



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.**

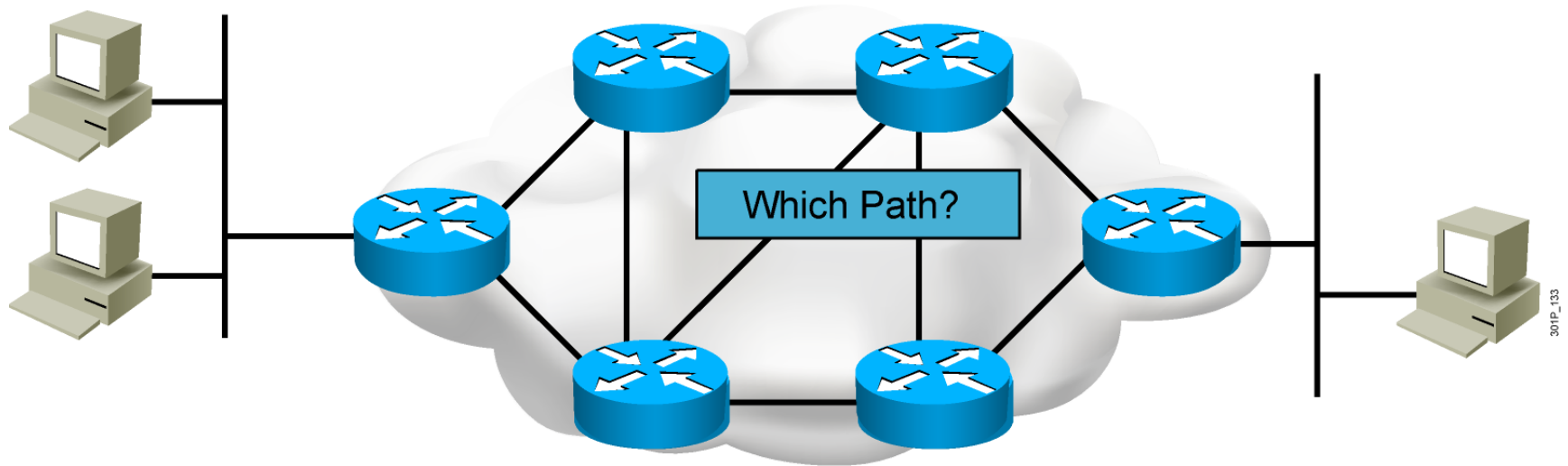
Router Functions

RouterX# show ip route

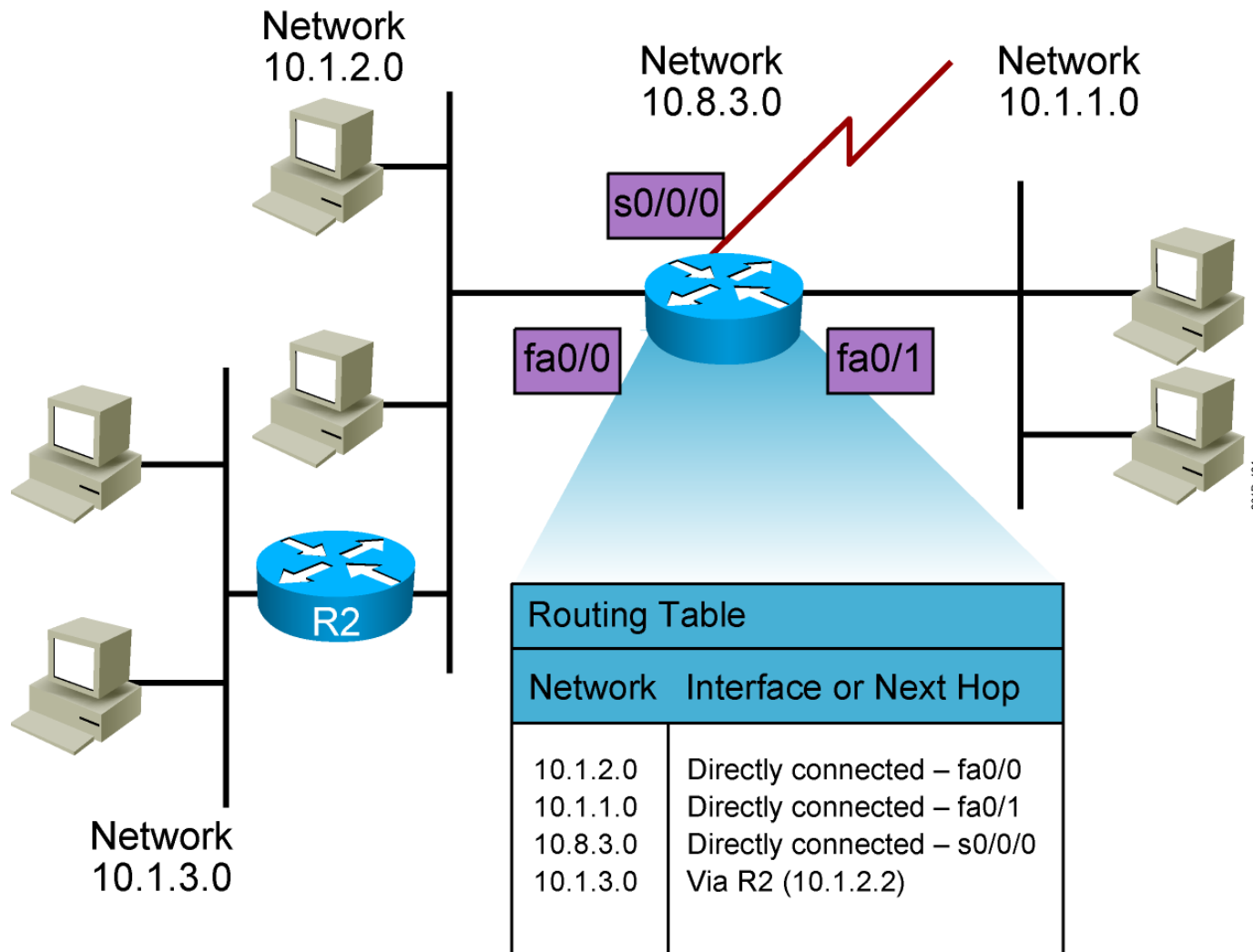
1 {
 D 192.168.1.0/24 [90/25789217] via 10.1.1.1
 R 192.168.2.0/24 [120/4] via 10.1.1.2
 O 192.168.3.0/24 [110/229840] via 10.1.1.3
} 2

