



Exploring the Functions of Routing

Routers

Cisco 2800 Series Router



- **Routers have the following components:**
 - **CPU**
 - **Motherboard**
 - **RAM**
 - **ROM**
- **Routers have network adapters to which IP addresses are assigned.**
- **Routers may have the following two kinds of ports:**
 - **Console:** For the attachment of a terminal used for management
 - **Network:** Different LAN or WAN media ports
- **Routers forward packets based upon a routing table.**

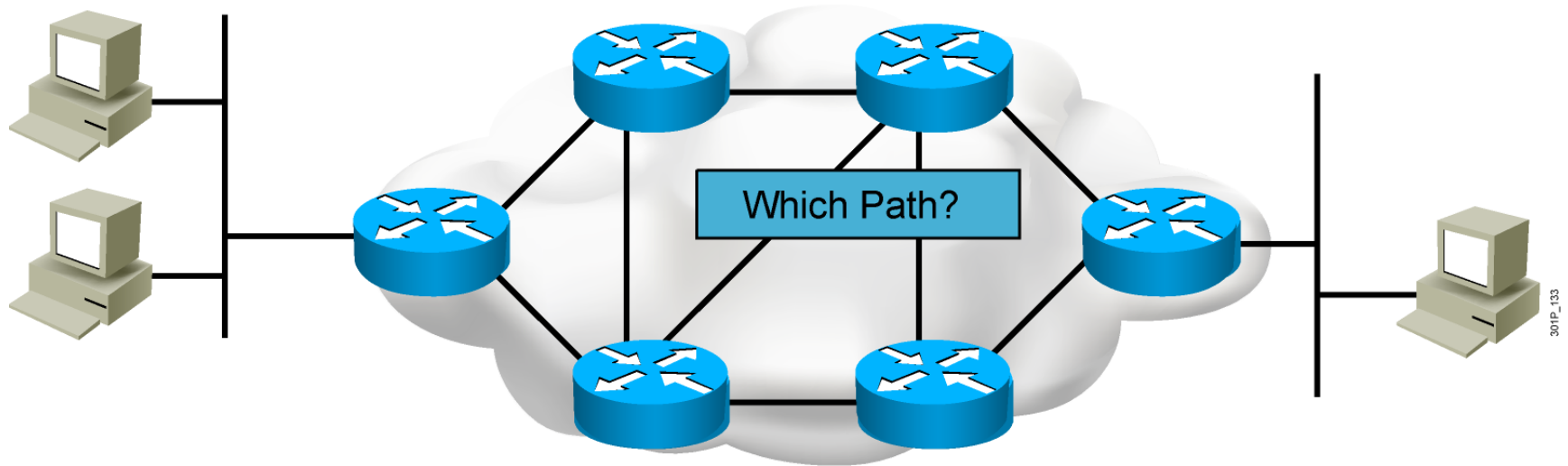
Router Functions

RouterX# show ip route

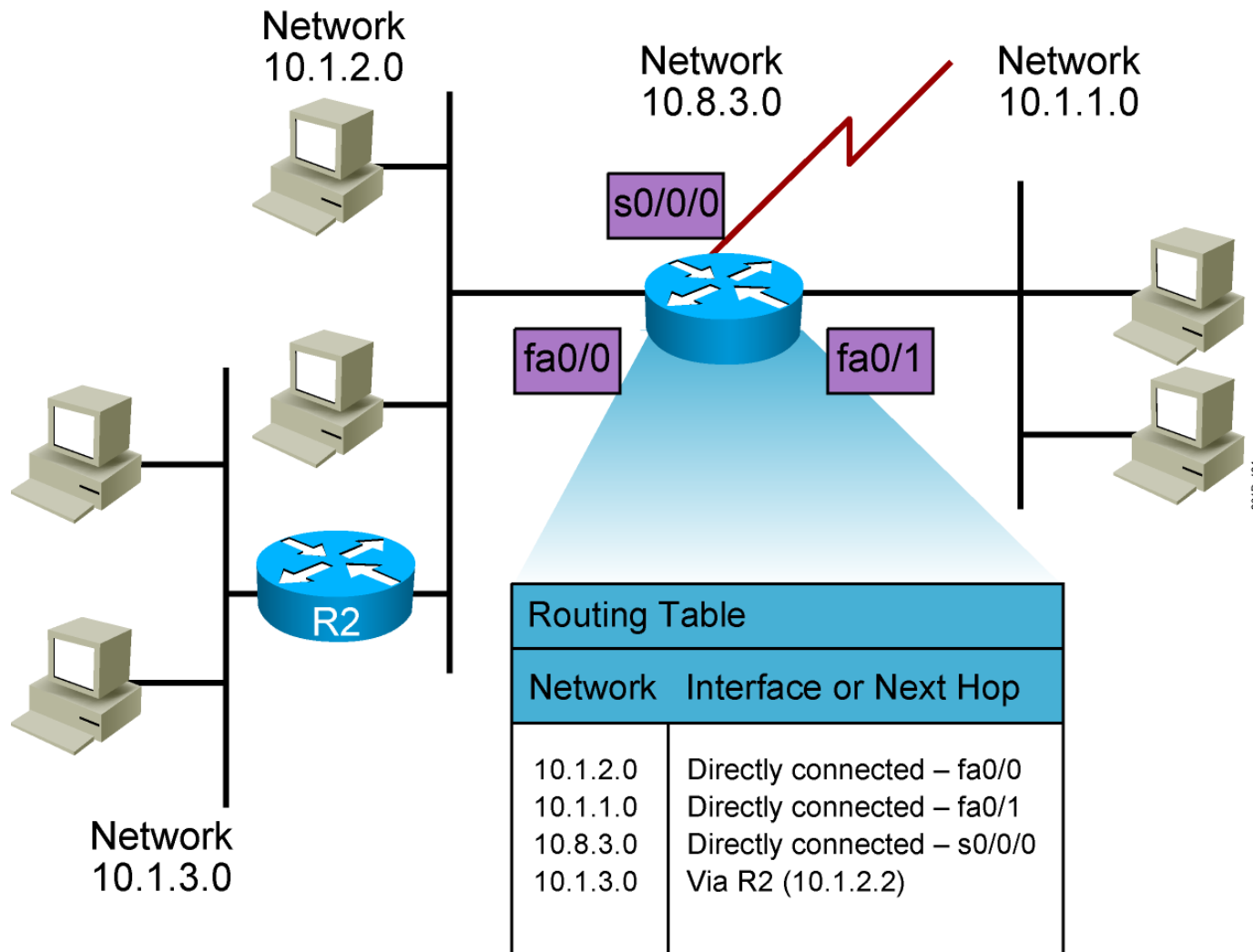
1 {
D 192.168.1.0/24 [90/25789217] via 10.1.1.1
R 192.168.2.0/24 [120/4] via 10.1.1.2
O 192.168.3.0/24 [110/229840] via 10.1.1.3 } 2

