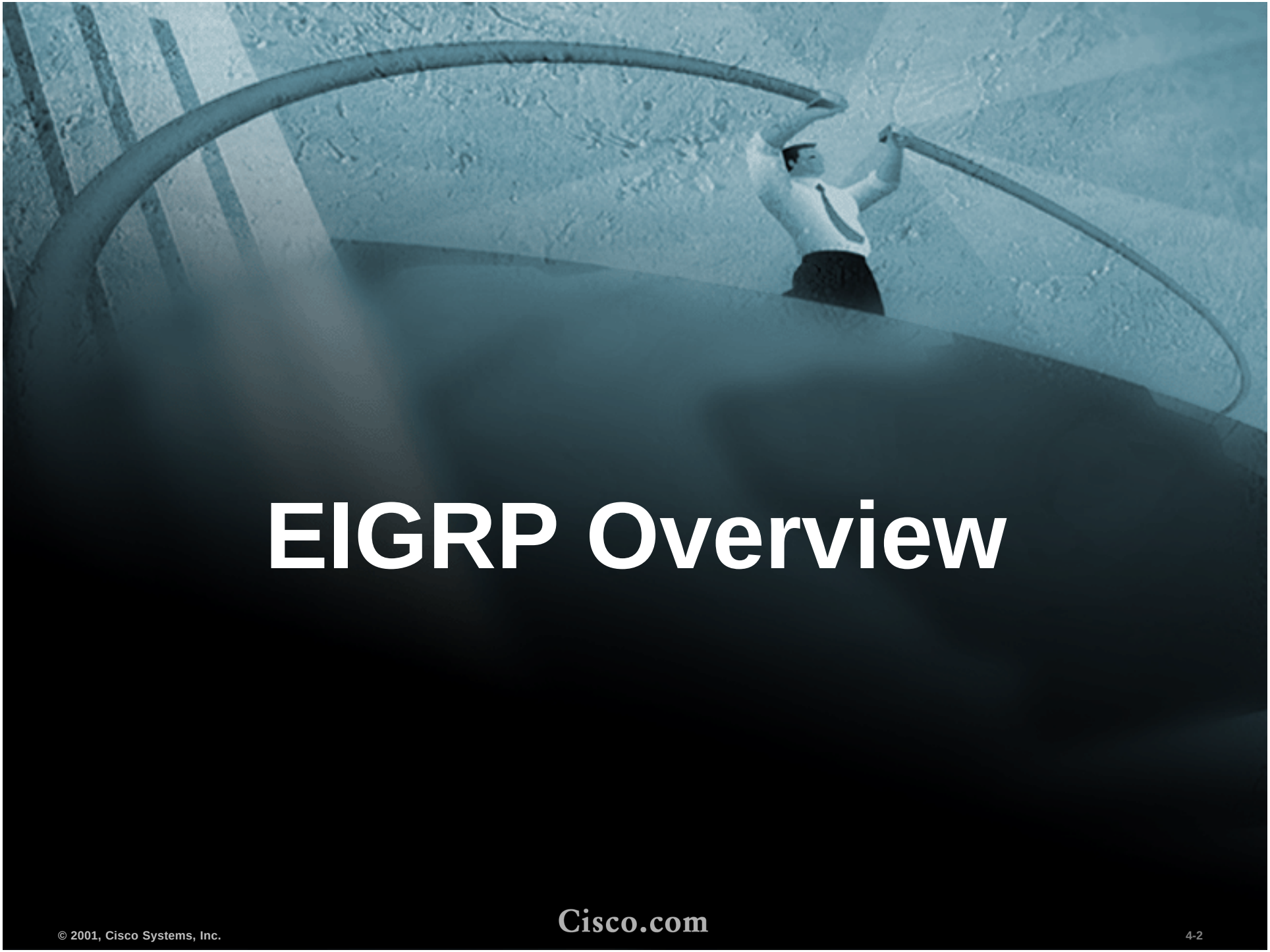
Configuring EIGRP



EIGRP Overview

What Is EIGRP?

EIGRP supports:

- Rapid convergence
- Reduced bandwidth usage
- Multiple network-layer protocols

EIGRP Features

- Advanced distance vector
- 100% loop free
- Fast convergence
- Easy configuration
- Less network design constraints than OSPF

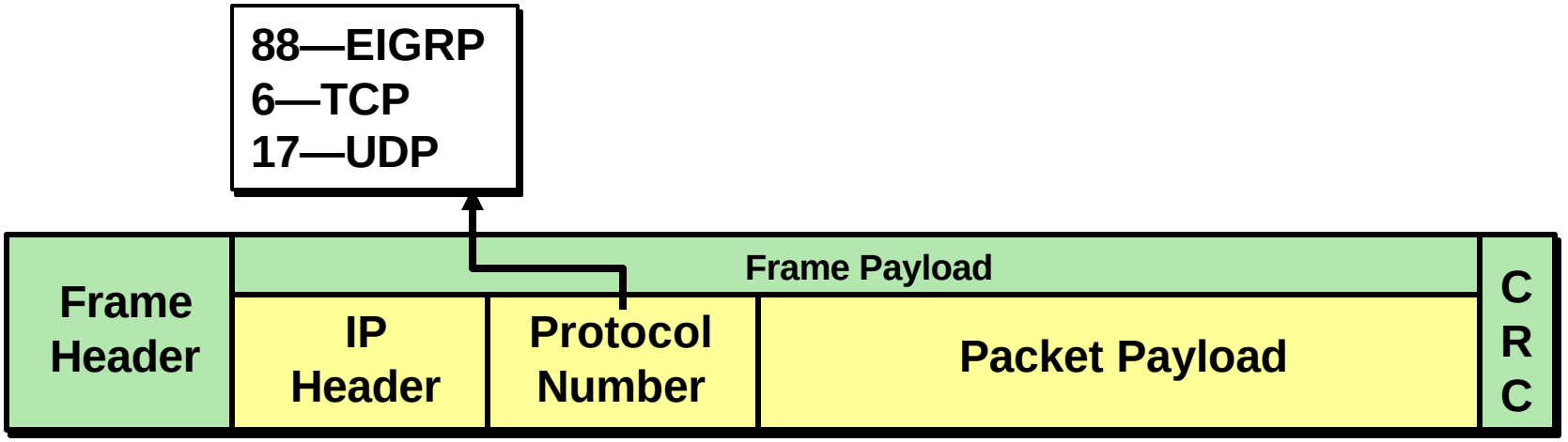
EIGRP Features (cont.)

- Incremental updates
- Supports VLSM and discontiguous networks
- Classless routing
- Compatible with existing IGRP networks
- Protocol independent (supports IPX and AppleTalk)

Advantages of EIGRP

- Multicast instead of broadcast
- Use of link bandwidth and delay
  - EIGRP metric = IGRP metric x 256 (32 bit versus 24 bit)
- Unequal cost path load balancing
- More flexible than OSPF
  - Manual summarization can be done in any interface at any router within the network

