



Implementing an EIGRP-Based Solution

Interconnecting Cisco Networking Devices, Part 2 (ICND2) v2.0



Implementing EIGRP

Implementing an EIGRP-Based Solution

Dynamic Routing Protocols

A dynamic routing protocol has these purposes:

- The discovery of remote networks
- Maintaining up-to-date routing information
- Choosing the best path to destination networks
- The ability to find a new best path if the current path is no longer available

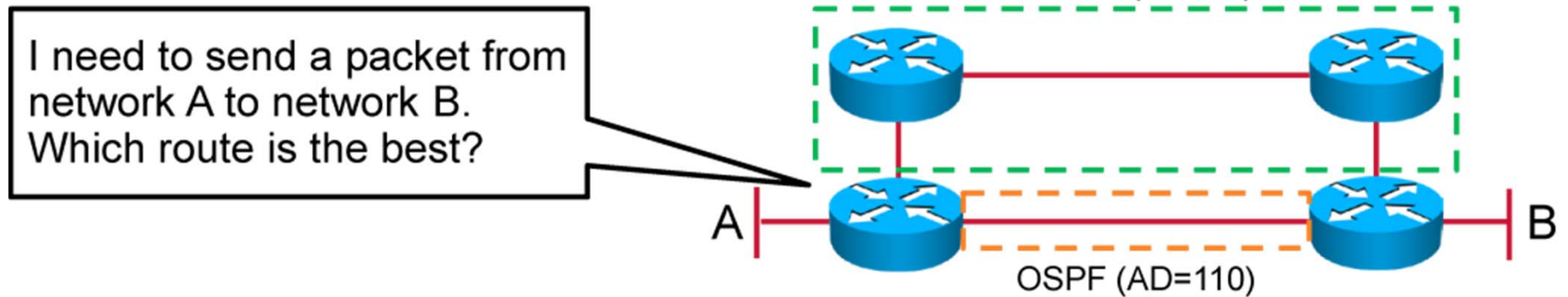
Dynamic Routing Protocols (Cont.)

Different protocols behave differently:

- IGP versus EGP
- Distance vector vs. link state
- Classless vs. classful

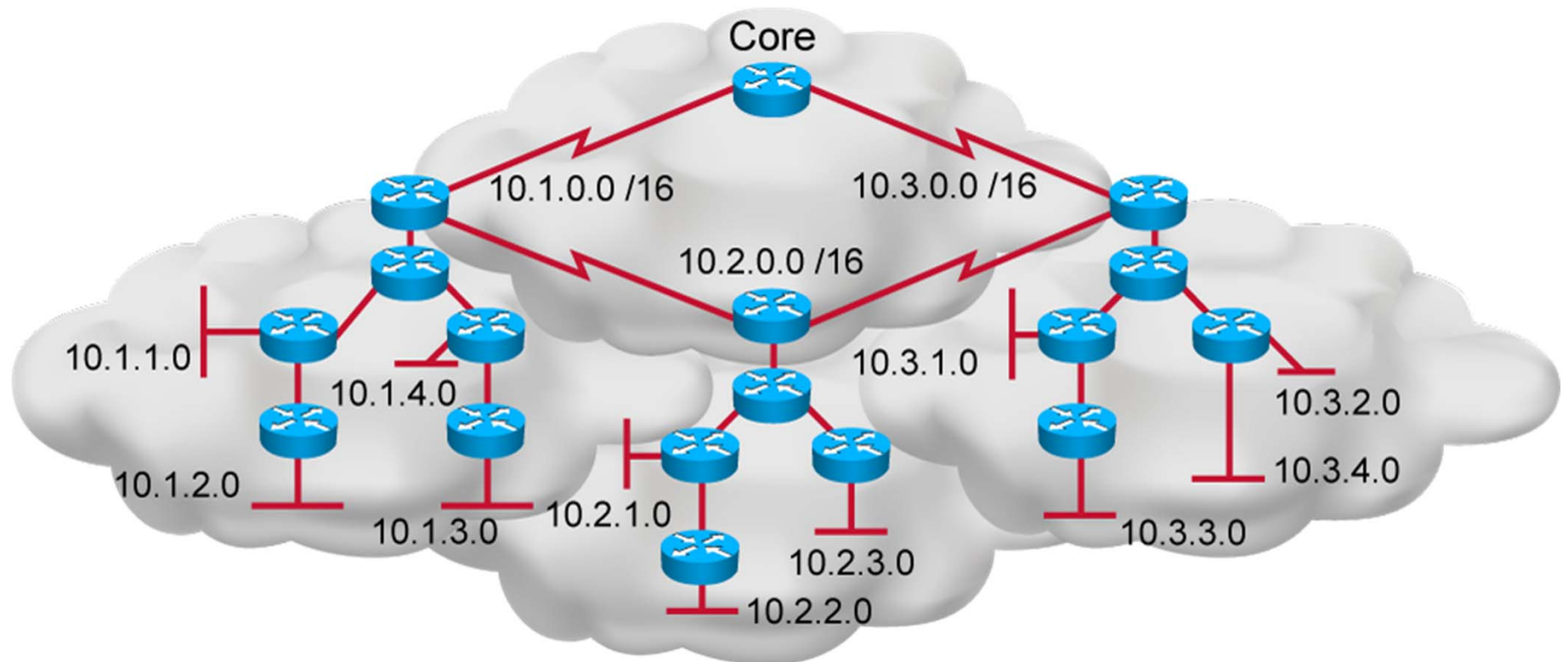
Administrative Distance

- Multiple routing protocols and static routes can be used at the same time.
- Routers choose the routing source with the lowest administrative distance.