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

Path Determination



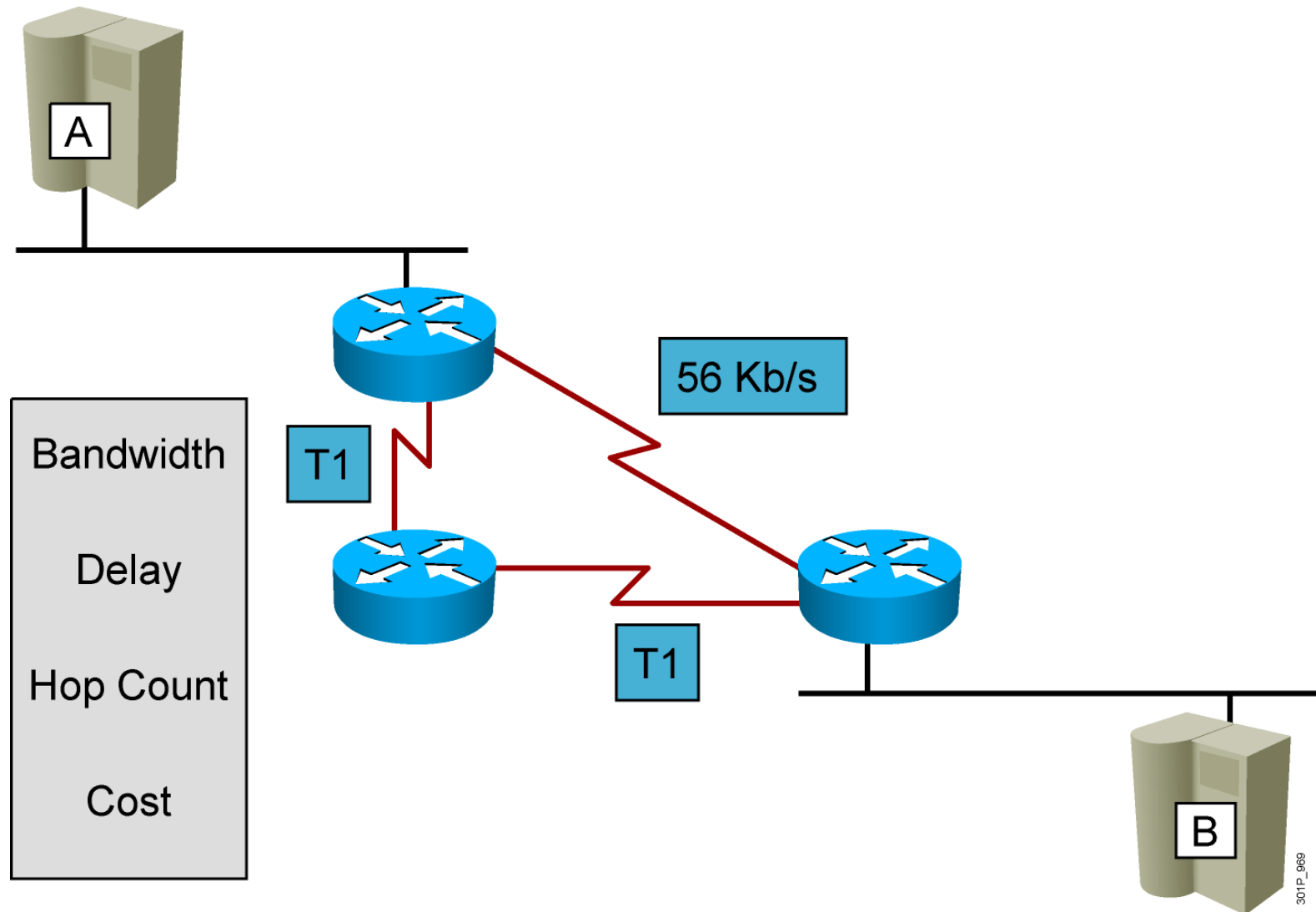
Routing Tables



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