1. Lets other routers know about changes
2. Determines where to forward packets

Path Determination



Routing Tables



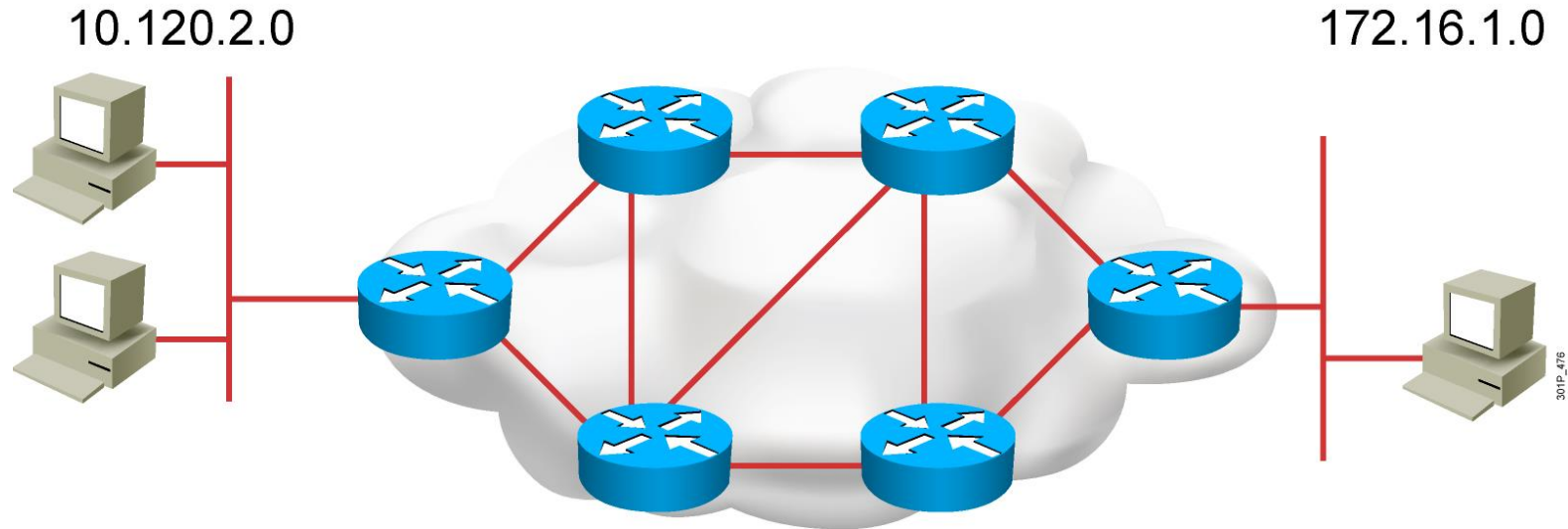
Routing Table Entries

- **Directly connected:** Router attaches to this network
- **Static routing:** Entered manually by a system administrator
- **Dynamic routing:** Learned by exchange of routing information
- **Default route:** Statically or dynamically learned; used when no explicit route to network is known