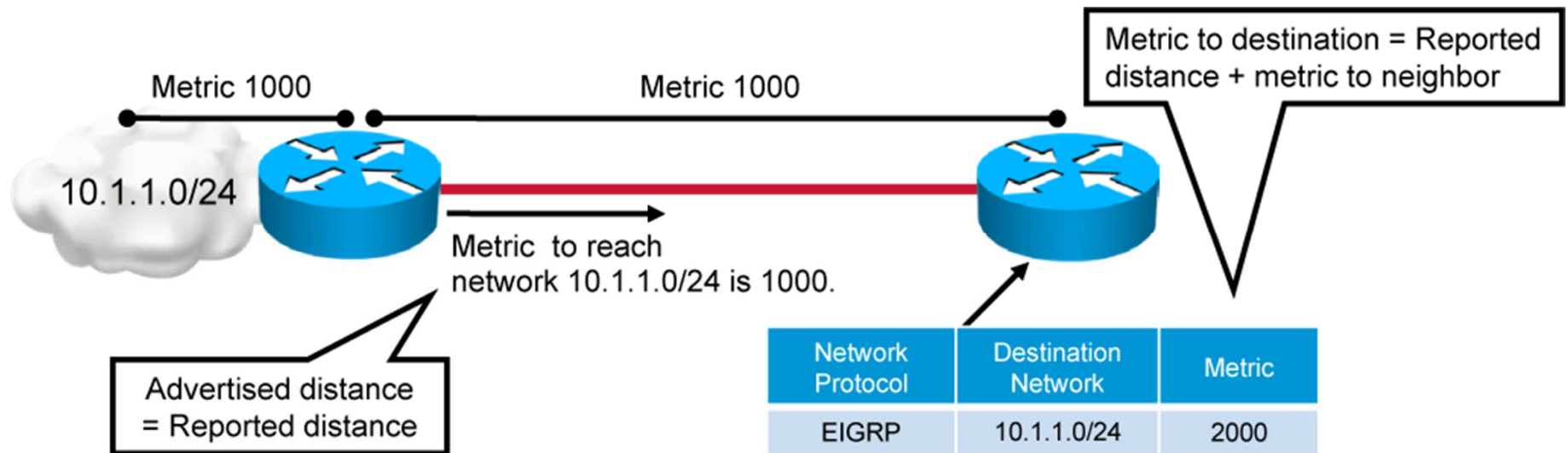


EIGRP Features

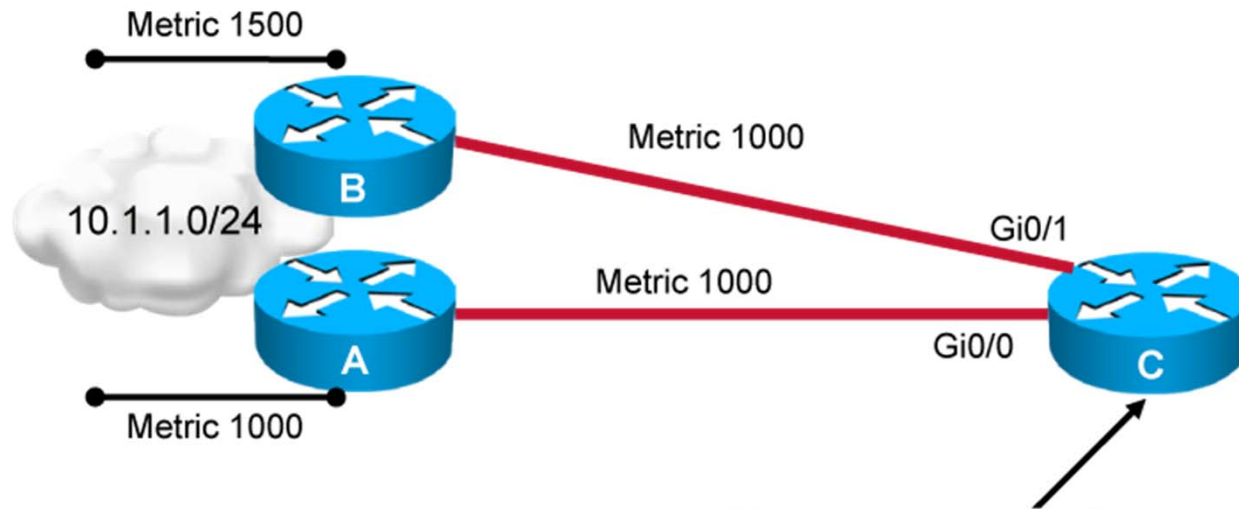
- Rapid convergence
- Load balancing
- Loop-free, classless routing
- Reduced bandwidth usage
 - Bounded updates
 - No broadcast



EIGRP Path Selection



EIGRP Path Selection (Cont.)



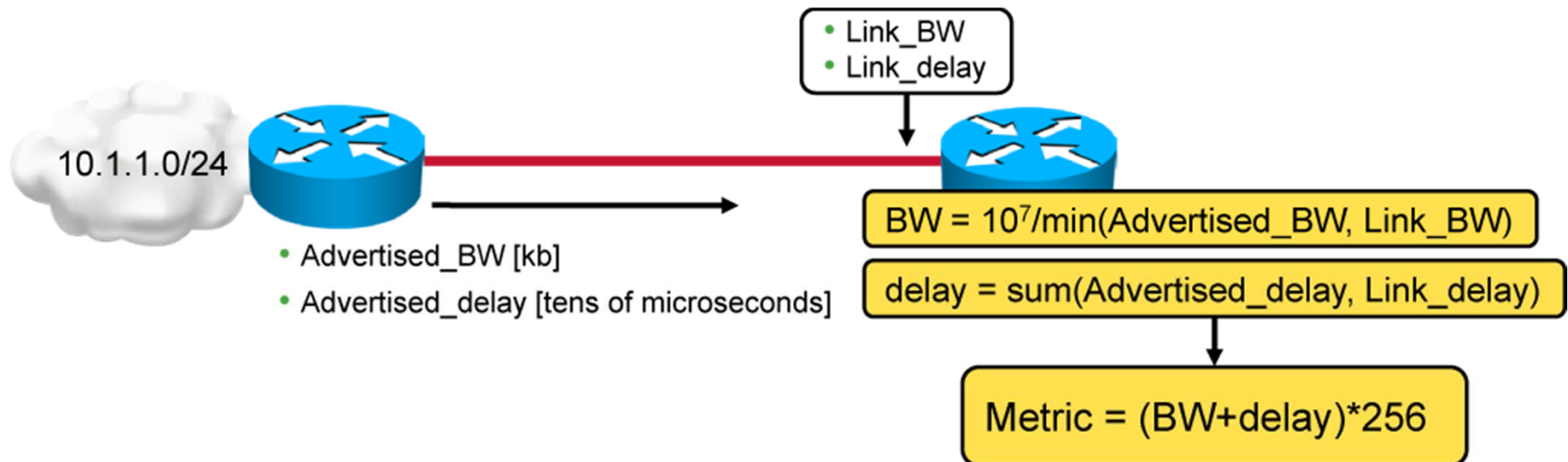
| EIGRP Neighbor Table | Next-Hop Router | Interface |
|----------------------|-----------------|-----------|
| | Router A | Gi0/0 |
| | Router B | Gi0/1 |

| EIGRP Topology Table | Network | Metric | Advertised Distance | EIGRP Neighbor |
|----------------------|-------------|--------|---------------------|----------------|
| Successor | 10.1.1.0/24 | 2000 | 1000 | Router A |
| Feasible Successor | 10.1.1.0/24 | 2500 | 1500 | Router B |

| Routing Table | Network | Metric | Outbound Interface | Next-Hop |
|---------------|-------------|--------|--------------------|----------|
| | 10.1.1.0/24 | 2000 | Gi0/0 | Router A |

EIGRP Metric

- EIGRP uses two criteria, by default, to calculate its metric:
 - Bandwidth
 - Delay
- Optionally, EIGRP can use these criteria when calculating its metric (not recommended):
 - Reliability
 - Load

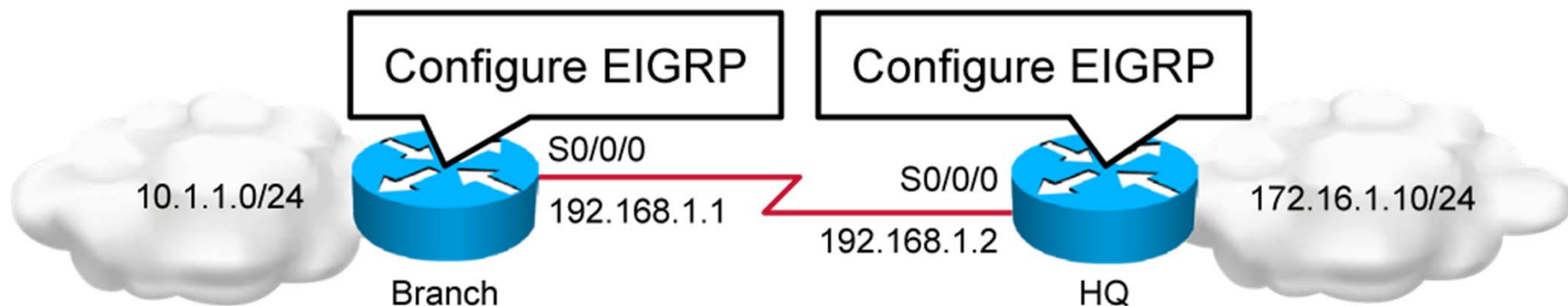


EIGRP Metric (Cont.)

```
HQ#show interfaces serial 0/0/0
Serial0/0/0 is up, line protocol is down
  Hardware is GT96K Serial
  Description: Link to Branch
  MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
<output omitted>
```

- Verifies the EIGRP metric values on the Serial 0/0/0 interface of router HQ

EIGRP Configuration



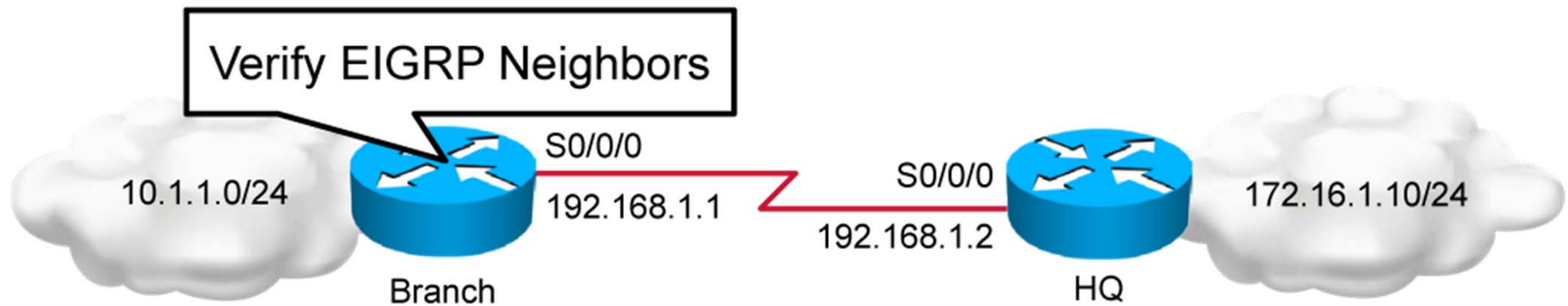
```
Branch(config)#router eigrp 100  
Branch(config-router)#network 10.1.1.0  
Branch(config-router)#network 192.168.1.0
```