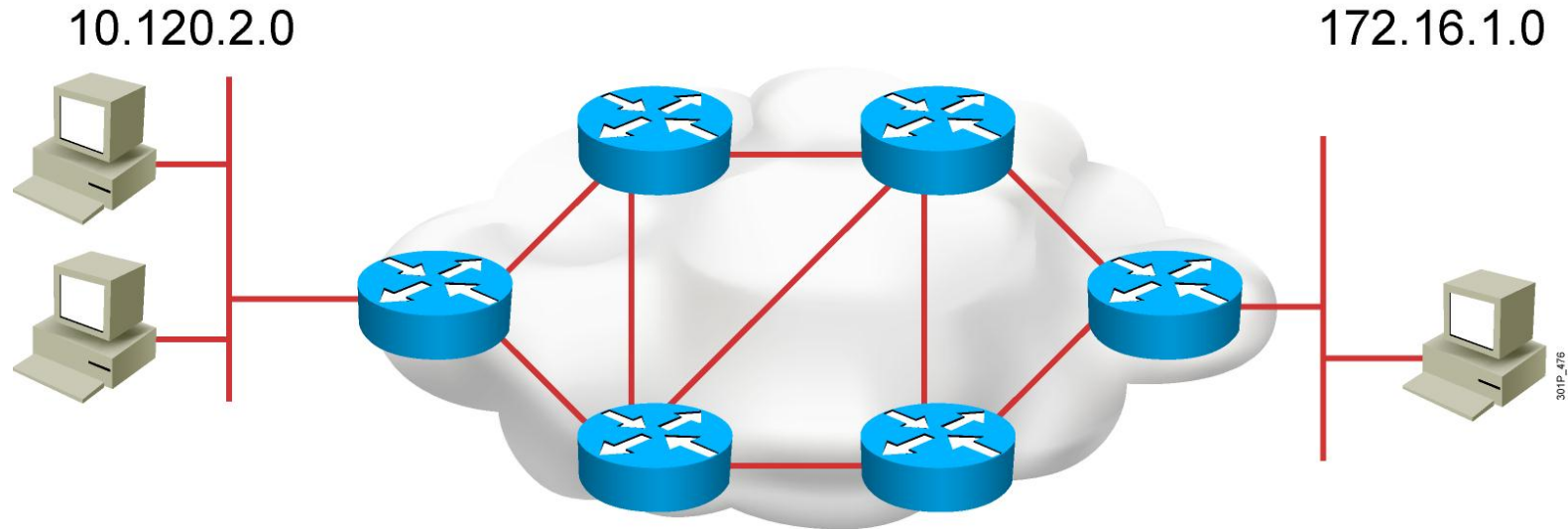
Routing Metrics





Enabling Static Routing

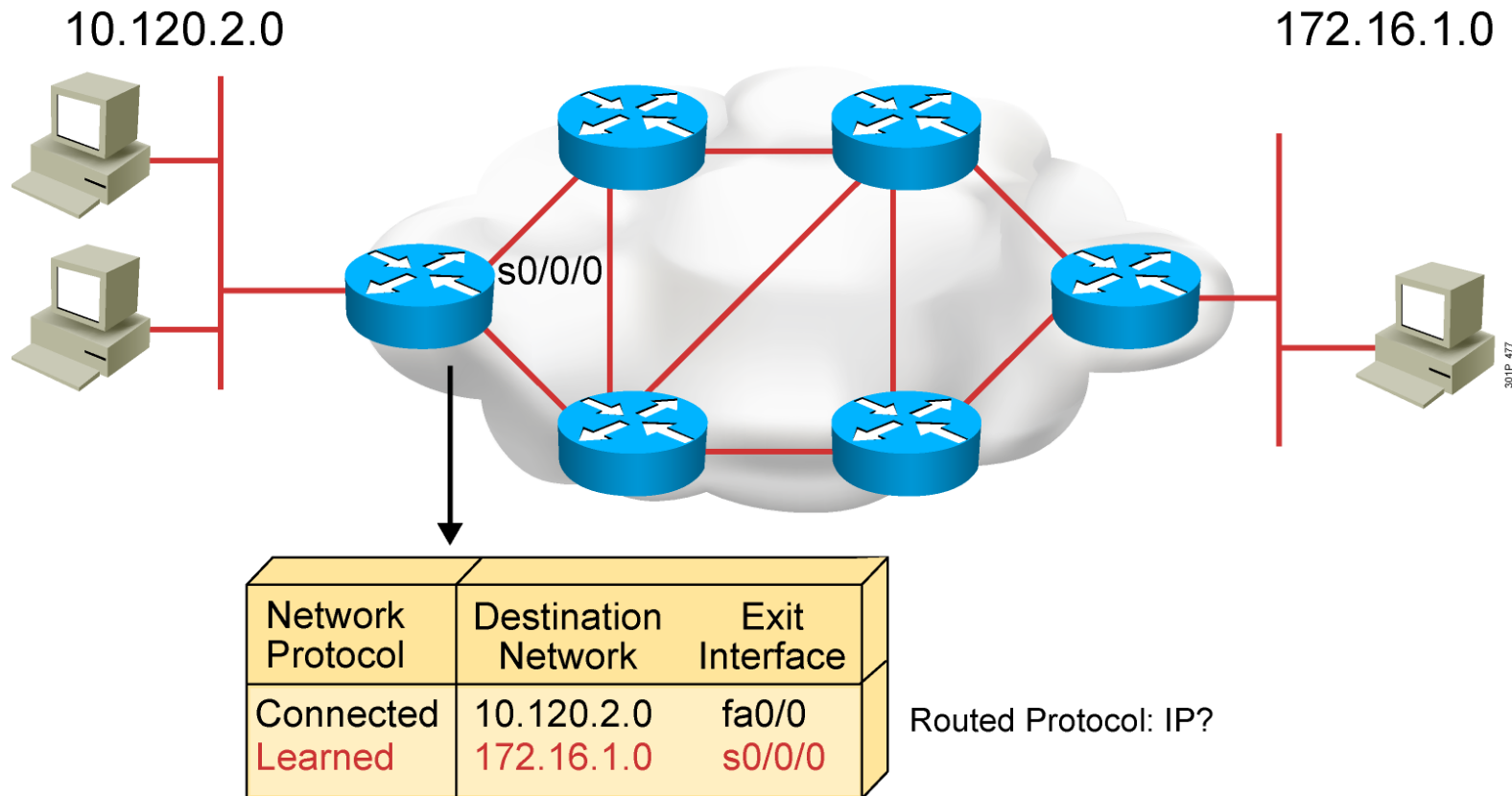