Enabling Static Routing

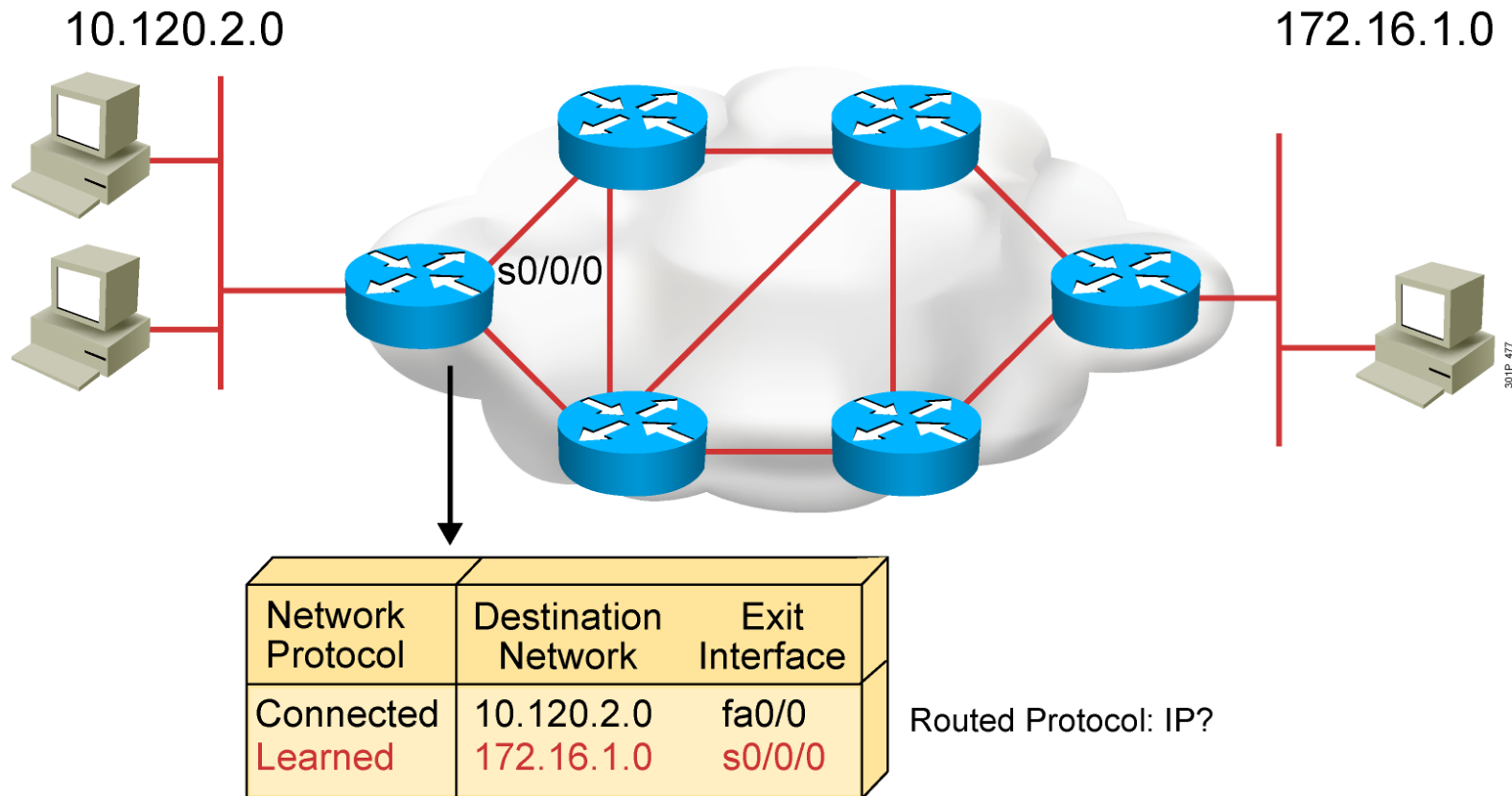
Router Operations



A router needs to do the following:

- **Know the destination address.**
- **Identify the sources from which the router can learn.**
- **Discover possible routes to the intended destination.**
- **Select the best route.**
- **Maintain and verify routing information.**

Router Operations (Cont.)