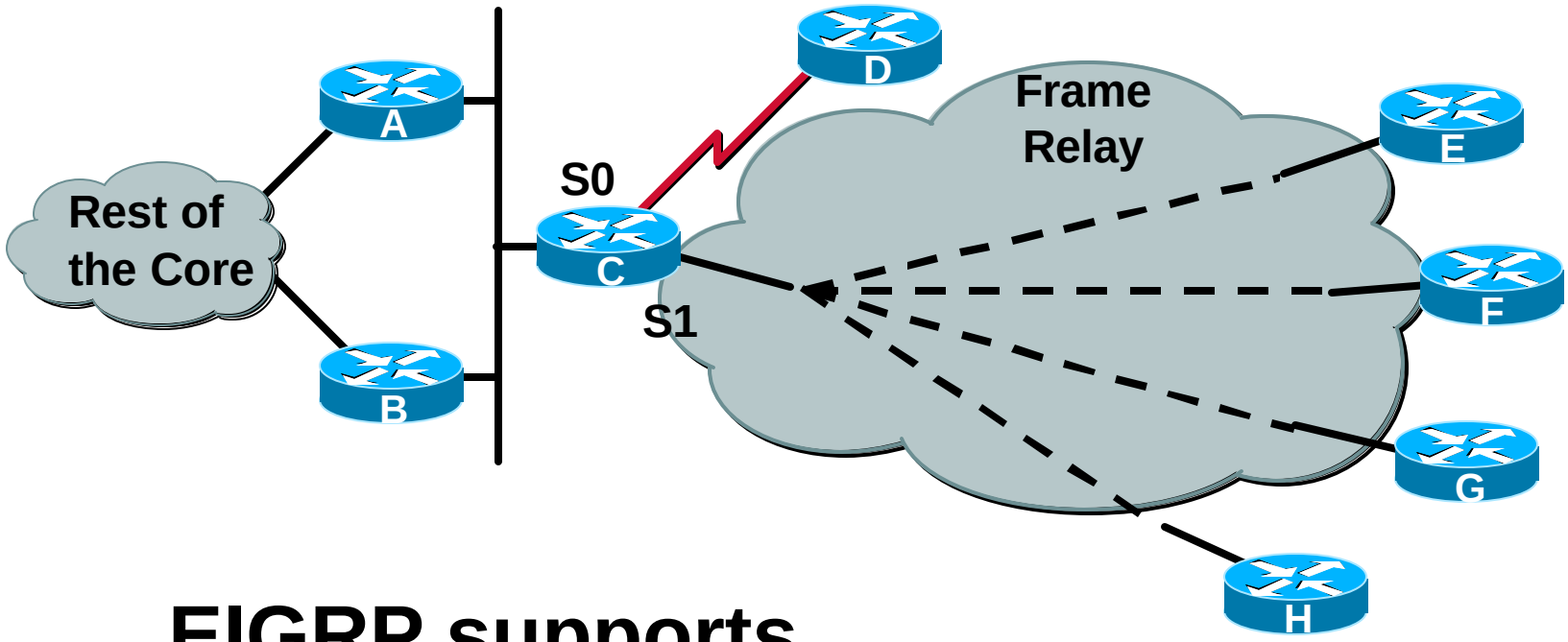
EIGRP in IP Packets



EIGRP is an advanced distance vector routing protocol:

- **Automatically establishes neighbor relationships with peer devices**
- **Relies on IP packets for delivery of routing information**

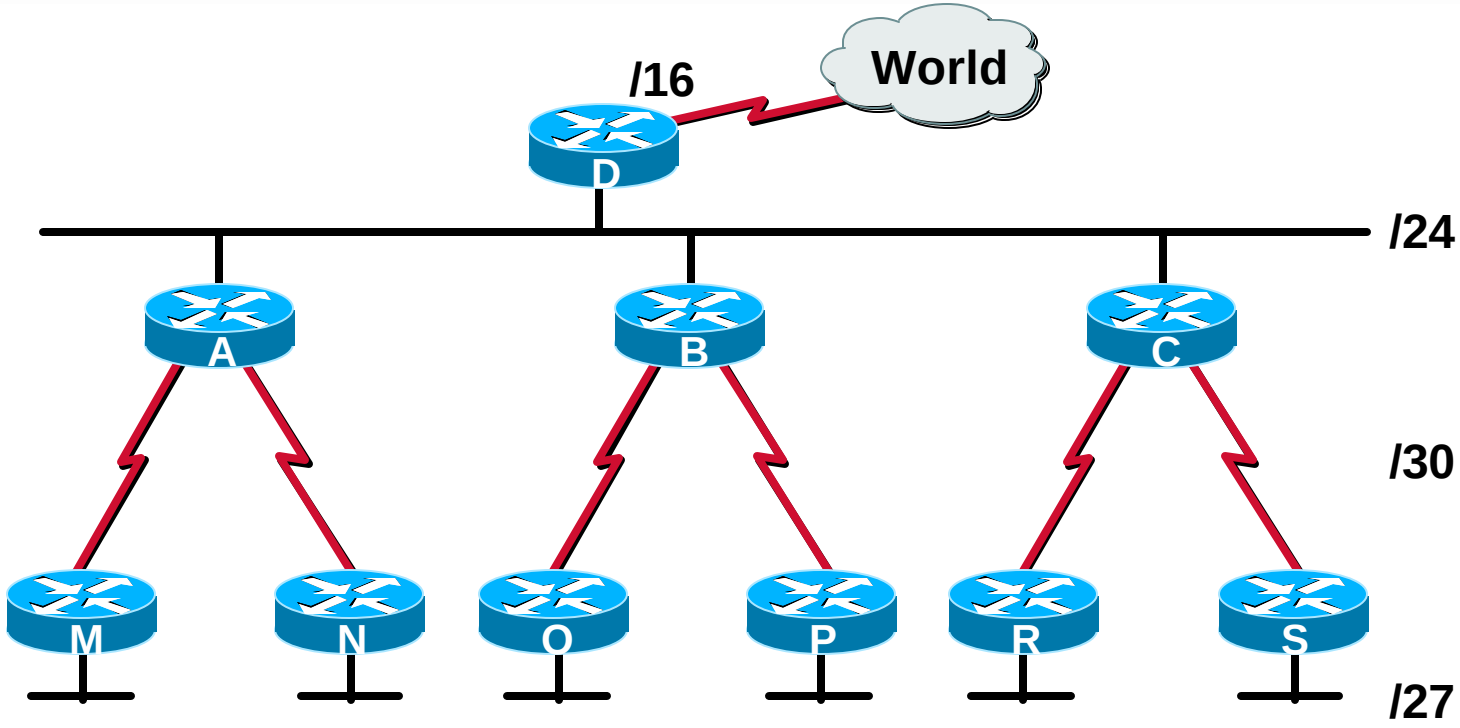
EIGRP Support for Different Topologies



EIGRP supports

- Multiaccess (LANs)
- Point-to-point (HDLC)
- NBMA (Frame Relay)

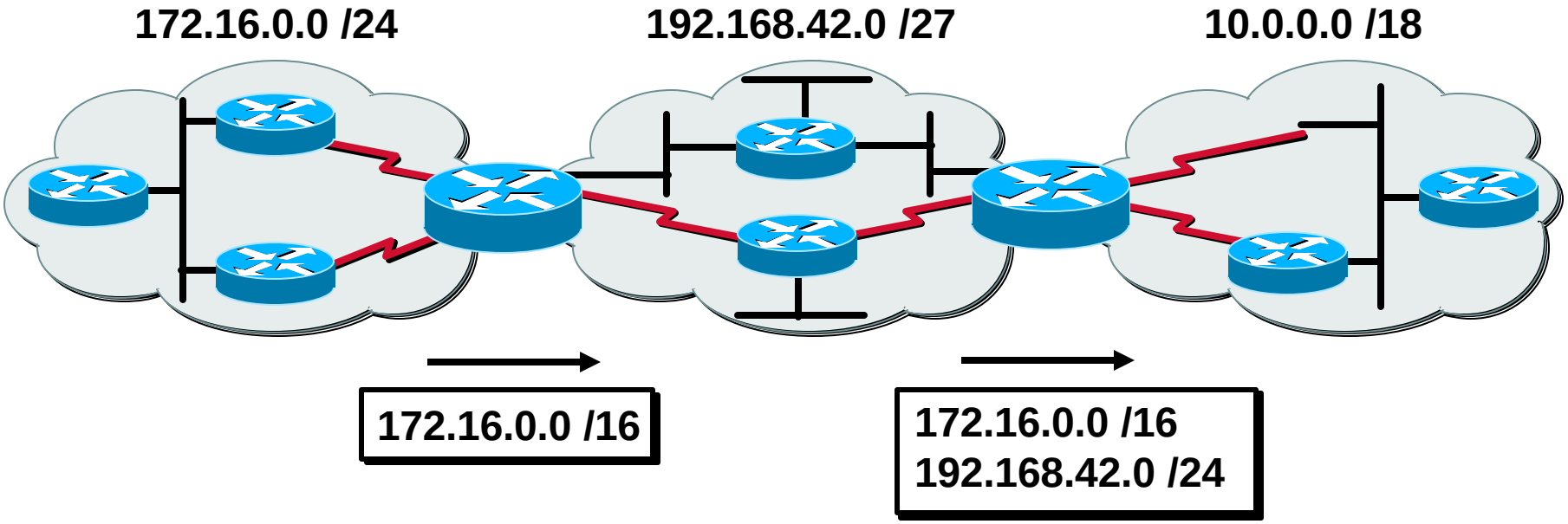
EIGRP Support for IP Addresses



EIGRP supports:

