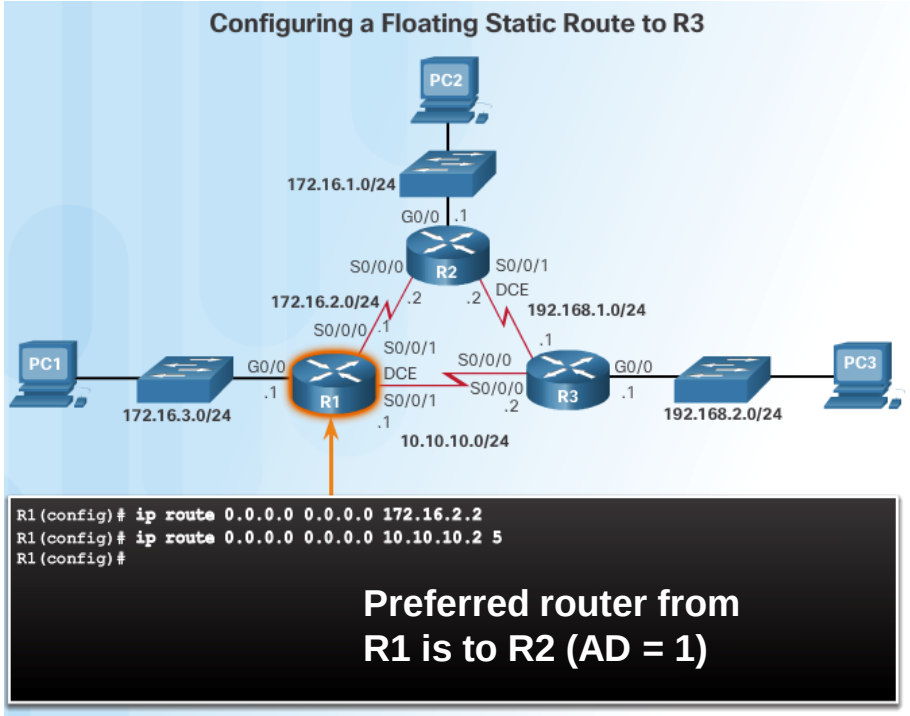
Floating Static Routes

Floating static routes have an administrative distance greater than the dynamic routing protocol or other static route

- Used as backup routes
- Administrative distance of common routing protocols
  - EIGRP = 90
  - IGRP = 100
  - OSPF = 110
  - IS-IS = 115
  - RIP = 120
- By default, AD of static route = 1
- Static route AD can be increased to make route less desirable until preferred route is lost