- Routers must learn destinations that are not directly connected.

Identifying Static and Dynamic Routes

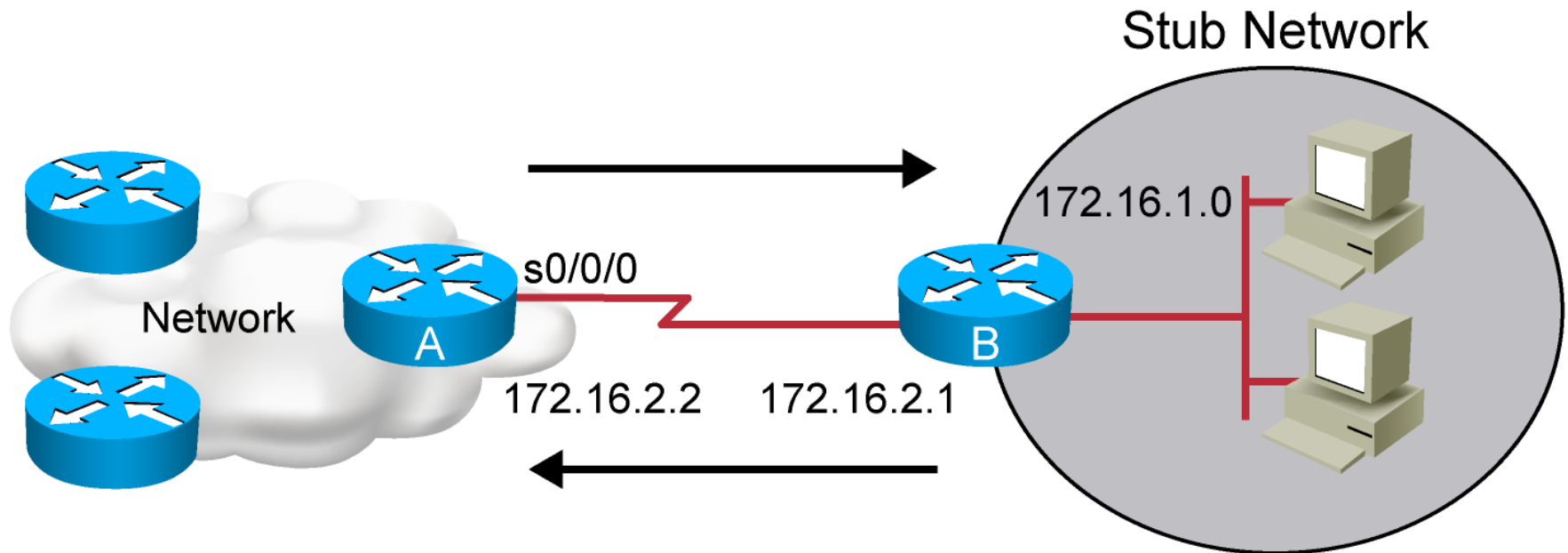
Static route

- **Uses a route that a network administrator enters into the router manually**

Dynamic route

- **Uses a route that a network routing protocol adjusts automatically for topology or traffic changes**