- VLSMs
- Hierarchical designs

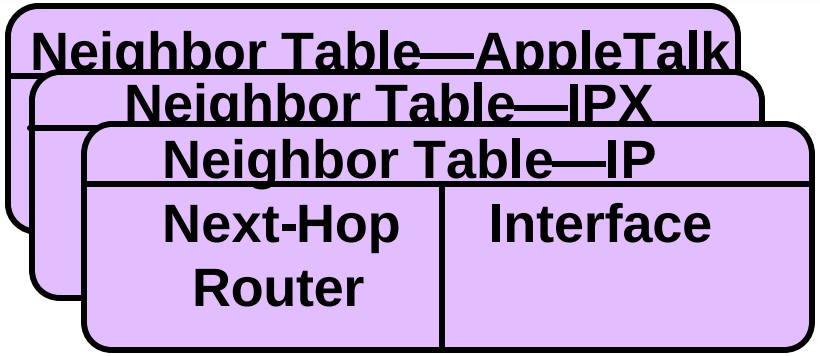
EIGRP Support for Route Summarization



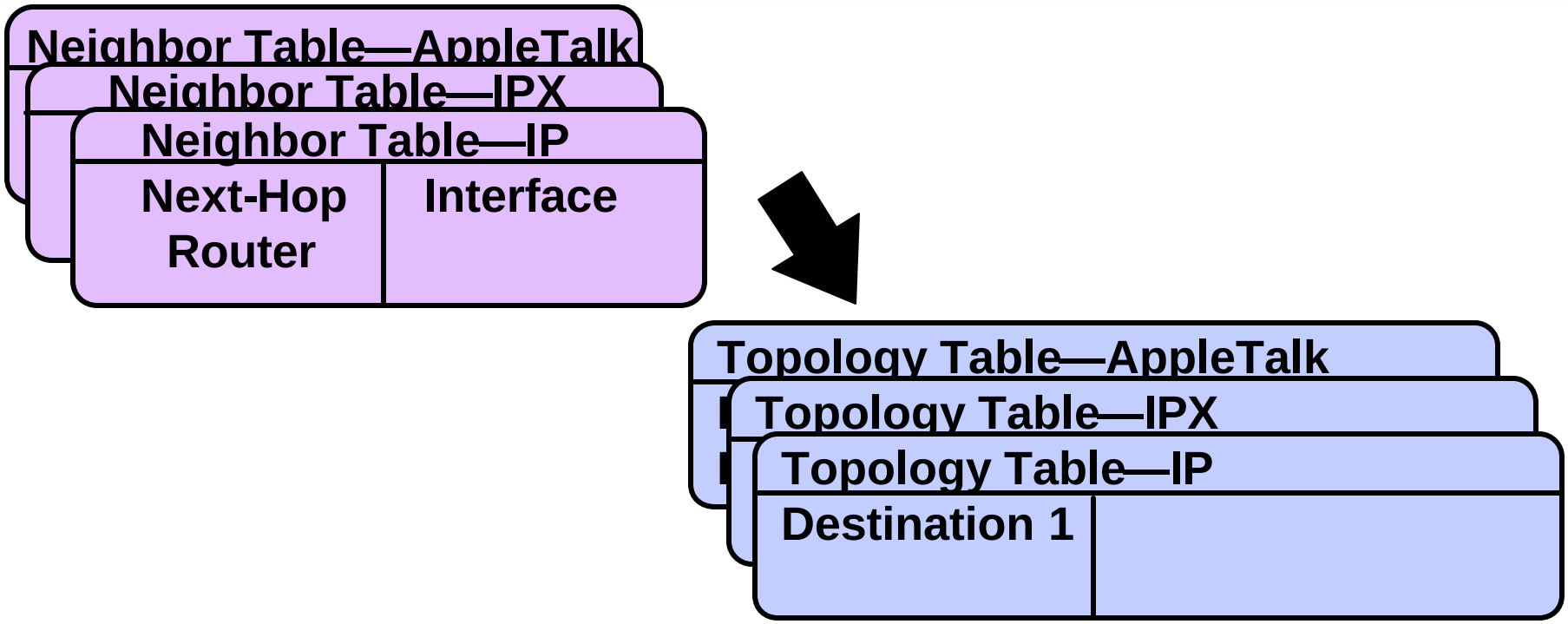
EIGRP performs route summarization

- Classful network boundaries (default)
- Arbitrary network boundaries (manual)