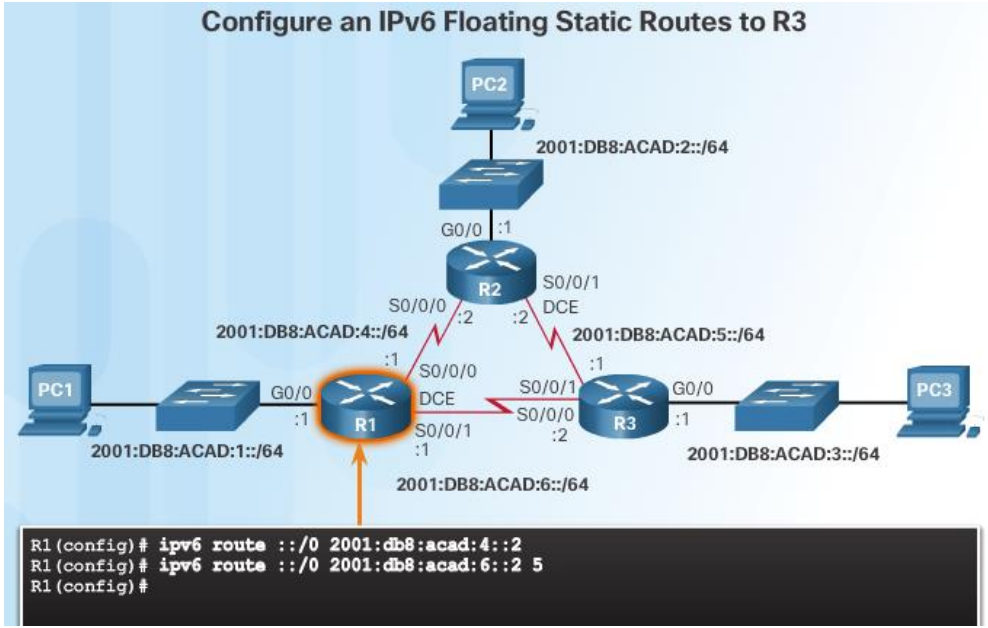
Configure a Floating Static Route

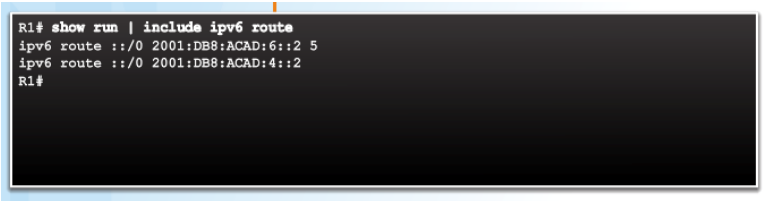


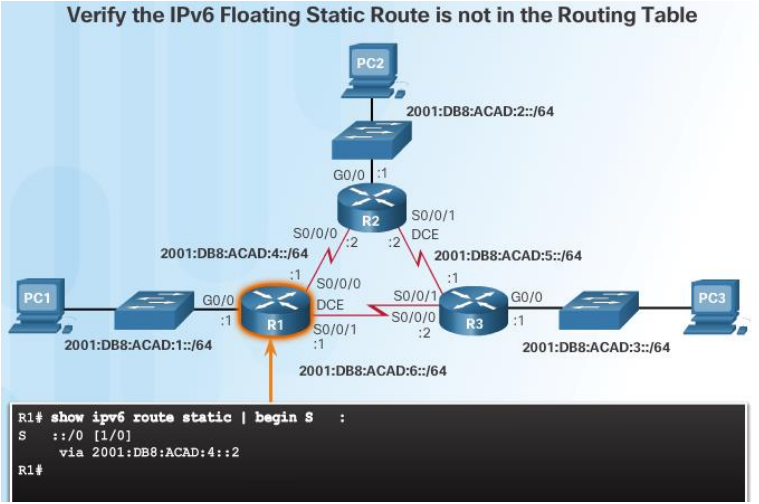

```
R1# show ip route static | begin Gateway
Gateway of last resort is 0.0.0.0 to network 0.0.0.0

S*    0.0.0.0/0 [1/0] via 172.16.2.2`
R1#
```

Configure an IPv6 Floating Static Route

- Similar to IPv4 floating static routes





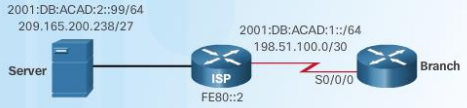


Automatically Installed Host Routes

Host route is an IPv4 address with a 32-bit mask or IPv6 address with a 128-bit mask.

- Automatically installed when IP address is configured
- Configured as a static host route
- Allows more efficiency for packets directed to the router
- Local route marked with “L” (introduced in IOS 15)