- Configures EIGRP on the Branch router

```
HQ(config)#router eigrp 100  
HQ(config-router)#network 172.16.1.0 0.0.0.255  
HQ(config-router)#network 192.168.1.0 0.0.0.255
```

- Configures EIGRP on the HQ router

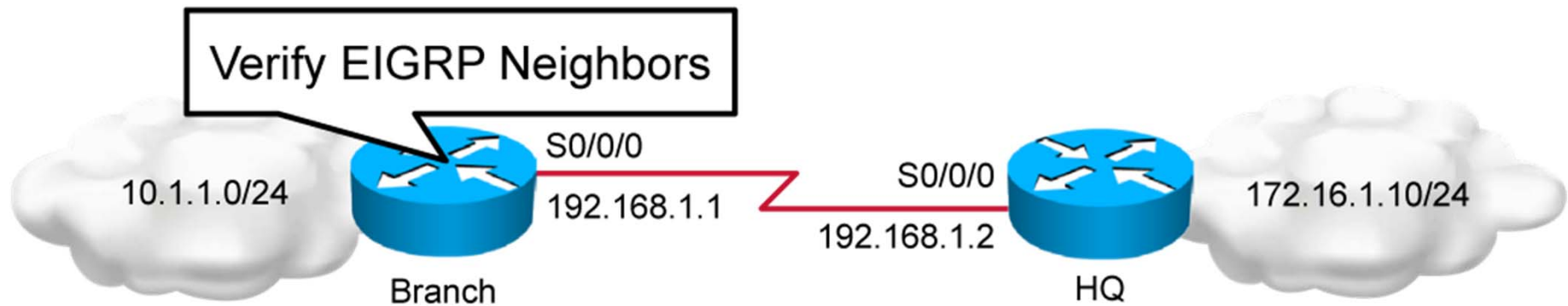
Verification of EIGRP Configuration



```
Branch#show ip eigrp neighbors
EIGRP-IPv4 Neighbors for AS(100)
H   Address          Interface    Hold    Uptime    SRTT    RTO    Q    Seq
   (sec)              (ms)                Cnt  Num
0   192.168.1.2       S0/0/0      11     00:17:22 1596    5000   0    3
```

- Verifies EIGRP neighbors on the Branch router. The Branch router has one neighbor. Branch is receiving hello packets from the peer through its Serial 0/0/0 interface.

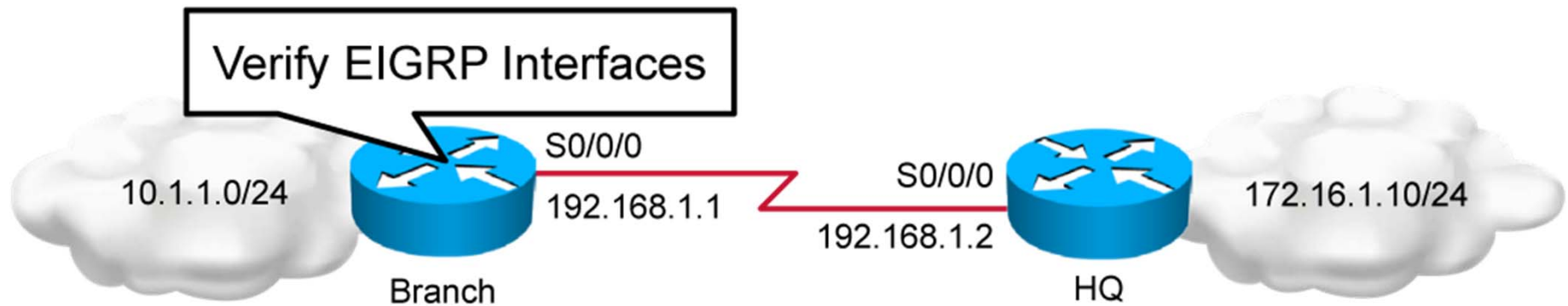
Verification of EIGRP Configuration (Cont.)



```
HQ#show ip eigrp neighbors
EIGRP-IPv4 Neighbors for AS(100)
H   Address           Interface           Hold   Uptime   SRTT   RTO   Q   Seq
   (sec)              (ms)              Cnt   Num
0   192.168.1.1        Se0/0/0            13    01:21:35 254    1524  0   4
```

- Verifies EIGRP neighbors on the HQ router. The HQ router has one neighbor. HQ is receiving hello packets from the peer through its Serial 0/0/0 interface.

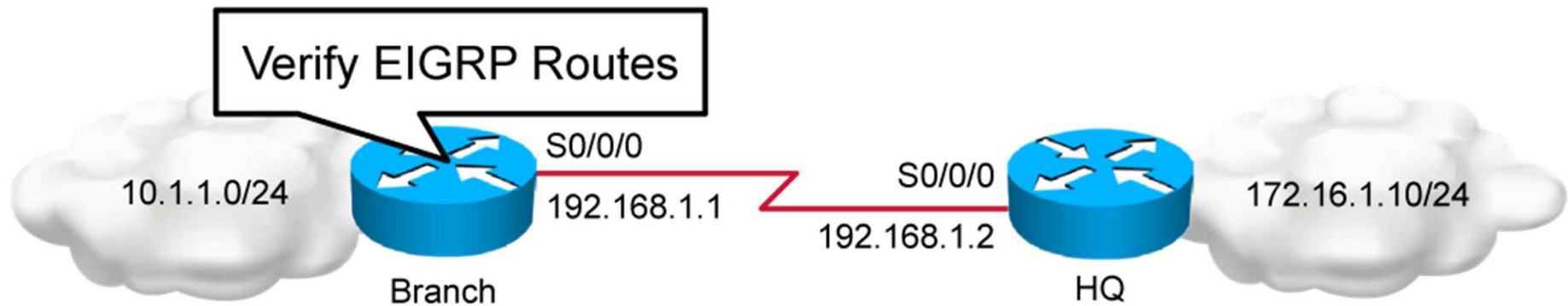
Verification of EIGRP Configuration (Cont.)



```
Branch#show ip eigrp interfaces
EIGRP-IPv4 Interfaces for AS(100)
      Xmit Queue  Mean      Pacing Time  Multicast    Pending
Interface    Peers  Un/Reliable  SRTT    Un/Reliable  Flow Timer  Routes
Gi0/0         0      0/0         0       0/1         0          0
S0/0/0       1      0/0       1596    0/1       7984         0
```

- Displays information about interfaces that are configured for EIGRP on the Branch router

Verification of EIGRP Configuration (Cont.)

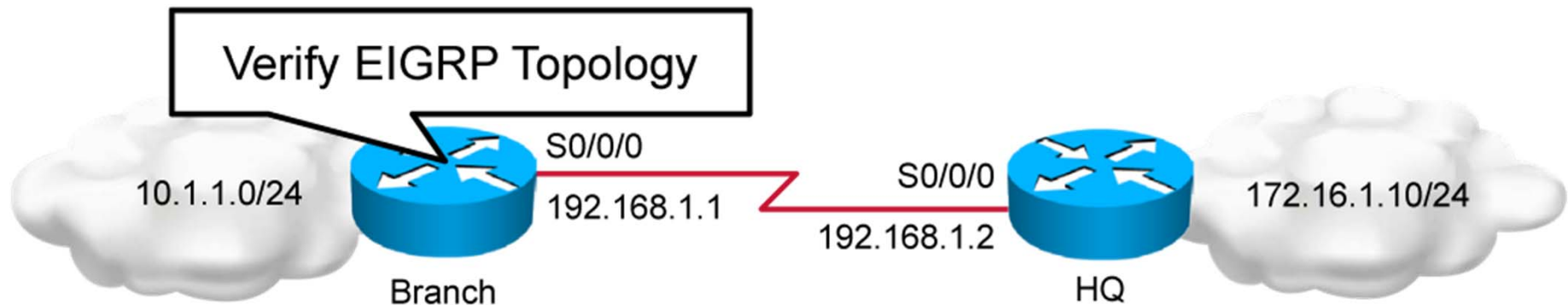


```
Gateway of last resort is not set
```

```
10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C      10.1.1.0/24 is directly connected, GigabitEthernet0/0
L      10.1.1.1/32 is directly connected, GigabitEthernet0/0
172.16.0.0/24 is subnetted, 1 subnets
D      172.16.1.0 [90/156160] via 192.168.1.2, 01:12:45, Serial 0/0/0
192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C      192.168.1.0/24 is directly connected, Serial0/0/0
L      192.168.1.1/32 is directly connected, Serial0/0/0
```

- Displays routes on the Branch router. Routes marked with D are those acquired through EIGRP.