Router Operations



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

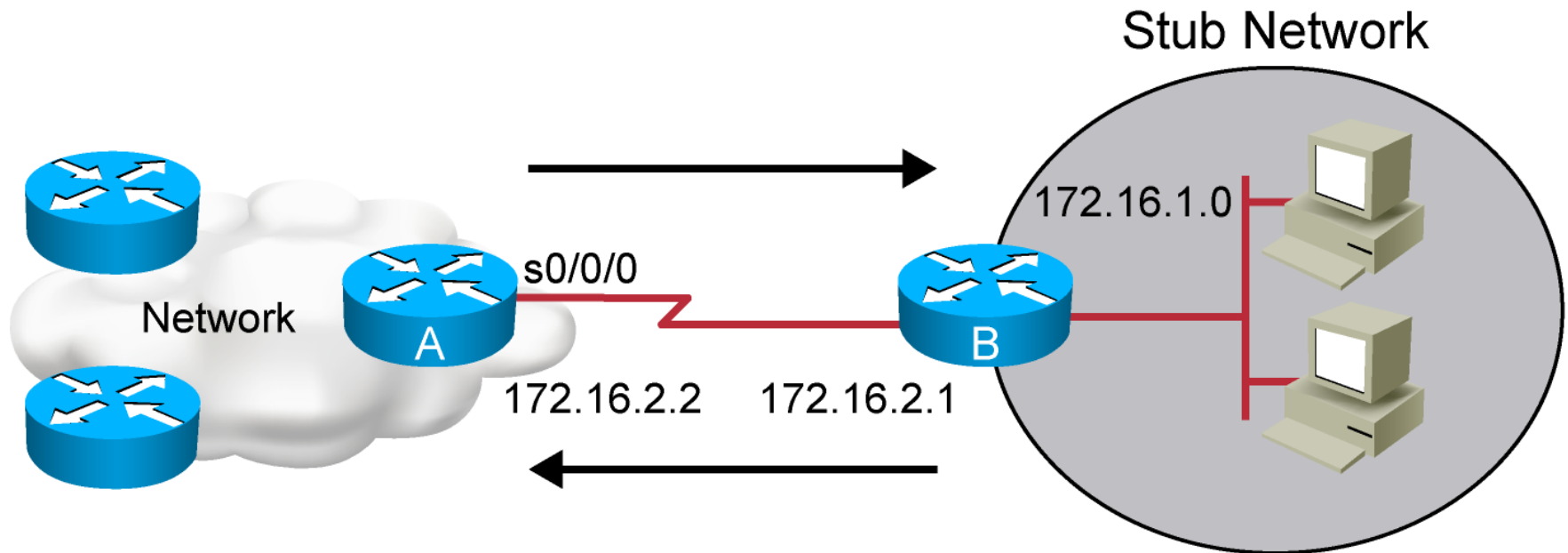
Static route

- **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