Static Routes



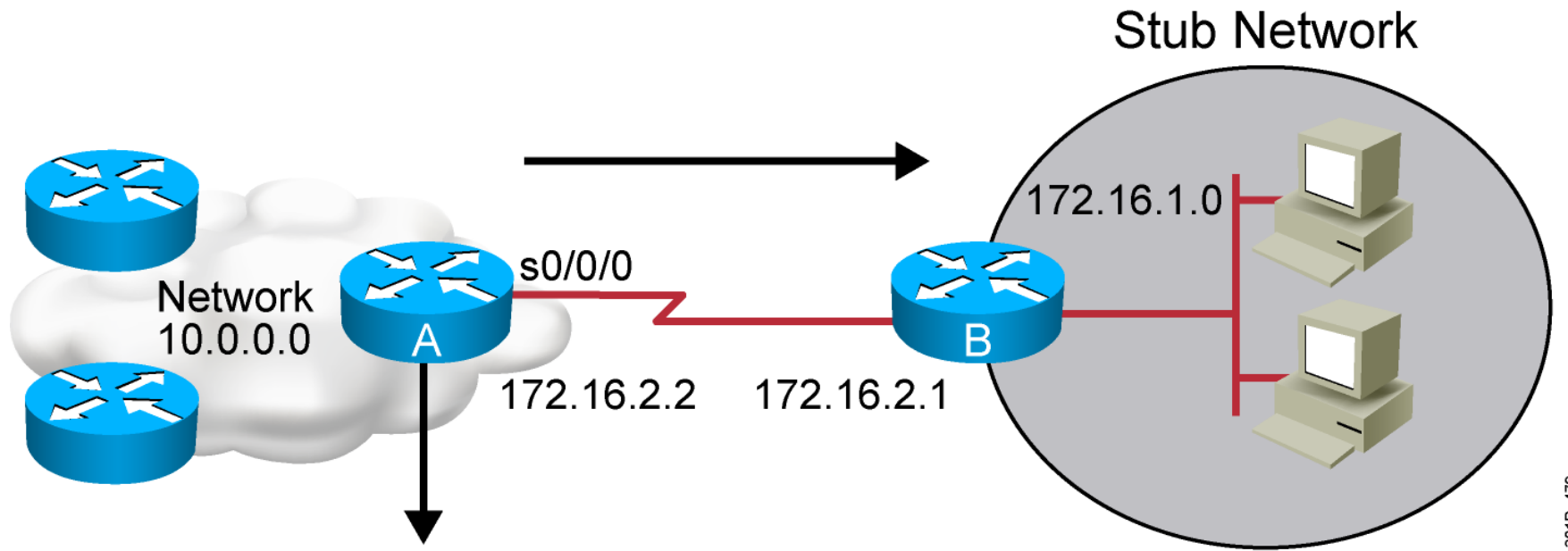
Configure unidirectional static routes to and from a stub network to allow communications to occur.

Static Route Configuration

```
RouterX(config)# ip route network [mask]  
{address | interface}[distance] [permanent]
```

- Defines a path to an IP destination network or subnet or host
- Address = IP address of the next hop router
- Interface = outbound interface of the local router