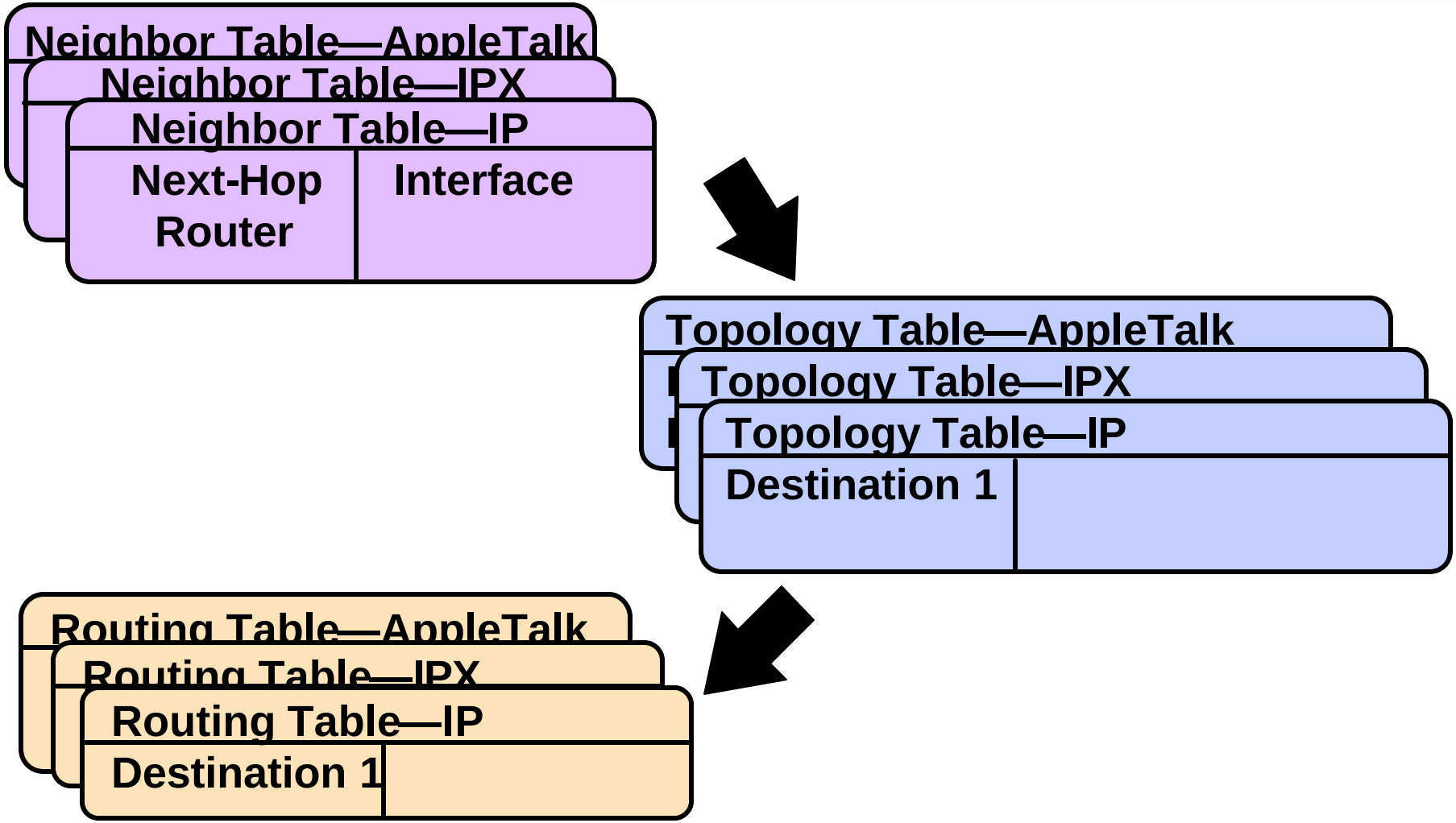
EIGRP Terminology



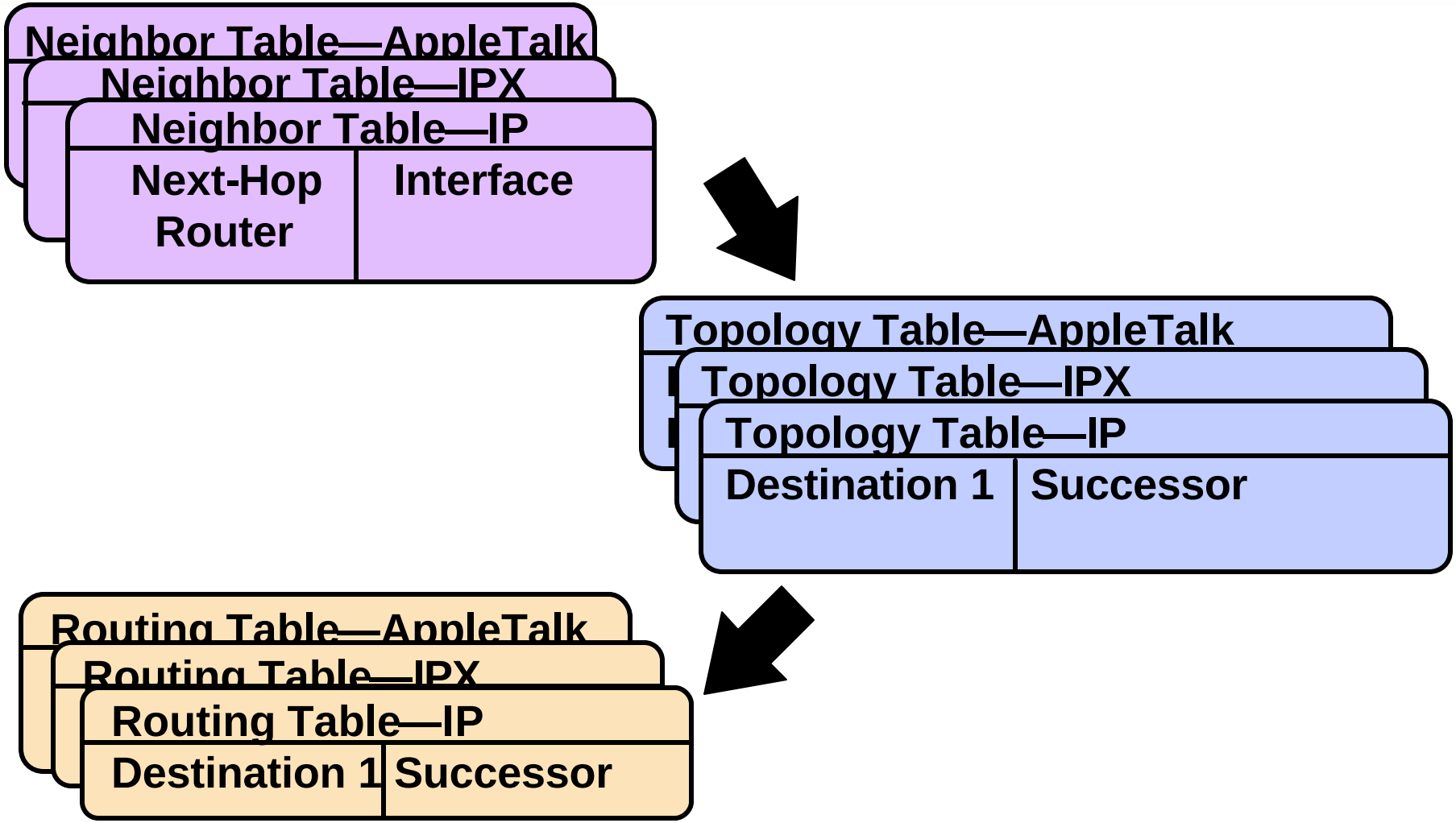
EIGRP Terminology (cont.)



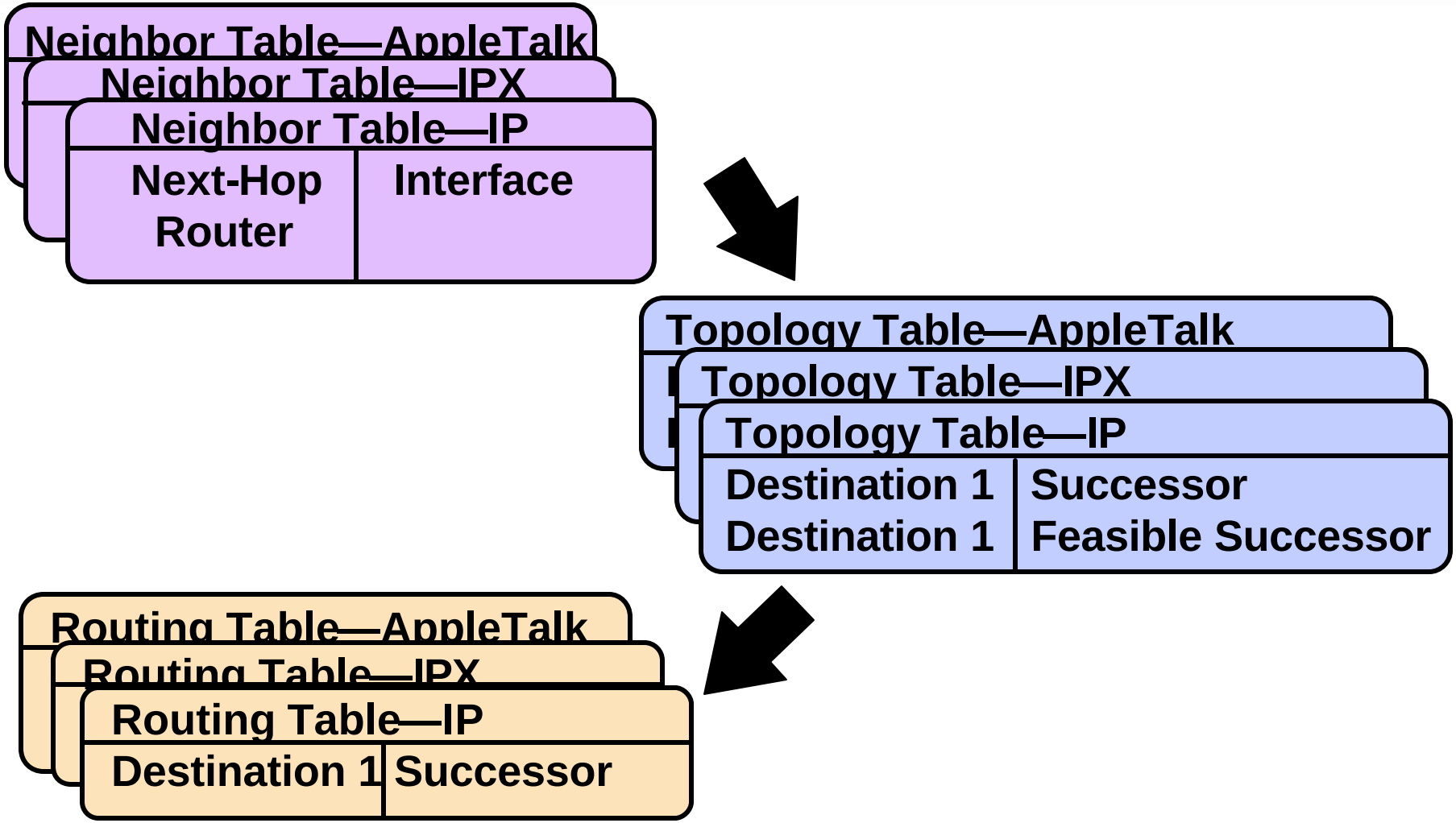
EIGRP Terminology (cont.)