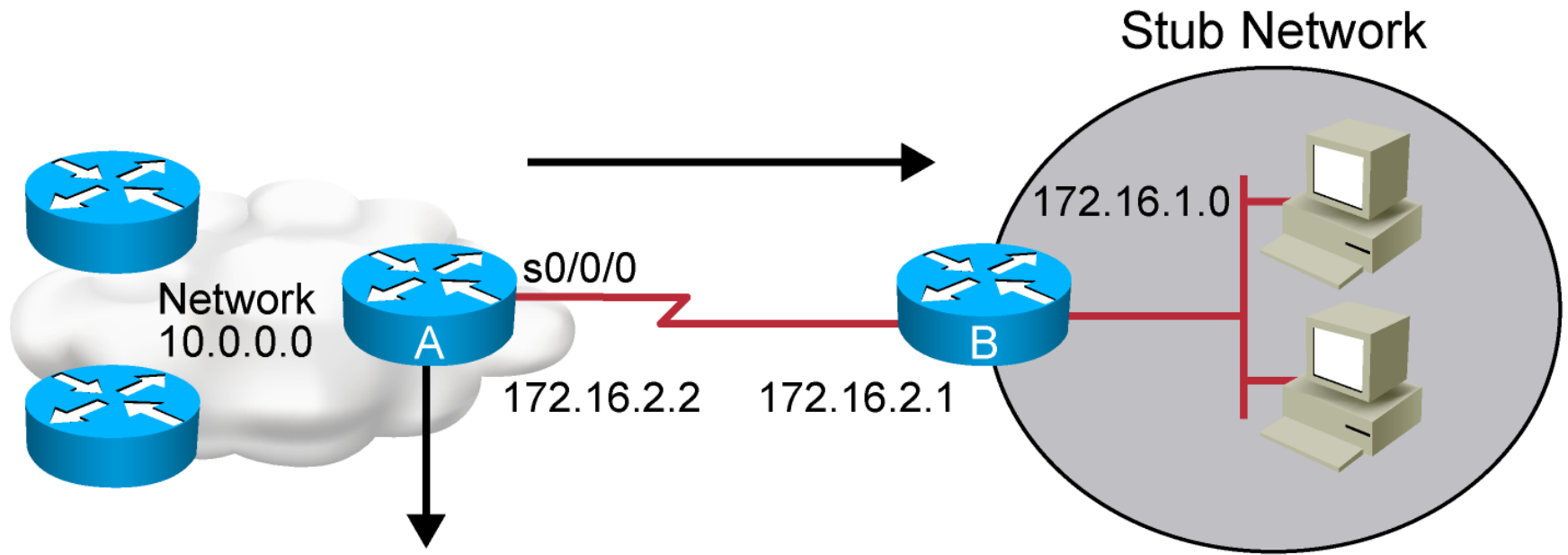
Configure unidirectional static routes to and from a stub network to allow communications to occur.