Branch IPv4 Routing Table



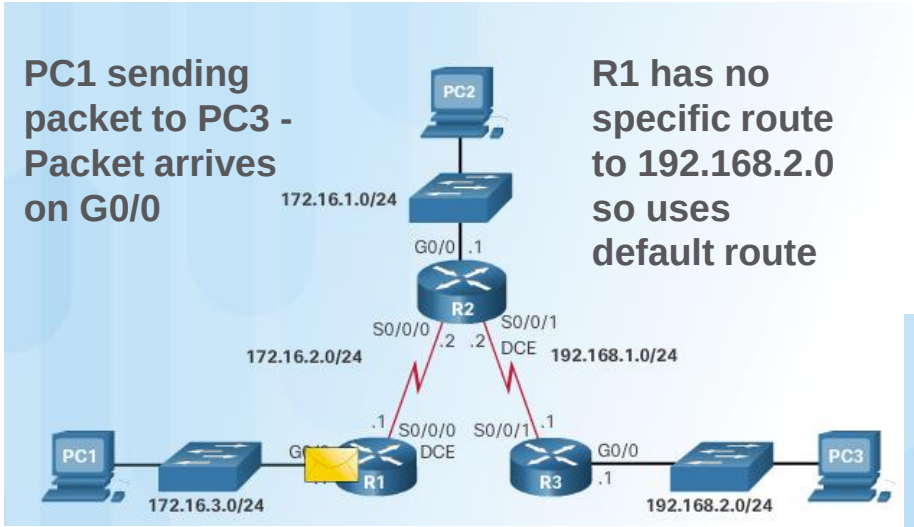

```
Branch# show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override
Gateway of last resort is not set

      198.51.100.0/24 is variably subnetted, 2 subnets, 2 masks
C        198.51.100.0/30 is directly connected, Serial0/0/0
L        198.51.100.1/32 is directly connected, Serial0/0/0
Branch#
```

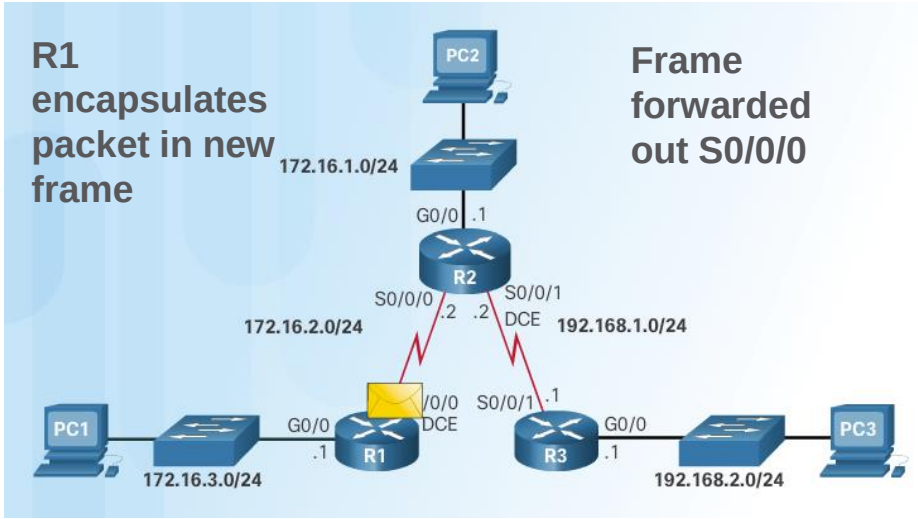
Branch IPv6 Routing Table


```
Branch# show ipv6 route
IPv6 Routing Table - default - 3 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, R - RIP, H - NHRP, I1 - ISIS L1
       I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary, D - EIGRP
       EX - EIGRP external, ND - ND Default, NDp - ND Prefix, DCE - Destination
       NDr - Redirect, O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1
       OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
       a - Application
C   2001:DB8:ACAD:1::/64 [0/0]
     via Serial0/0/0, directly connected
L   2001:DB8:ACAD:1::1/128 [0/0]
     via Serial0/0/0, receive
L   FF00::/8 [0/0]
     via Null0, receive
Branch#
```