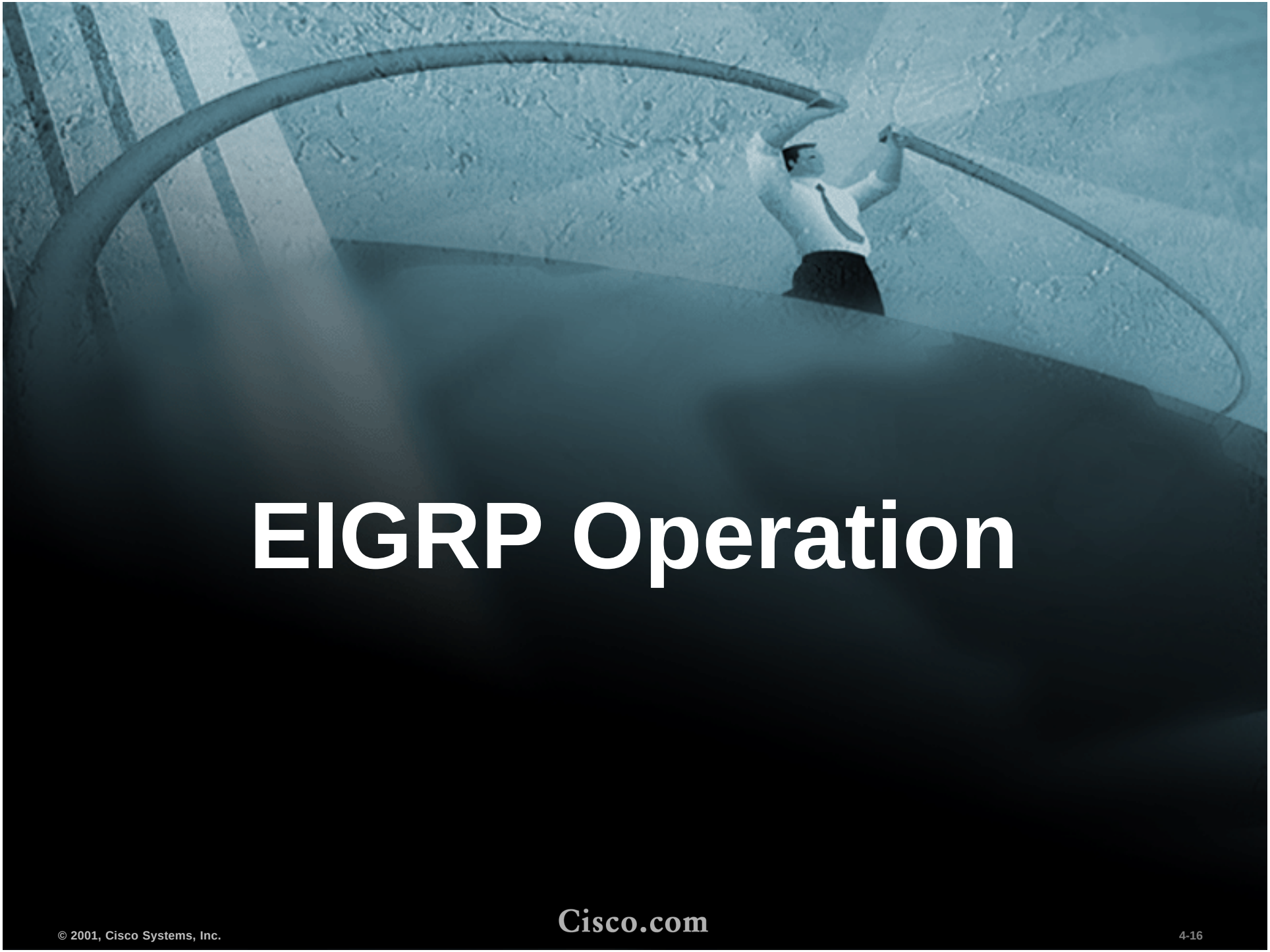


EIGRP Terminology (cont.)



EIGRP Terminology (cont.)





EIGRP Operation

EIGRP Packets

- **Hello: Establish neighbor relationships**
- **Update: Send routing updates**
- **Query: Ask neighbors about routing information**
- **Reply: Response to query about routing information**
- **ACK: Acknowledgment of a reliable packet**

EIGRP Neighbor Relationship

- Two routers become neighbors when they see each other's hello packet
  - Hello address = 224.0.0.10
- Hellos sent once every 5 seconds on the following links:
  - Broadcast media: Ethernet, Token Ring, FDDI
  - Point-to-point serial links: PPP, HDLC, point-to-point Frame Relay/ATM subinterfaces
  - Multipoint circuits with bandwidth greater than T1: ISDN PRI, SMDS, Frame Relay

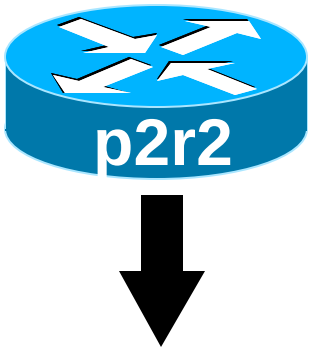
EIGRP Neighbor Relationship (cont.)

- Hellos sent once every 60 seconds on the following links:
  - Multipointcircuits with bandwidth less than or equal to T1: ISDN BRI, Frame Relay, SMDS, and so on
- Neighbor declared dead when no EIGRP packets are received within hold interval
- Hold time by default is three times the hello time

EIGRP Neighbor Relationship (cont.)

- EIGRP will form neighbors even though hello time and hold time don’t match
- EIGRP sources hello packets from primary address of the interface
- EIGRP will not form neighbor if K-values are mismatched
- EIGRP will not form neighbor if AS numbers are mismatched

What Is in a Neighbor Table?




```
p2r2#show ip eigrp neighbors
IP-EIGRP neighbors for process 400
H Address       Interface  Hold Uptime  SRTT  RTO Q  Seq
                             (sec)       (ms)      Cnt Num
1 172.68.2.2    To0        13 02:15:30    8   200  0  9
0 172.68.16.2   Se1         10 02:38:29   29   200  0  6
```

EIGRP Reliability

- EIGRP reliable packets are packets that require explicit acknowledgment:
  - Update
  - Query
  - Reply
- EIGRP unreliable packets are packets that do not require explicit acknowledgment:
  - Hello
  - ACK

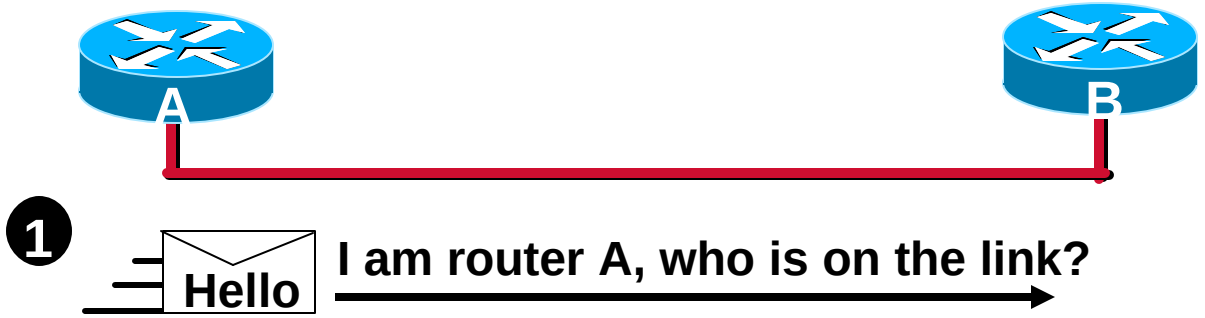
EIGRP Reliability (cont.)