Verification of EIGRP Configuration (Cont.)



```
Branch#show ip eigrp topology
EIGRP-IPv4 Topology Table for AS(100)/ID(10.1.1.1)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status

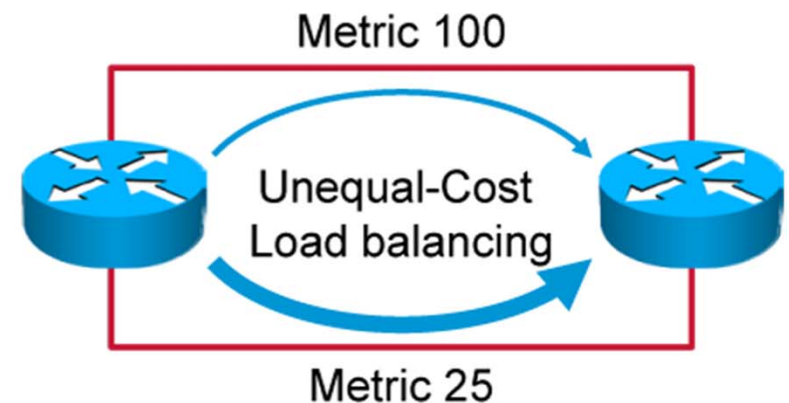
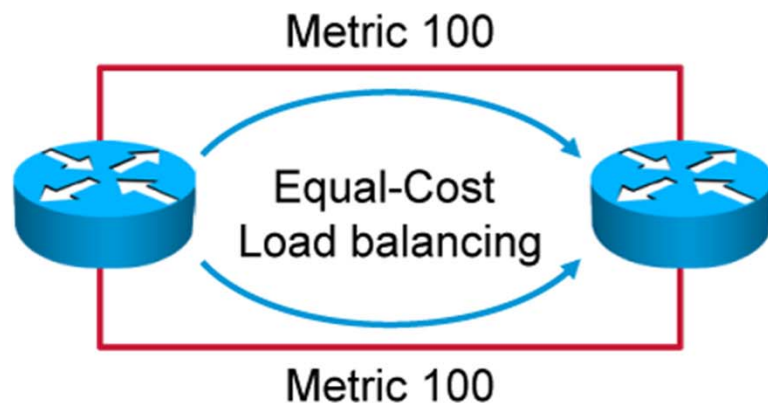
P 192.168.1.0/24, 1 successors, FD is 28160
   via Connected, Serial0/0/0
P 172.16.1.0/24, 1 successors, FD is 156160
   via 192.168.1.2 (156160/128256), Serial0/0/0
P 10.1.1.0/24, 1 successors, FD is 28160
   via Connected, GigabitEthernet0/0
```

- Displays entries in the EIGRP topology table. All routes throughout the EIGRP AS are displayed here.

Load Balancing with EIGRP

EIGRP knows two types of load balancing:

- Equal-cost load balancing:
 - By default, up to four routes with a metric equal to the minimum metric are installed in the routing table.
 - The routing table can have up to 16 entries for the same destination.
- Unequal-cost load balancing:
 - By default, it is *not* turned on.
 - Load balancing can be performed through paths that have up to 128 times worse metrics than the successor route.



Summary

- EIGRP is a classless, advanced distance vector routing protocol that runs the DUAL algorithm.
- The composite metric formula is used by EIGRP to calculate metric value; by default, it uses only bandwidth and delay.
- EIGRP is configured on a router through the **router eigrp** and **network** commands.
- There are three tables:
 - The EIGRP neighbor table lists directly connected routers that are running EIGRP.
 - The EIGRP topology table lists all routes that are learned from each EIGRP neighbor.
 - The routing table lists the best routes from the EIGRP topology table and the other routing processes.