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



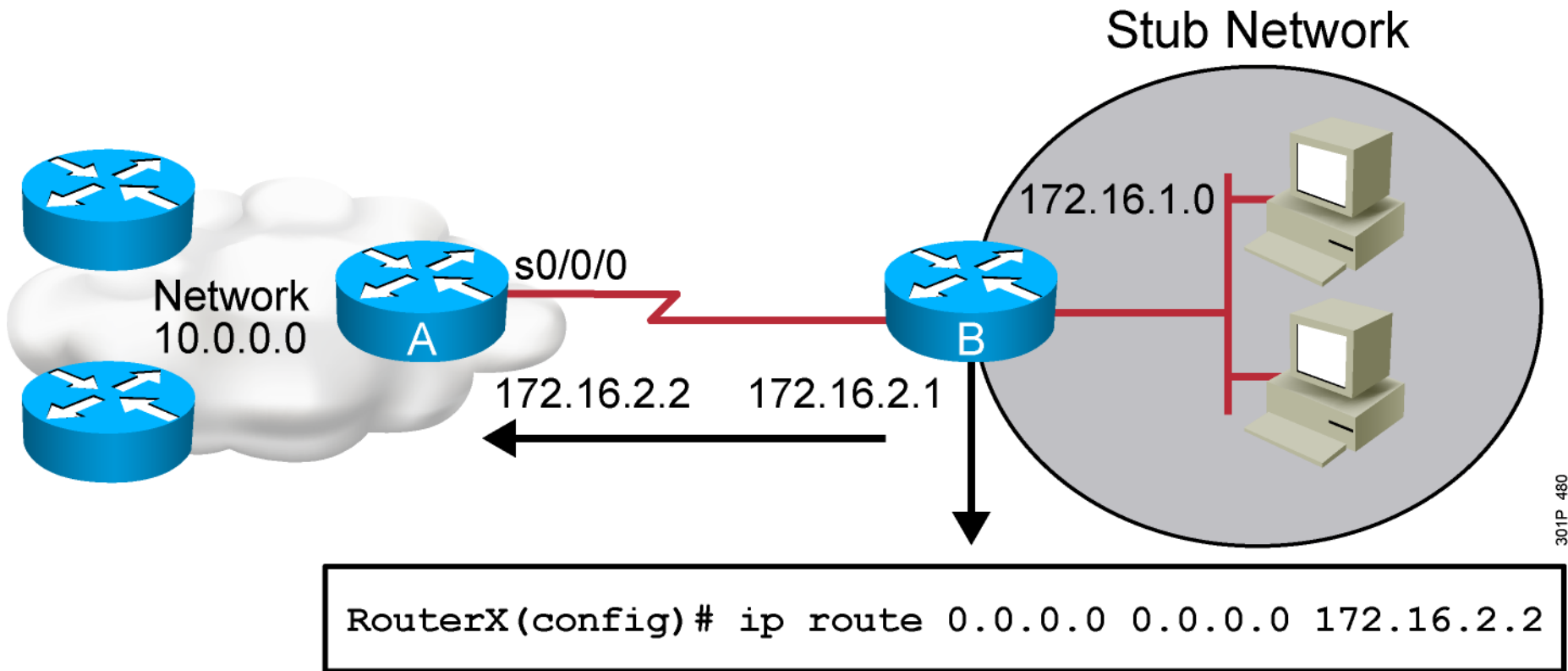
```
RouterX(config)# ip route 172.16.1.0 255.255.255.0 172.16.2.1
```