- The router keeps a neighbor list and a retransmission list for every neighbor
- Each reliable packet (update, query, reply) will be retransmitted when packet is not acknowledged
- Neighbor relationship is reset when retry limit (limit = 16) for reliable packets is reached

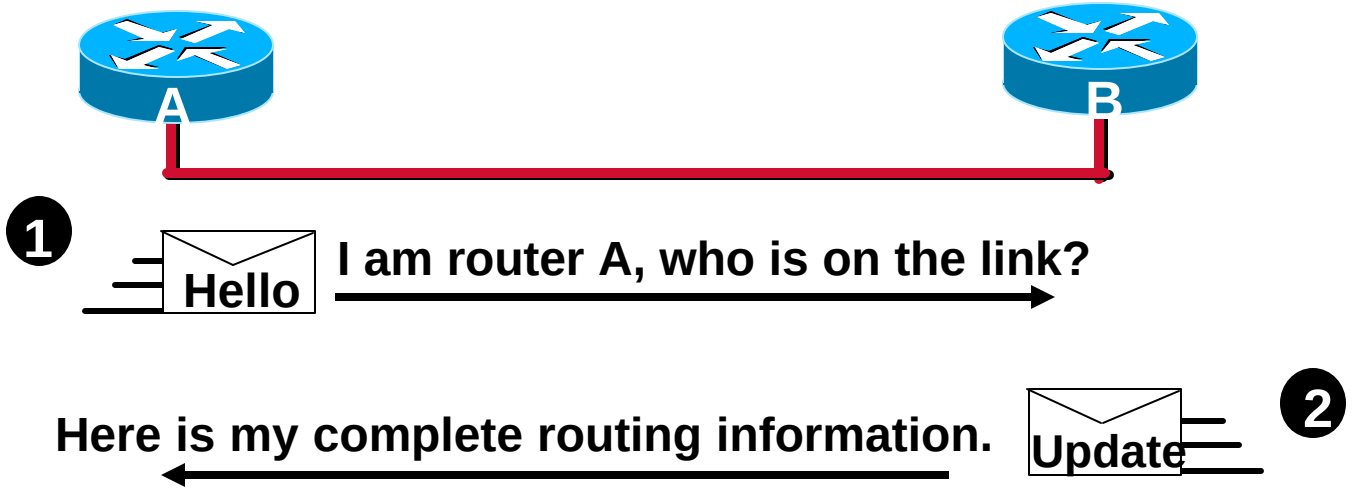
EIGRP Reliability (cont.)

- EIGRP transport has window size of one (stop-and-wait mechanism)
  - Every single reliable packet needs to be acknowledged before the next sequenced packet can be sent
  - If one or more peers are slow in acknowledging, all other peers suffer
- Solution: The nonacknowledged multicast packet will be retransmitted as a unicast to the slow neighbor

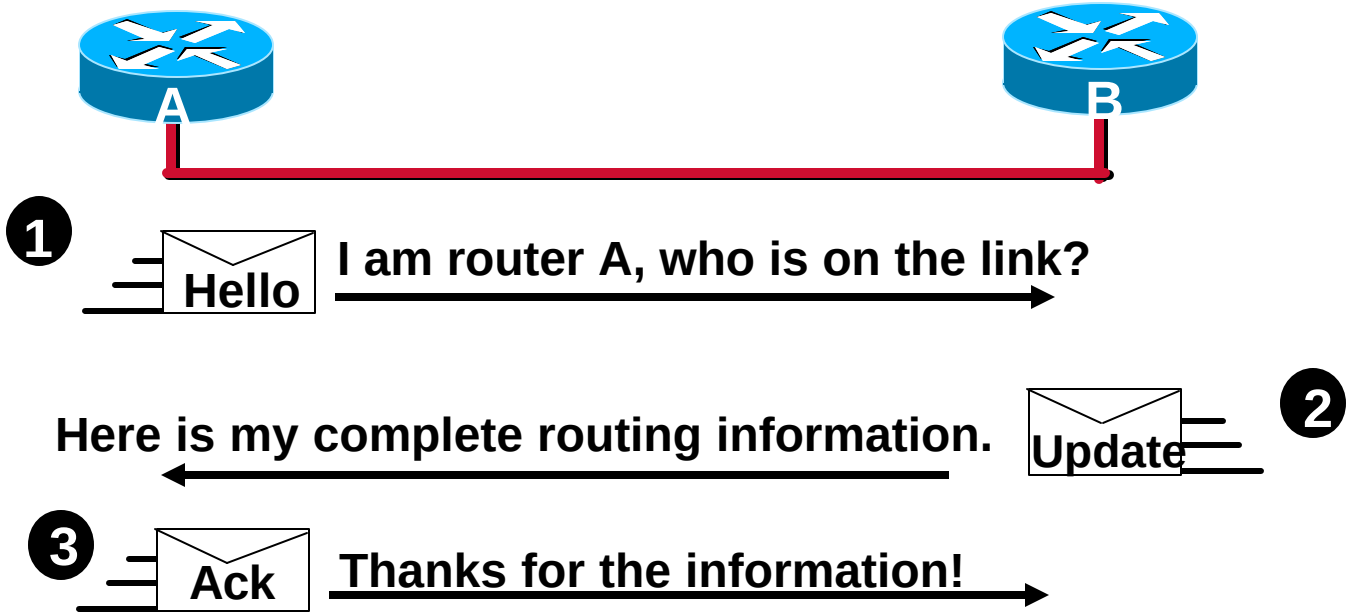
Initial Route Discovery



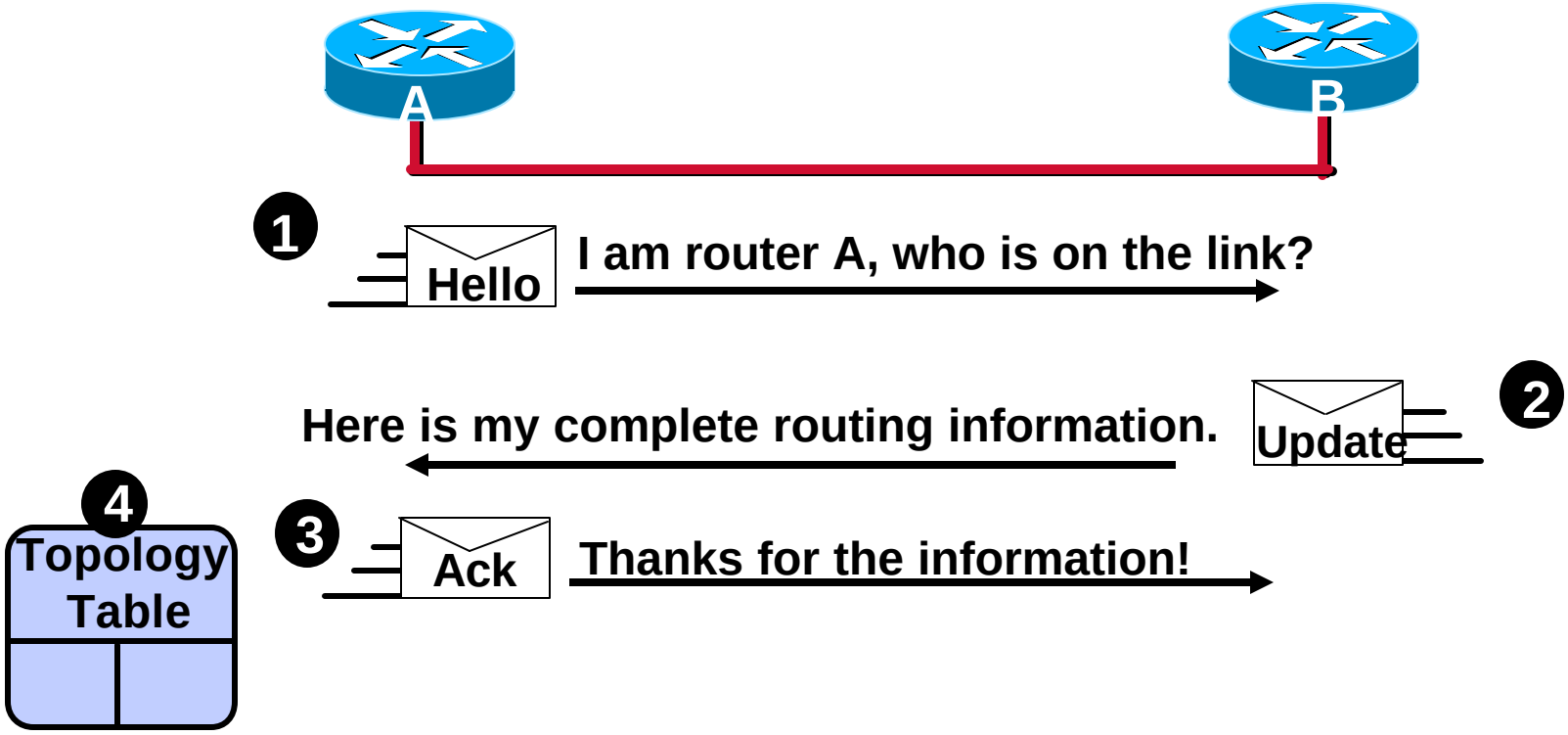
Initial Route Discovery (cont.)