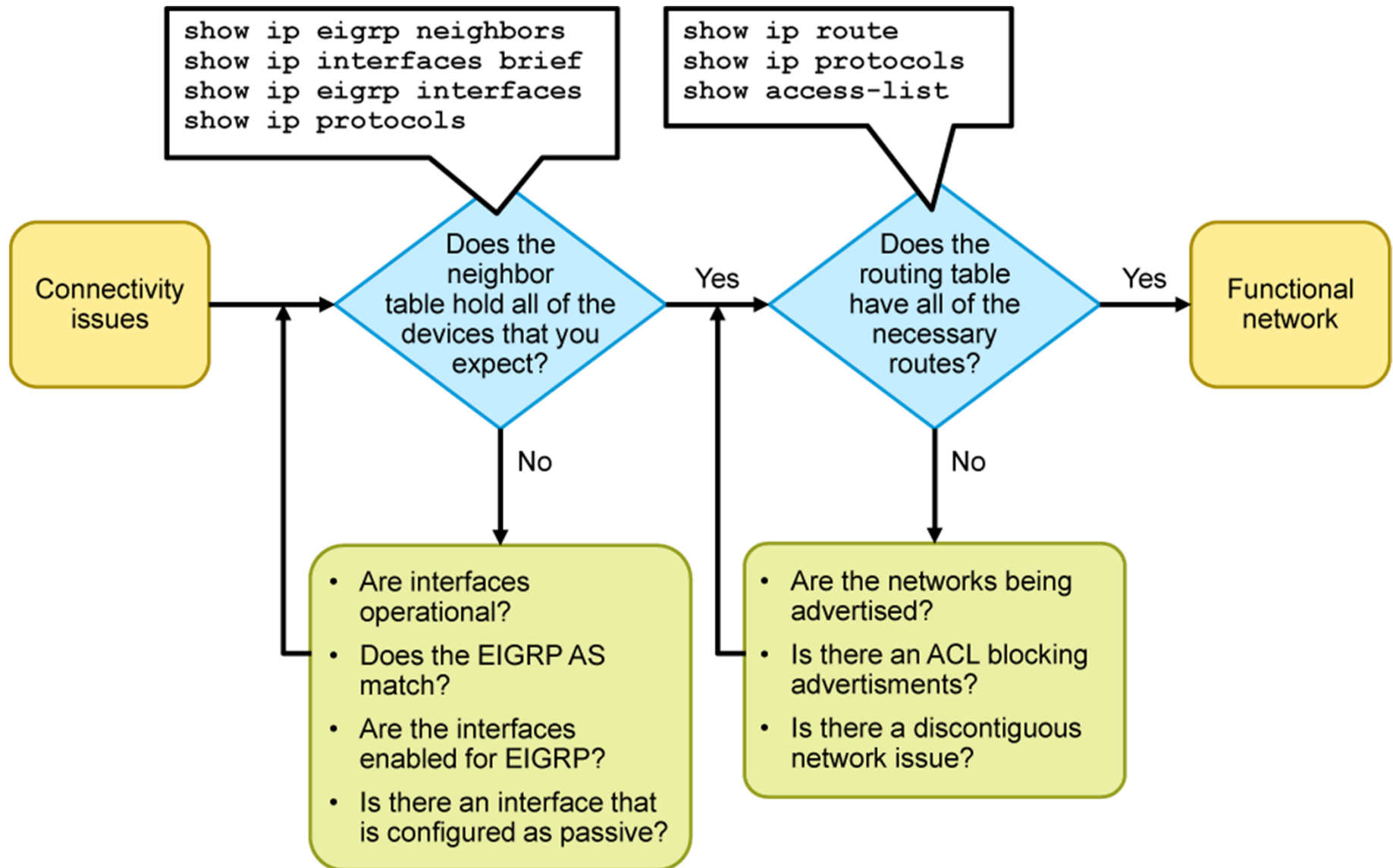




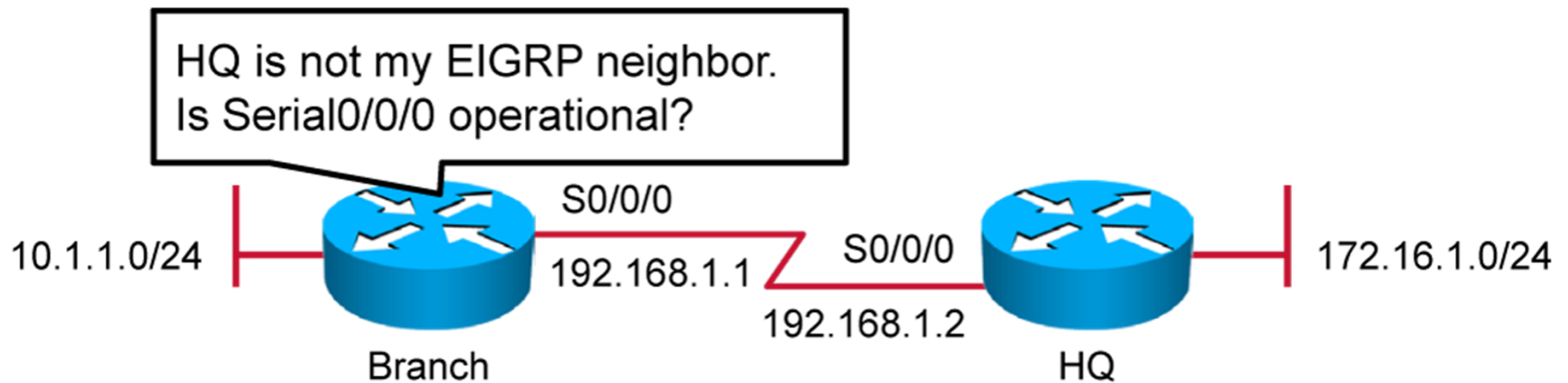
Troubleshooting EIGRP

Implementing an EIGRP-Based Solution

Components of Troubleshooting EIGRP



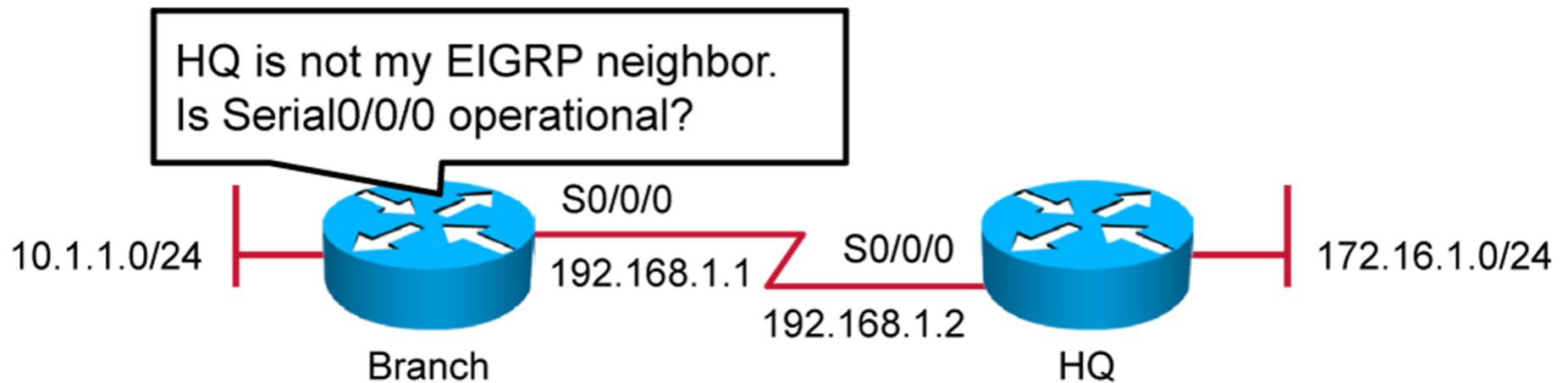
Troubleshooting EIGRP Neighbor Issues



```
Branch#show ip route eigrp  
Branch#
```

- Investigates whether there are EIGRP routes in the routing table. There are none in this example.

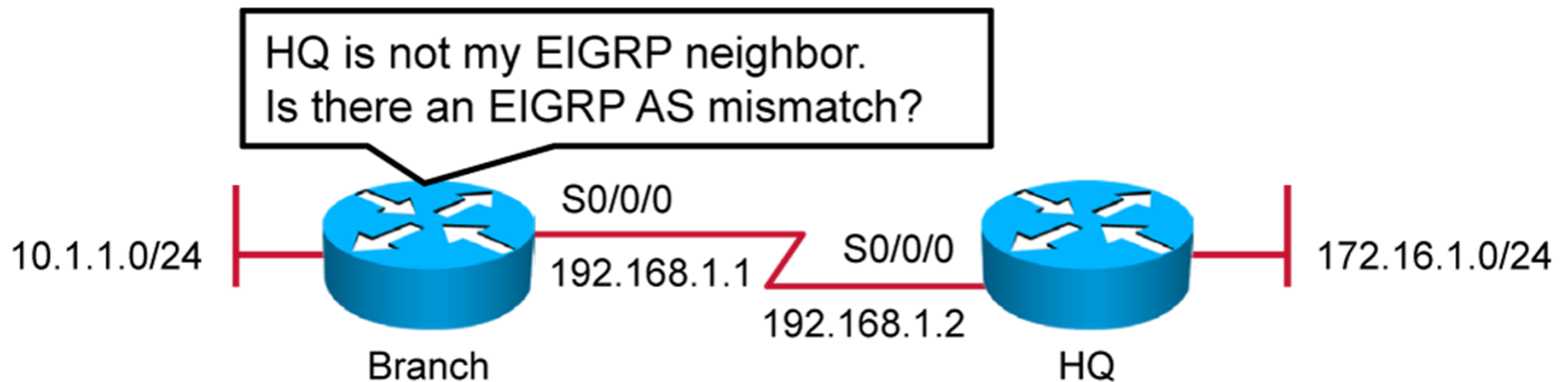
Troubleshooting EIGRP Neighbor Issues (Cont.)



```
Branch#show ip interface brief
Interface                IP-Address      OK? Method Status  Protocol
GigabitEthernet0/0       10.1.1.1        YES manual up      up
Serial0/0/0              192.168.1.1    YES manual up      up
<output omitted>
```

- Verifies that the protocol and status of the link between neighboring routers is up

Troubleshooting EIGRP Neighbor Issues (Cont.)

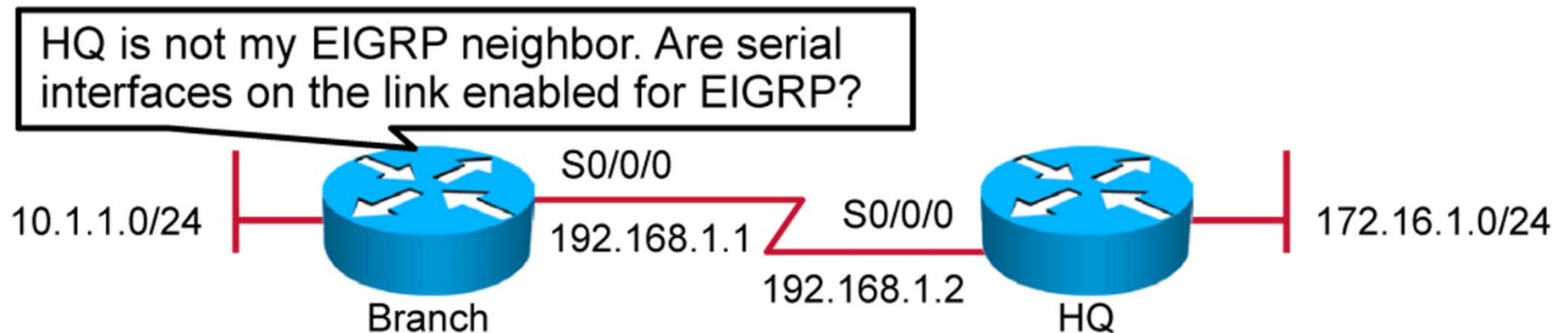


```
Branch#show ip protocols  
Routing Protocol is "eigrp 1"  
<output omitted>
```

```
HQ#show ip protocols  
Routing Protocol is "eigrp 2"  
<output omitted>
```

- Because the EIGRP autonomous systems do not match, the routers will not form a neighbor adjacency.