Static Route Example



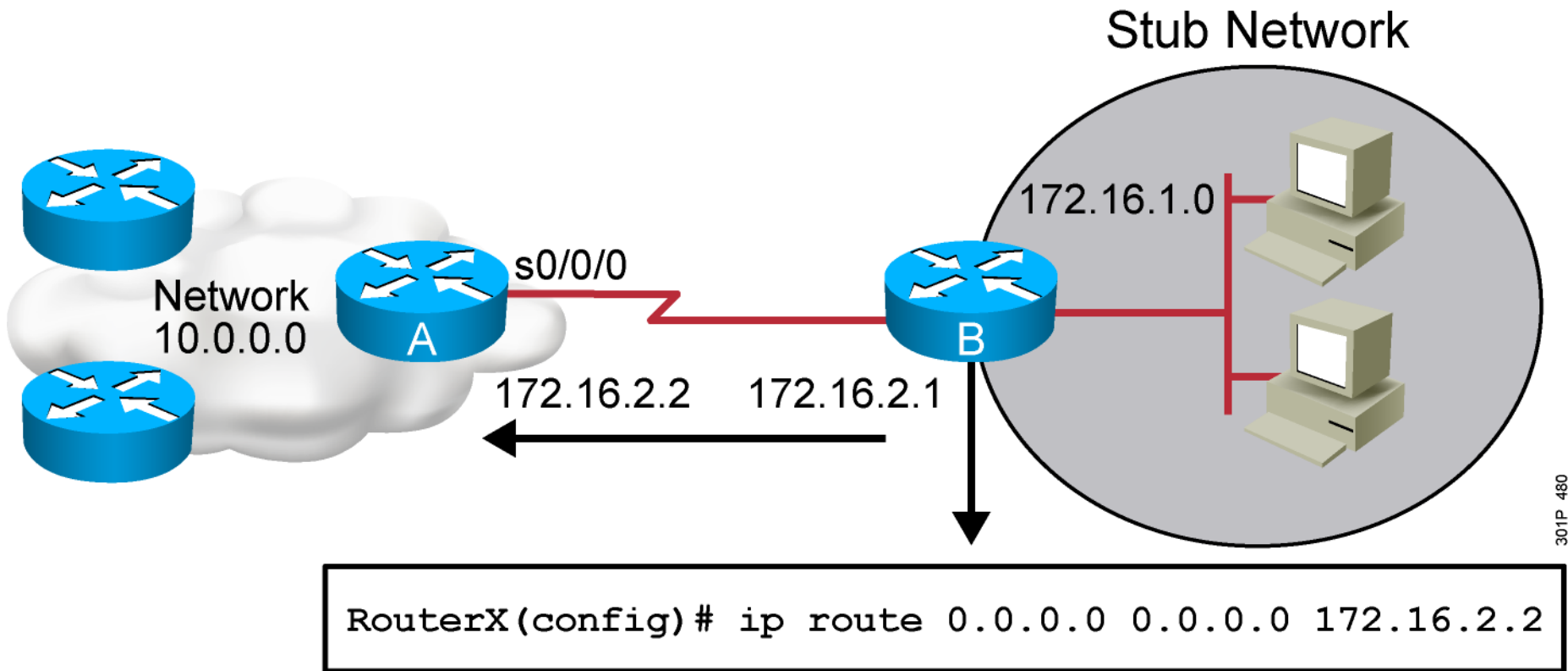
```
RouterX(config)# ip route 172.16.1.0 255.255.255.0 172.16.2.1
```

or

```
Router(config)#ip route 172.16.1.0 255.255.255.0 s0/0/0
```

- This is a unidirectional route. You must have a route configured in the opposite direction.

Default Routes



- This route allows the stub network to reach all known networks beyond Router A.

Verifying the Static Route Configuration

```
RouterX# show ip route
```

```
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP  
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP  
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate default  
       U - per-user static route
```

```
Gateway of last resort is 0.0.0.0 to network 0.0.0.0
```

```
    10.0.0.0/8 is subnetted, 1 subnets
```

```
C        10.1.1.0 is directly connected, Serial0/0/0
```

```
S*    0.0.0.0/0 is directly connected, Serial0
```