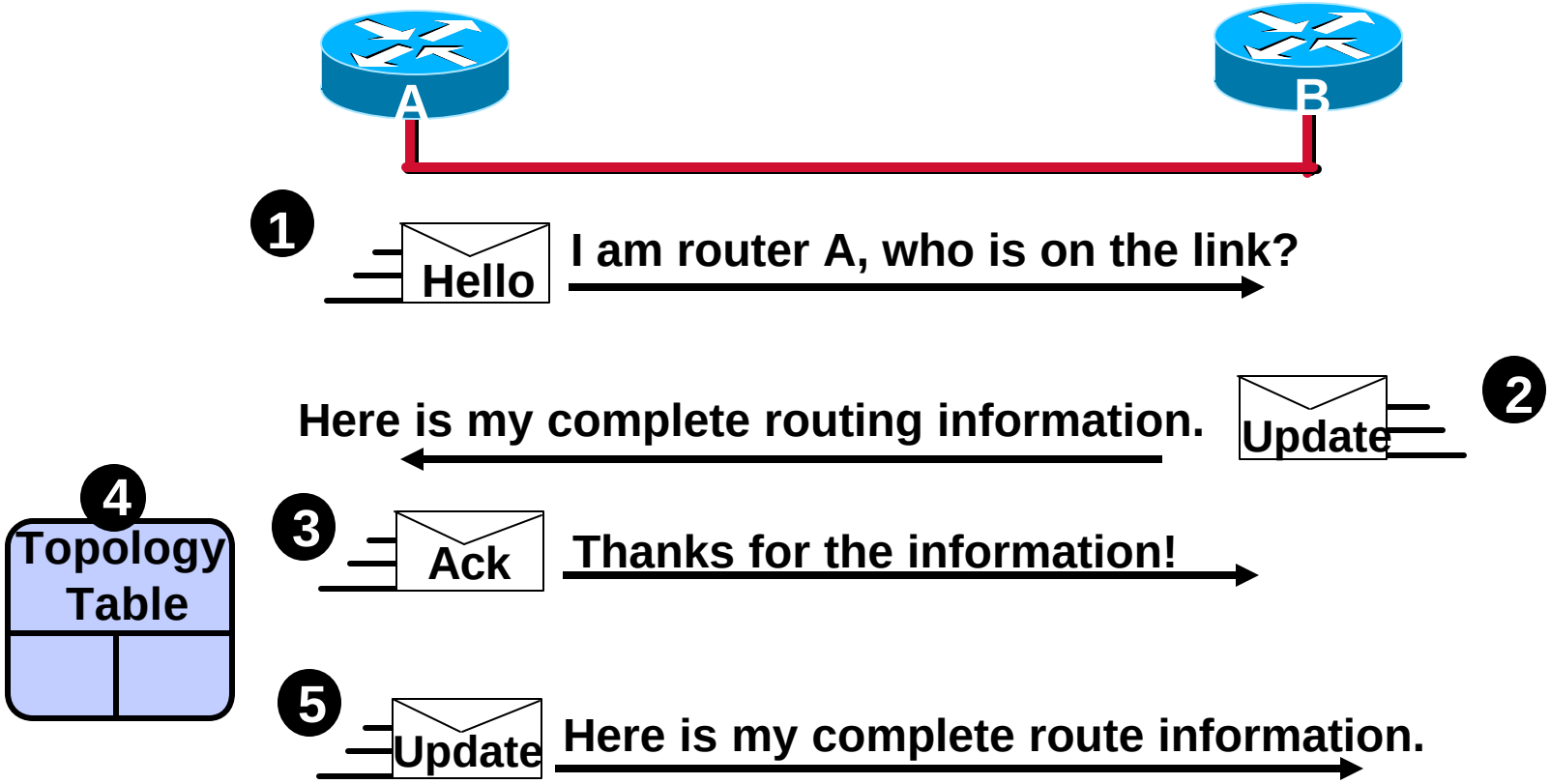
Initial Route Discovery (cont.)



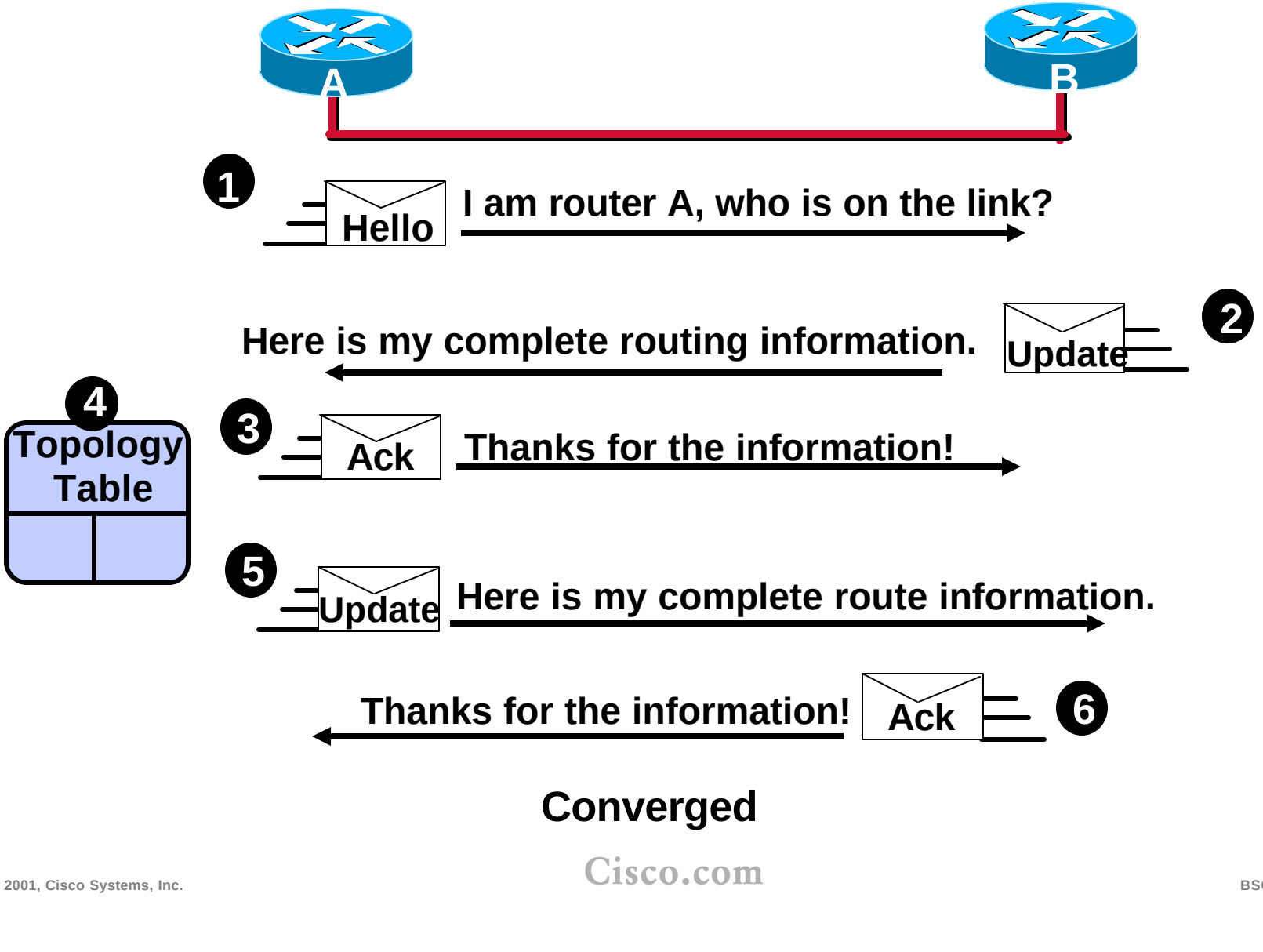
Initial Route Discovery (cont.)