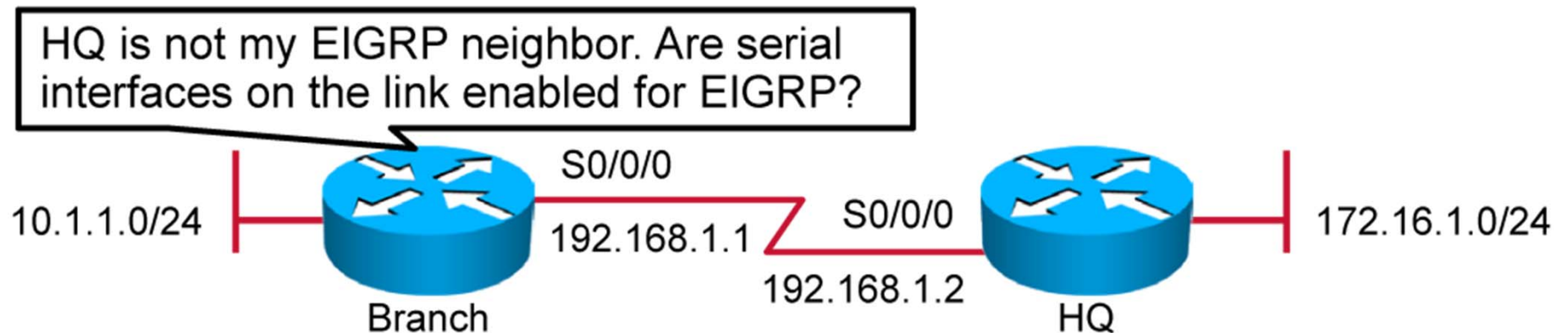
Troubleshooting EIGRP Neighbor Issues (Cont.)



```
Branch#show ip eigrp interfaces Serial 0/0/0
EIGRP-IPv4 Interfaces for AS(1)
Interface          Peers    Xmit Queue Mean    Pacing Time Multicast Pending
                  Un/Reliable SRTT      Un/Reliable Flow Timer Routes
S0/0/0             0        0/0       0       0/0       0         0
```

- If serial interfaces on both routers are not enabled for the EIGRP process, a neighbor adjacency will not be formed. In this example, Branch has Serial 0/0/0 enabled for EIGRP.

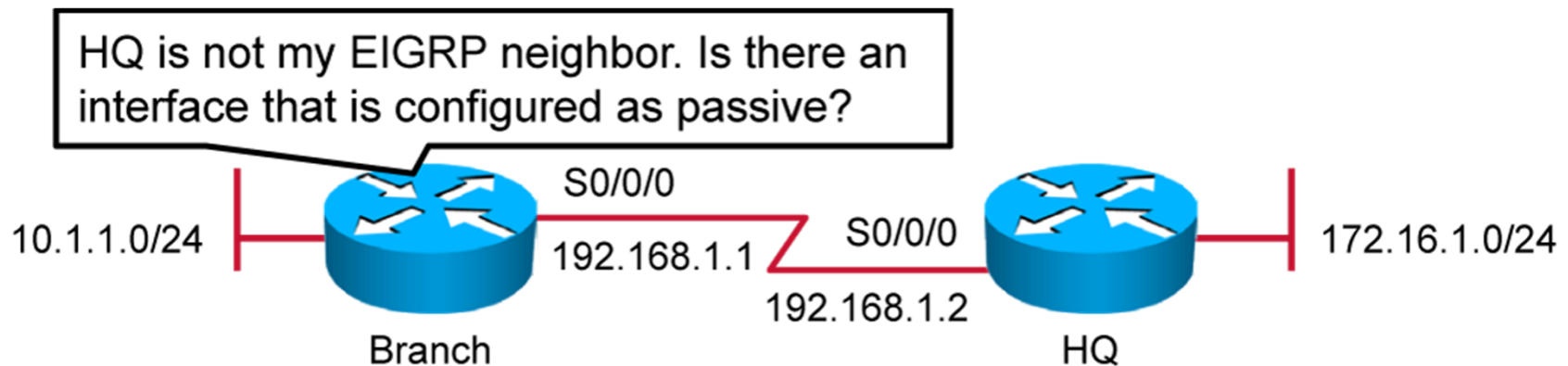
Troubleshooting EIGRP Neighbor Issues (Cont.)



```
HQ#show ip eigrp interfaces Serial 0/0/0
EIGRP-IPv4 Interfaces for AS(1)
Interface           Peers  Xmit Queue  Mean    Pacing Time  Multicast  Pending
                   Un/Reliable SRTT      Un/Reliable  Flow Timer   Routes
```

- If serial interfaces on both routers are not enabled for the EIGRP process, a neighbor adjacency will not be formed. In this example, HQ does not have Serial 0/0/0 enabled for EIGRP, and therefore the routers are not becoming EIGRP neighbors.

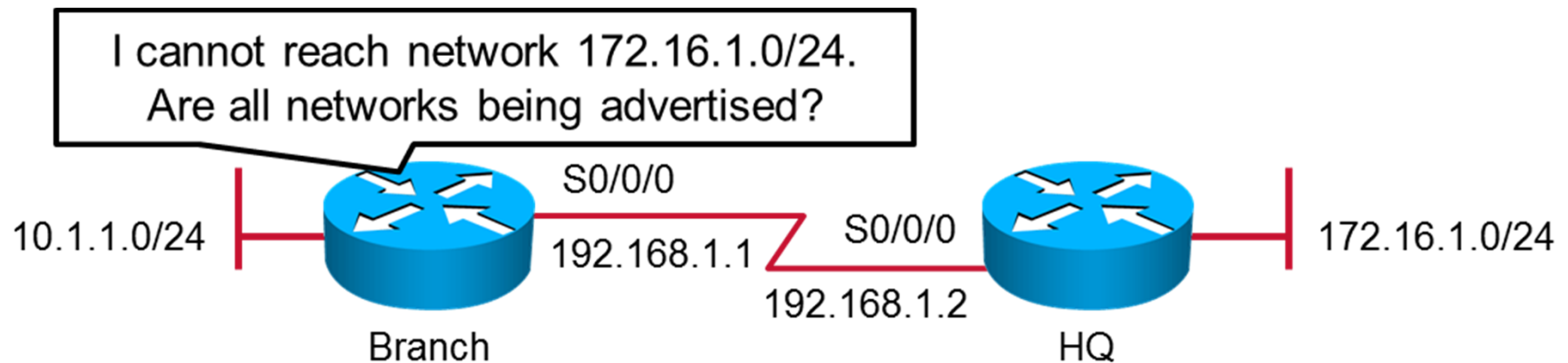
Troubleshooting EIGRP Neighbor Issues (Cont.)



```
HQ#show ip protocols
<output omitted>
Routing Protocol is "eigrp 1"
<output omitted>
  Routing for Networks:
    172.16.0.0
    192.168.1.0
  Passive Interface(s):
    Serial0/0/0
<output omitted>
```

- Because the HQ interface S0/0/0 is configured as neighbor, an adjacency is not formed.

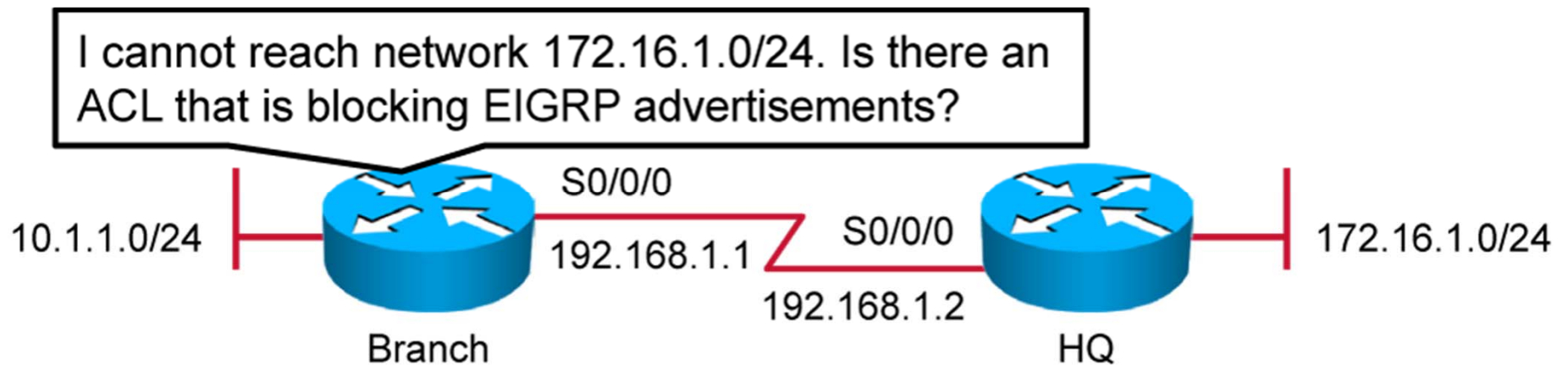
Troubleshooting EIGRP Routing Table Issues



```
HQ#show ip protocols
Routing Protocol is "eigrp 1"
<output omitted>
  Routing for Networks:
    192.168.1.0
    10.0.0.0
<output omitted>
```

- The HQ router is missing the network statement for the 172.16.1.0 network.