ICMP and Traceroute

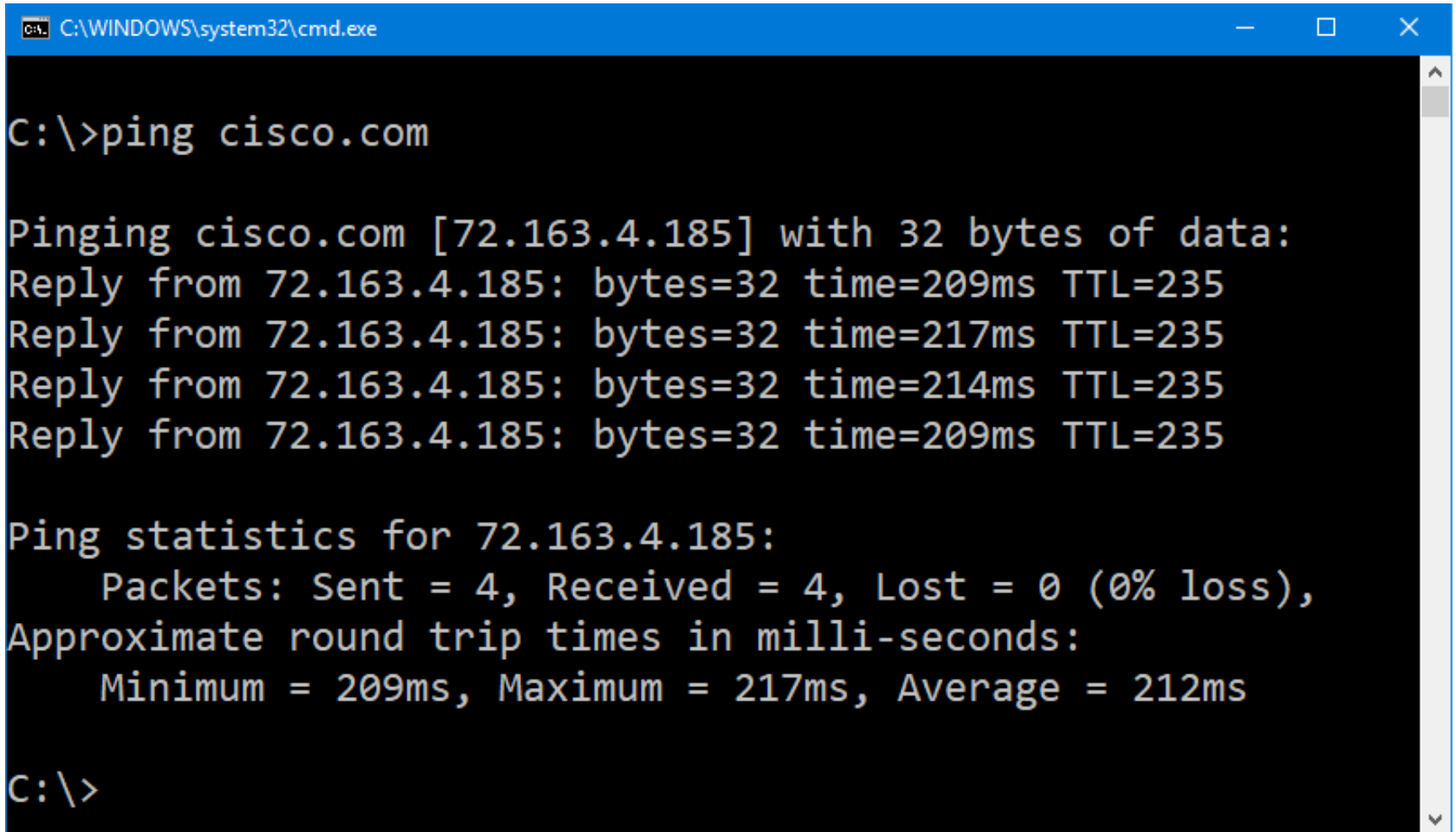
ping

Router#

```
ping [[protocol {host-name | system-address}]
```

- To diagnose basic network connectivity, use the ping command in user EXEC or privileged EXEC mode.

Host-Based Tools: ping



```
C:\WINDOWS\system32\cmd.exe

C:\>ping cisco.com

Pinging cisco.com [72.163.4.185] with 32 bytes of data:
Reply from 72.163.4.185: bytes=32 time=209ms TTL=235
Reply from 72.163.4.185: bytes=32 time=217ms TTL=235
Reply from 72.163.4.185: bytes=32 time=214ms TTL=235
Reply from 72.163.4.185: bytes=32 time=209ms TTL=235

Ping statistics for 72.163.4.185:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 209ms, Maximum = 217ms, Average = 212ms

C:\>
```

traceroute

Router#

```
traceroute [protocol] destination
```

- To discover the routes that packets will actually take when traveling to their destination address, use the traceroute command in user EXEC or privileged EXEC mode.

Host-Based Tools: tracert

```
Command Prompt
Microsoft Windows [Version 10.0.14393]
(c) 2016 Microsoft Corporation. All rights reserved.

C:\Users\QQ>tracert google.com

Tracing route to google.com [216.58.221.142]
over a maximum of 30 hops:

  0  <1 ms    <1 ms    <1 ms    192.168.1.1
  1   4 ms     4 ms     2 ms     113.22.4.117
  2  27 ms    27 ms    26 ms    118.69.166.149
  3  24 ms    24 ms    23 ms    118.69.131.170
  4  27 ms    28 ms    28 ms    74.125.50.73
  5  28 ms    32 ms    *        108.170.241.33
  6  25 ms    24 ms    24 ms    108.170.232.255
  7  26 ms    31 ms    27 ms    hkg07s02-in-f14.1e100.net [216.58.221.142]

Trace complete.

C:\Users\QQ>
```



CISCO