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
```

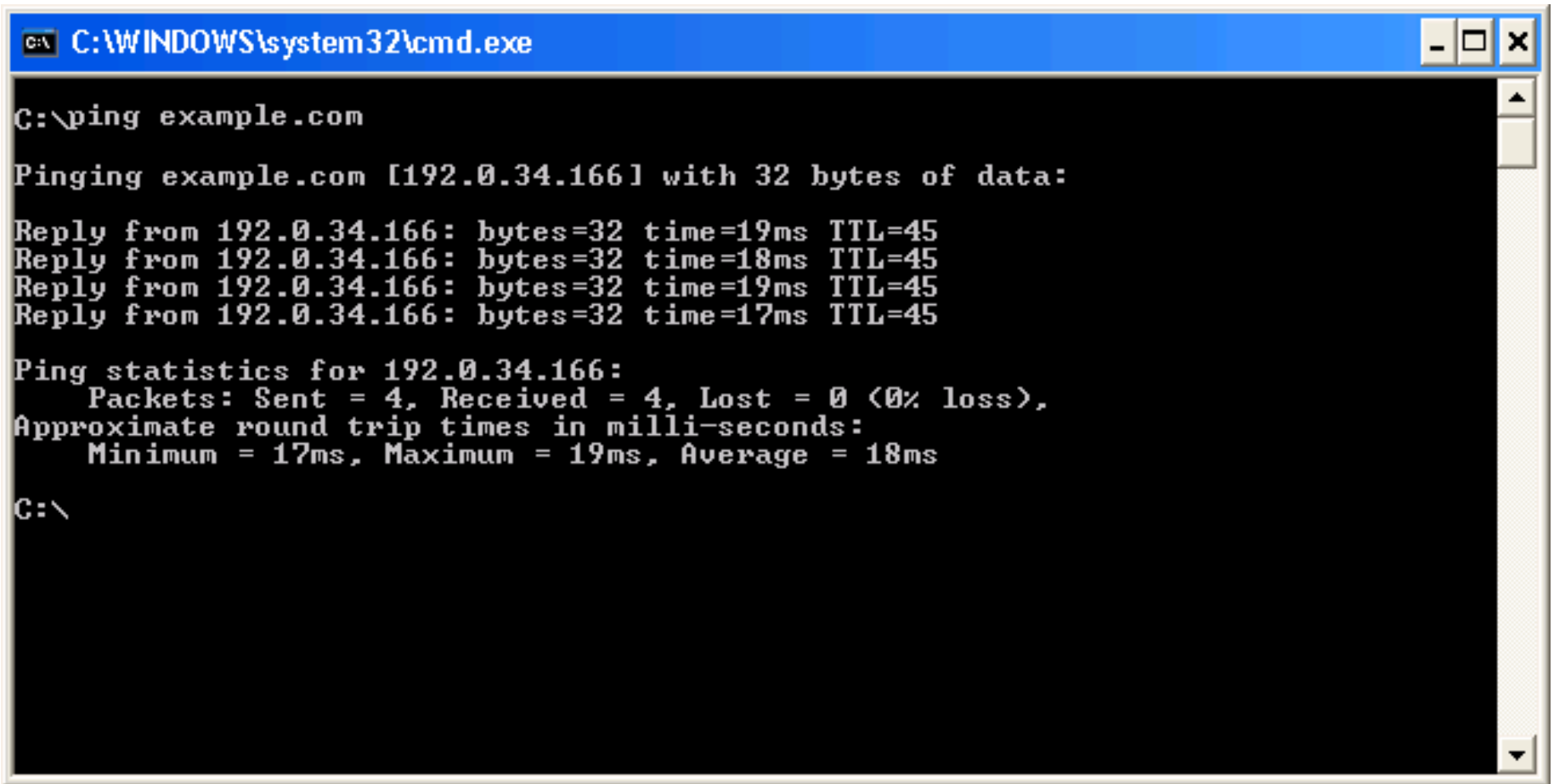
```
C        10.1.1.0 is directly connected, Serial0/0/0
```

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




ICMP and Traceroute

Host-Based Tools: ping



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

C:\>ping example.com

Pinging example.com [192.0.34.166] with 32 bytes of data:

Reply from 192.0.34.166: bytes=32 time=19ms TTL=45
Reply from 192.0.34.166: bytes=32 time=18ms TTL=45
Reply from 192.0.34.166: bytes=32 time=19ms TTL=45
Reply from 192.0.34.166: bytes=32 time=17ms TTL=45

Ping statistics for 192.0.34.166:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 17ms, Maximum = 19ms, Average = 18ms

C:\>
```