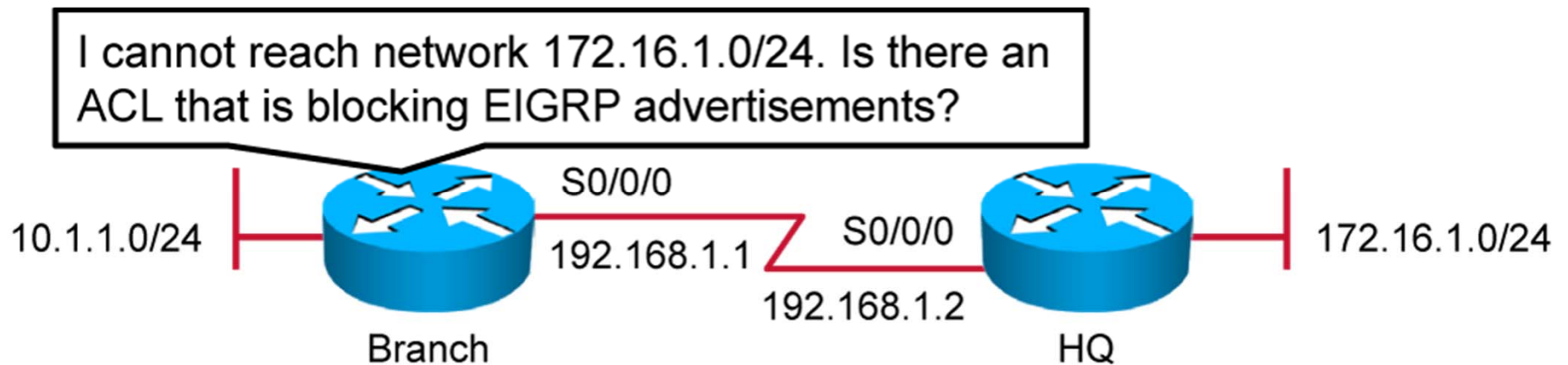
Troubleshooting EIGRP Routing Table Issues (Cont.)



```
HQ#show ip protocols
<output omitted>
Routing Protocol is "eigrp 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
<output omitted>
```

- Checks whether any ACLs are applied to the EIGRP network advertisements

Troubleshooting EIGRP Routing Table Issues (Cont.)

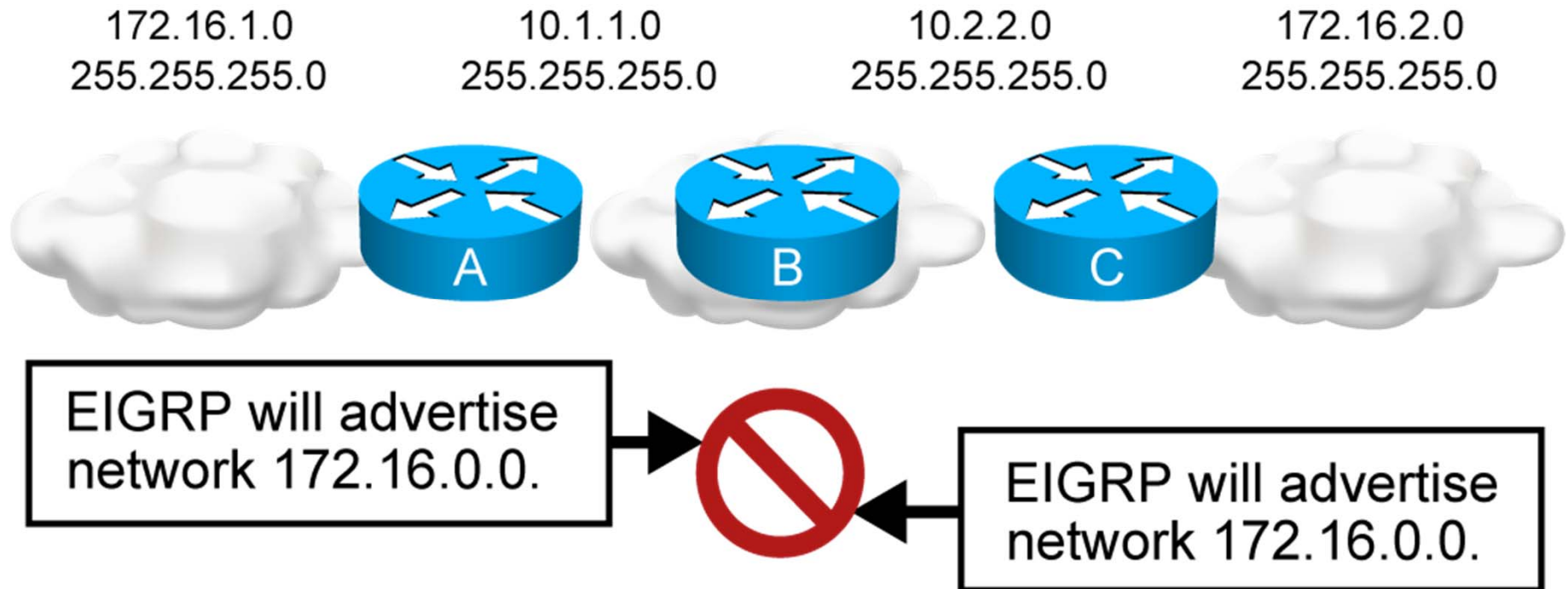


```
Branch#show ip protocols
<output omitted>
Routing Protocol is "eigrp 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
<output omitted>
```

- Checks whether any ACLs are applied to the EIGRP network advertisements

Troubleshooting EIGRP Routing Table Issues (Cont.)

EIGRP can be configured to perform automatic summarization on classful boundaries that are causing issues with discontinuous networks.



Summary

- Use the **show ip route** command to verify routes to remote networks.
- Use the **show ip eigrp neighbors** command to verify the EIGRP neighbor relationship.
- Use the **show ip interface brief** command to verify that the link between devices is operational.
- Use the **show ip eigrp interface *interface*** command to verify that the interface is participating in the EIGRP process.
- Use the **show ip protocols** command to verify that EIGRP AS numbers match, that proper networks are being advertised, that there are no interfaces misconfigured as passive, and that there is no ACL blocking EIGRP advertisements.





Implementing EIGRP for IPv6

Implementing an EIGRP-Based Solution

EIGRP for IPv6

- Easy to configure
- Advanced distance vector mechanism with some features that are common to link-state protocols
- Uses protocol-dependent modules to support multiple protocols
- Supports IPv6 as a separate routing context

EIGRP for IPv6 (Cont.)