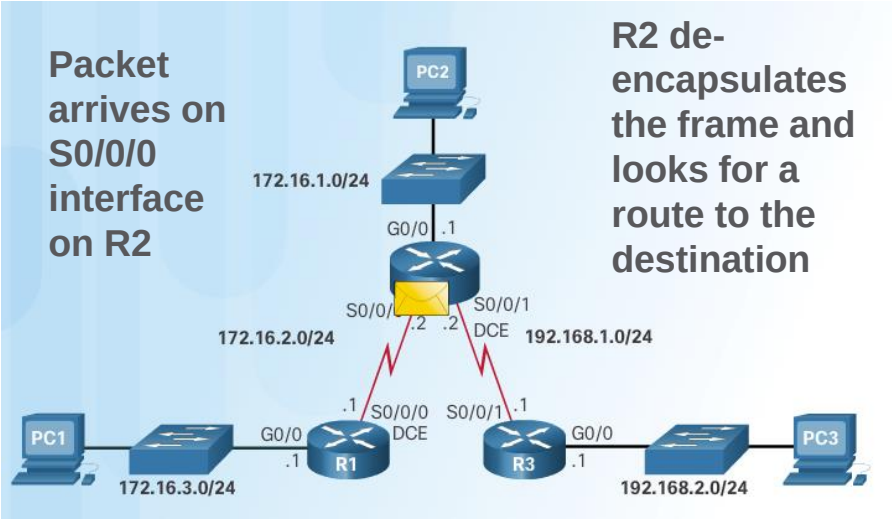
Troubleshoot Static and Default Routes

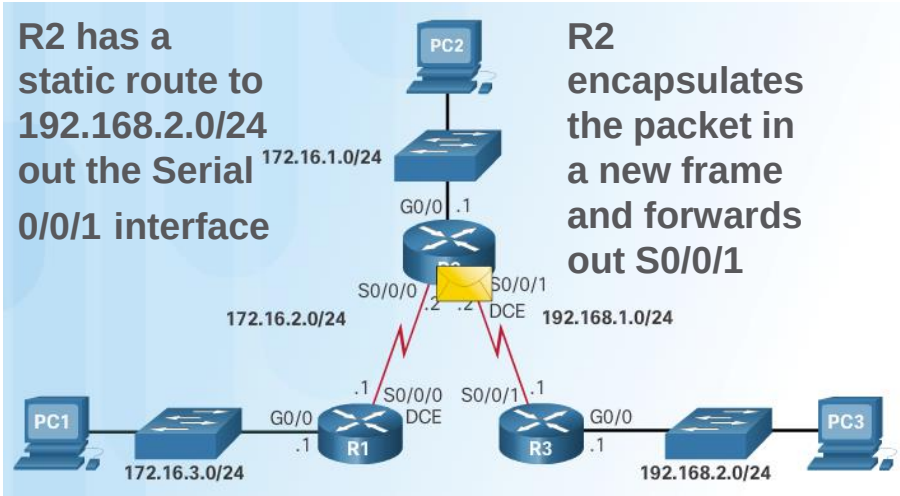
Static Routes and Packet Forwarding



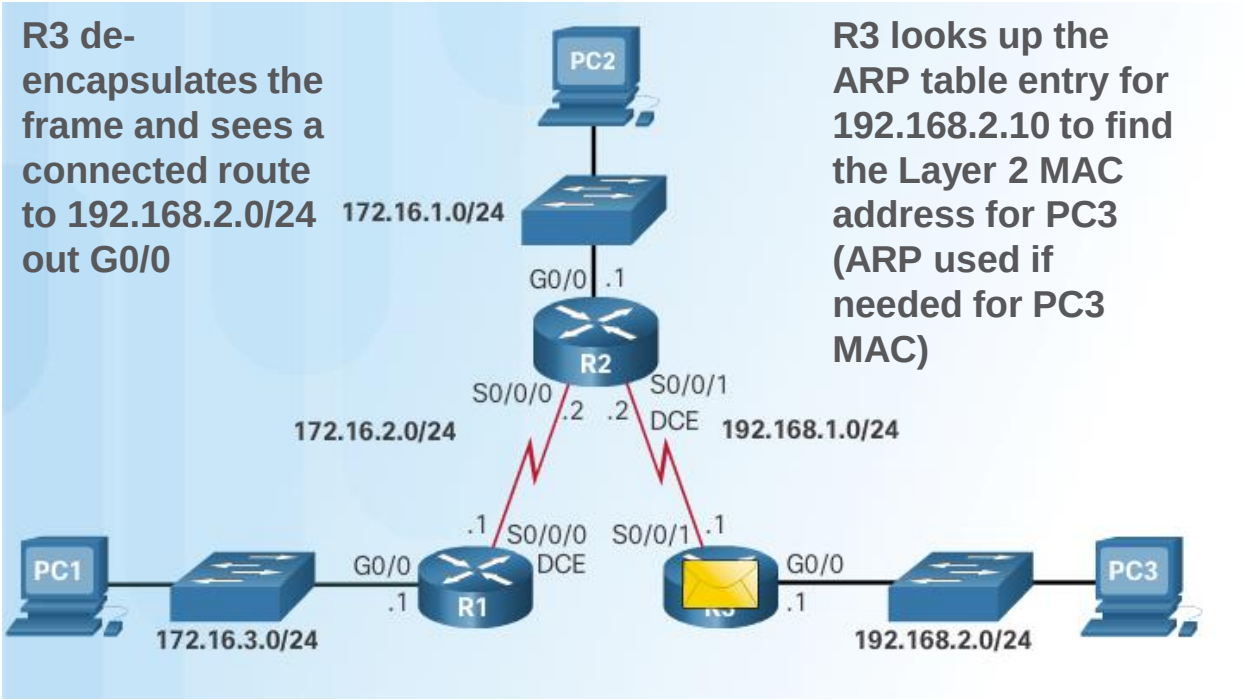


Static Routes and Packet Forwarding (Cont.)





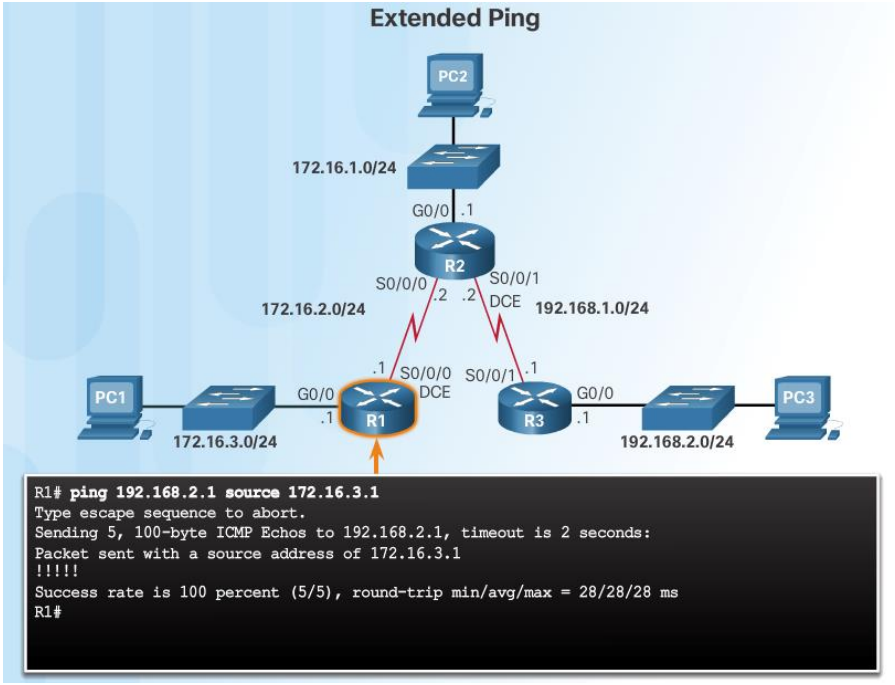
Static Routes and Packet Forwarding (Cont.)



- R3 encapsulates the packet in a new frame with the MAC address of the G0/0 interface as the source Layer 2 address and the MAC address of PC3 as the destination MAC address
- Frame is forwarded out of G0/0 interface and packet arrives on the NIC interface of PC3

Troubleshoot a Missing Route

- Common IOS troubleshooting commands include:
  - **ping**
  - **traceroute**
  - **show ip route**
  - **show ip interface brief**
  - **show cdp neighbors detail**



Chapter Summary

Static Routing

- Explain how static routes are implemented in a small to medium-sized business network.
- Configure static routes to enable connectivity in a small to medium-sized business network.
- Troubleshoot static and default route configurations.