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: tracer

```
C:\WINDOWS\system32\cmd.exe
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\pvancil>tracert yahoo.com

Tracing route to yahoo.com [66.94.234.13]
over a maximum of 30 hops:

  1      1 ms      1 ms      1 ms      rtp-pvancil-vpn.cisco.com [10.83.2.161]
  2      67 ms     59 ms     57 ms     rtp5-access-sdg1-t10.cisco.com [10.82.96.2]
  3      58 ms     58 ms     57 ms     rtp5-access-gw1-vlan100.cisco.com [10.83.100.9]

  4      58 ms     58 ms     57 ms     rtp7-bb-gw1-ge5-8.cisco.com [10.81.254.117]
  5      60 ms     59 ms     57 ms     rtp5-rbb-gw1-ge4-2.cisco.com [10.81.254.181]
  6      58 ms     59 ms     60 ms     rtp5-corp-gw1.cisco.com [10.81.254.194]
  7      59 ms     58 ms     58 ms     rtp7-dmzbb-gw1.cisco.com [64.102.241.135]
  8      60 ms     60 ms     58 ms     rtp1-isp-gw1-g1-2.cisco.com [64.102.254.193]
  9      59 ms     58 ms     58 ms     rtp5-isp-ssw1-v110.cisco.com [64.102.254.174]
 10      59 ms     59 ms     58 ms     rtp5-isp-ssw1-v151.cisco.com [64.102.254.249]
 11      60 ms     60 ms     59 ms     rtp1-isp-gw1-v100.cisco.com [64.102.254.165]
 12      64 ms     66 ms     65 ms     sl-gw20-rly-1-0.sprintlink.net [144.232.244.209]

 13      64 ms     66 ms     68 ms     sl-bb20-rly-3-2.sprintlink.net [144.232.14.29]
 14      66 ms     64 ms     65 ms     sl-bb24-rly-9-0.sprintlink.net [144.232.14.122]

 15      66 ms     66 ms     69 ms     sl-st22-ash-5-0.sprintlink.net [144.232.20.155]

 16      67 ms     68 ms     67 ms     te-4-2.car4.Washington1.Level3.net [4.68.111.169]
 17      67 ms    127 ms     68 ms     ae-2-54.bbr2.Washington1.Level3.net [4.68.121.97]

 18     136 ms      *      137 ms     as-1-0.bbr2.SanJose1.Level3.net [64.159.0.242]
 19     134 ms    136 ms    133 ms     ae-23-52.car3.SanJose1.Level3.net [4.68.123.45]

 20     142 ms    135 ms    135 ms     4.71.112.14
 21     133 ms    134 ms    134 ms     ge-3-0-0-p271.msr2.scd.yahoo.com [216.115.106.19]
 22     135 ms    135 ms    135 ms     ten-2-3-bas1.scd.yahoo.com [66.218.82.221]
 23     136 ms    136 ms    135 ms     w2.rc.vip.scd.yahoo.com [66.94.234.13]

Trace complete.
```

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.



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