- Neighbor discovery
- Incremental updates
- Fast convergence—DUAL
- Uses multicast for updates
- Composite metric
- Load balancing
- Three tables:
 - Neighbor table
 - Topology table
 - Routing table

EIGRP for IPv6 Commands

```
Router(config)#ipv6 unicast-routing
```

- Globally enables IPv6 routing and must be the first IPv6 command executed on the router

```
Router(config)#ipv6 router eigrp 1
```

- Creates and enters the EIGRP router submode with AS 1

```
Router(config-rtr)#no shutdown
```

- EIGRP for IPv6 has a shutdown feature. The routing process should be in "no shut" mode to start running.

```
Router(config-if)#ipv6 eigrp 1  
Router(config-if)#no shutdown
```

- Configures EIGRP for IPv6 on an interface

EIGRP for IPv6 Commands (Cont.)

```
Router#show ipv6 eigrp topology
```

- Displays entries in the EIGRP IPv6 topology table

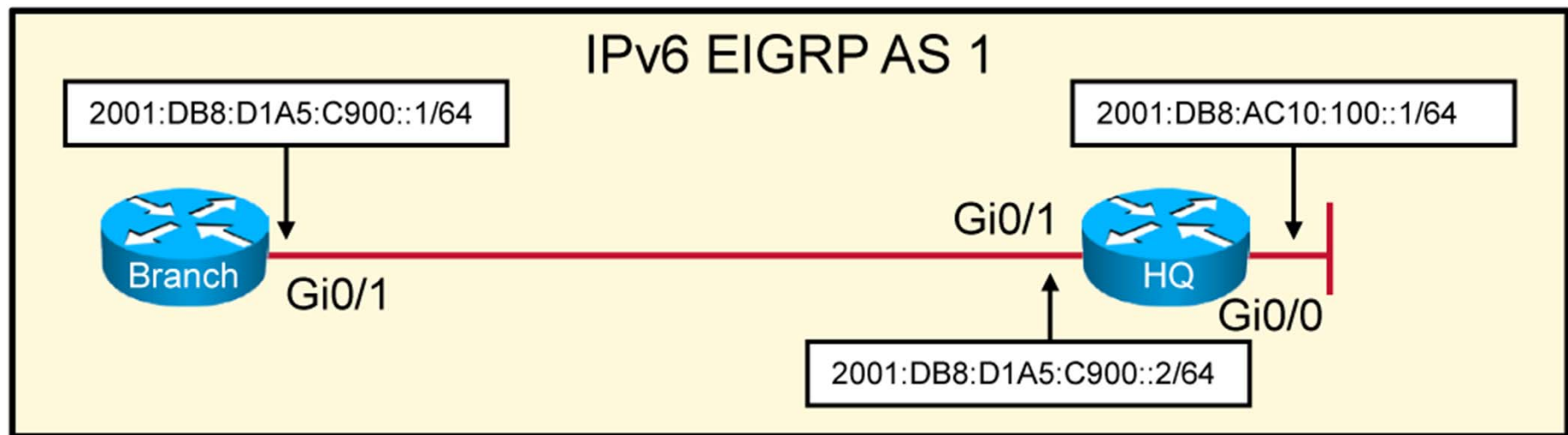
```
Router#show ipv6 eigrp neighbors
```

- Displays the neighbors that are discovered by EIGRP for IPv6

```
Router#show ipv6 route eigrp
```

- Shows EIGRP routes in the IPv6 routing table

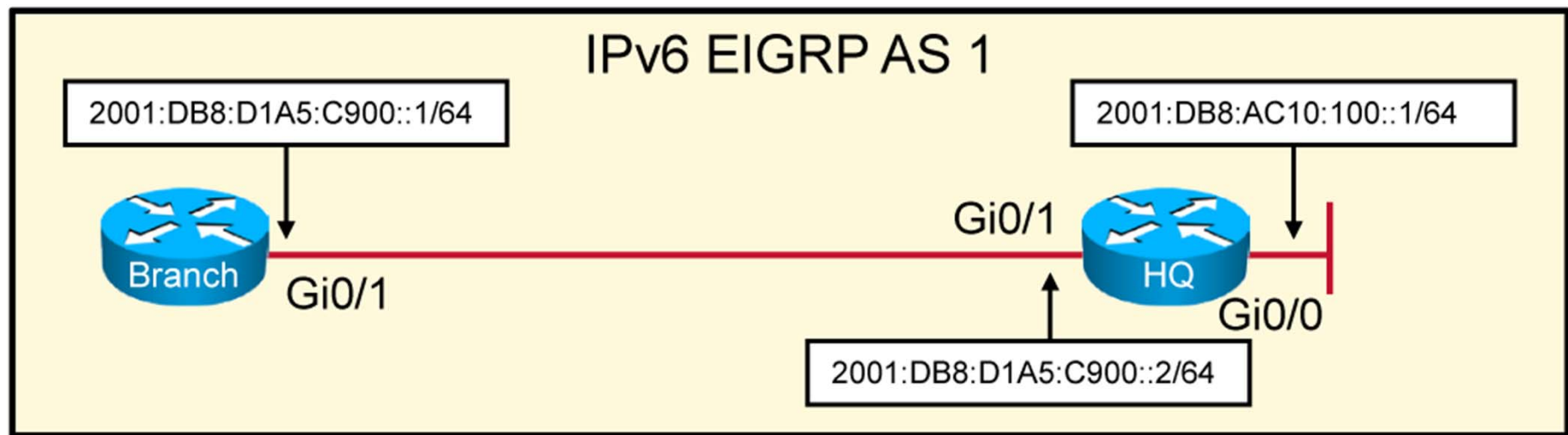
EIGRP for IPv6 Configuration Example



```
Branch(config)#ipv6 router eigrp 1  
Branch(config-router)#exit  
Branch(config)#interface GigabitEthernet0/1  
Branch(config-if)#ipv6 eigrp 1
```

- EIGRP for IPv6 configuration on the Branch router

EIGRP for IPv6 Configuration Example (Cont.)



```
HQ(config)#ipv6 router eigrp 1
HQ(config)#exit
HQ(config)#interface GigabitEthernet0/0
HQ(config-if)#ipv6 eigrp 1
HQ(config-if)#exit
HQ(config)#interface GigabitEthernet0/1
HQ(config-if)#ipv6 eigrp 1
```

- EIGRP for IPv6 configuration on the HQ router

EIGRP for IPv6 Configuration Example (Cont.)

```
Branch#show ipv6 eigrp interfaces
EIGRP-IPv6 Interfaces for AS(1)

          Xmit Queue  PeerQ           Mean Pacing Time Multicast  Pending
Interface Peers Un/Reliable Un/Reliable SRTT Un/Reliable Flow Timer Routes
Gi0/1      1      0/0          0/0          9      0/0          50          0
```

- Verifies that the Branch router has the GigabitEthernet 0/1 interface

```
Branch#show ipv6 eigrp neighbors
EIGRP-IPv6 Neighbors for AS(1)
H   Address                Interface      Hold  Uptime    SRTT   RTO    Q   Seq
   Address                Interface      (sec)      (ms)          Cnt  Num
0   Link-local address:    Gi0/1         12      00:20:48   9      100    0   2
   FE80::FE99:47FF:FEE5:2671
```

- Verifies EIGRP neighbors

EIGRP for IPv6 Configuration Example (Cont.)

```
Branch#show ipv6 eigrp topology
EIGRP-IPv6 Topology Table for AS(1)/ID(209.165.201.1)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status

P 2001:DB8:D1A5:C900::/64, 1 successors, FD is 28160
   via Connected, GigabitEthernet0/1
P 2001:DB8:AC10:100::/64, 1 successors, FD is 156160
   via FE80::FE99:47FF:FEE5:2671 (156160/128256), GigabitEthernet0/1
```

- Verifies the EIGRP for IPv6 topology table

EIGRP for IPv6 Configuration Example (Cont.)

```
Branch#show ipv6 route eigrp
IPv6 Routing Table - default - 4 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
        B - BGP, R - RIP, 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
D    2001:DB8:AC10:100::/64 [90/156160]
    via FE80::FE99:47FF:FEE5:2671, GigabitEthernet0/1
```

- Verifies IPv6 routes acquired via EIGRP

Summary

- EIGRP has extended its multiprotocol support to IPv6.
- EIGRP for IPv6 is configured per interface on Cisco routers (there is no **network** command).
- You can enable IPv6 routing with the **ipv6 unicast-routing** command.
- EIGRP for IPv6 has a shutdown feature. The routing process should be in **no shutdown** mode in order to start running.



Module Summary

- EIGRP is a classless, advanced distance vector routing protocol that runs the DUAL algorithm.
- EIGRP is configured on a router through the **router eigrp** and **network** commands.
- There are three tables:
 - The EIGRP neighbor table lists directly connected routers running EIGRP.
 - The EIGRP topology table lists all routes learned from each EIGRP neighbor.
 - The routing table lists the best routes from the EIGRP topology table and the other routing processes.
- When you suspect an EIGRP issue, first check if the neighbors are up, then start troubleshooting the routing table.
- EIGRP for IPv6 is enabled per interface (there is no **network** command). EIGRP for IPv6 has a shutdown feature. The routing process should be in no shutdown mode in order to start running.