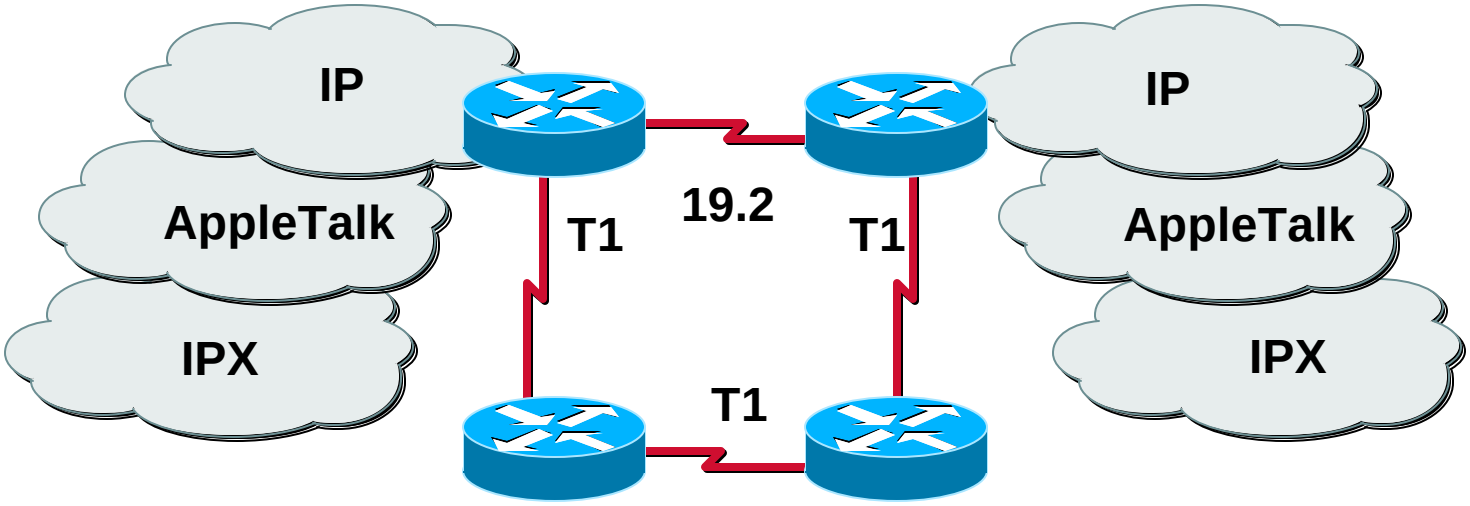
Initial Route Discovery (cont.)



Initial Route Discovery (cont.)



EIGRP Route Selection

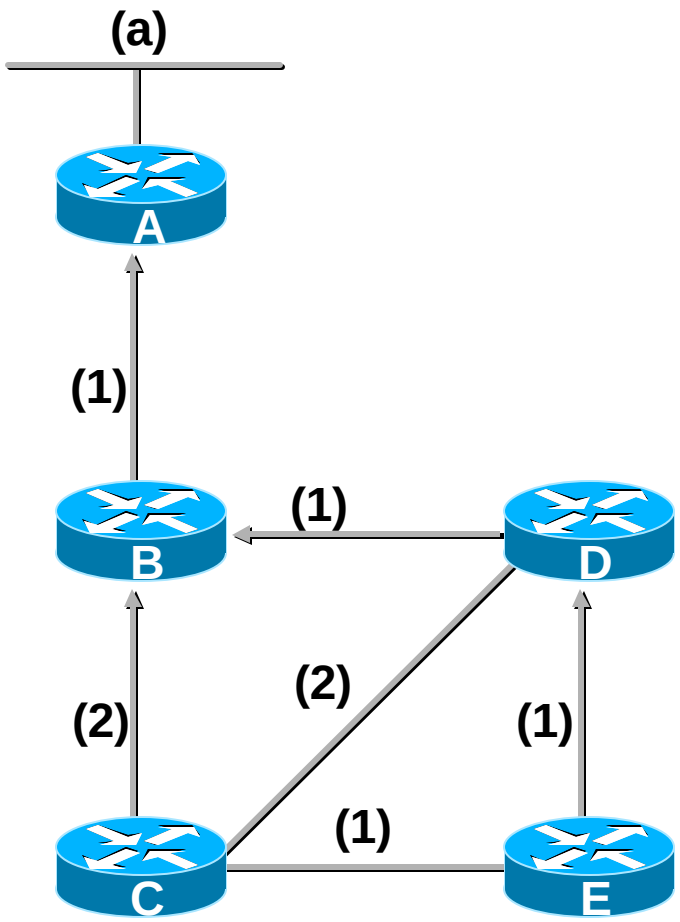


EIGRP uses a composite metric to pick the best path

EIGRP DUAL

- Diffusing Update Algorithm (DUAL)
- Finite-state machine
  - Tracks all routes advertised by neighbors
  - Selects loop-free path using a successor and remembers any feasible successors
  - If successor lost:
    - Use feasible successor
      - If no feasible successor:
        - Query neighbors and recompute new successor

DUAL Example (Start)

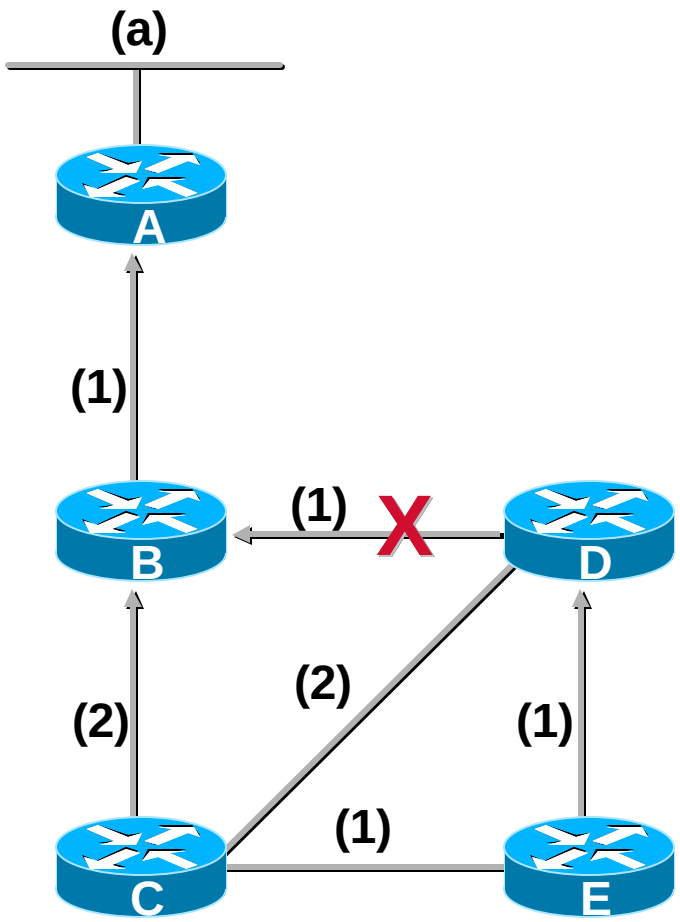


C	EIGRP	FD	AD	Topology
(a)		3		(fd)
	via B	3	1	(Successor)
	via D	4	2	(fs)
	via E	4	3	

D	EIGRP	FD	AD	Topology
(a)		2		(fd)
	via B	2	1	(Successor)
	via C	5	3	

E	EIGRP	FD	AD	Topology
(a)		3		(fd)
	via D	3	2	(Successor)
	via C	4	3	

DUAL Example

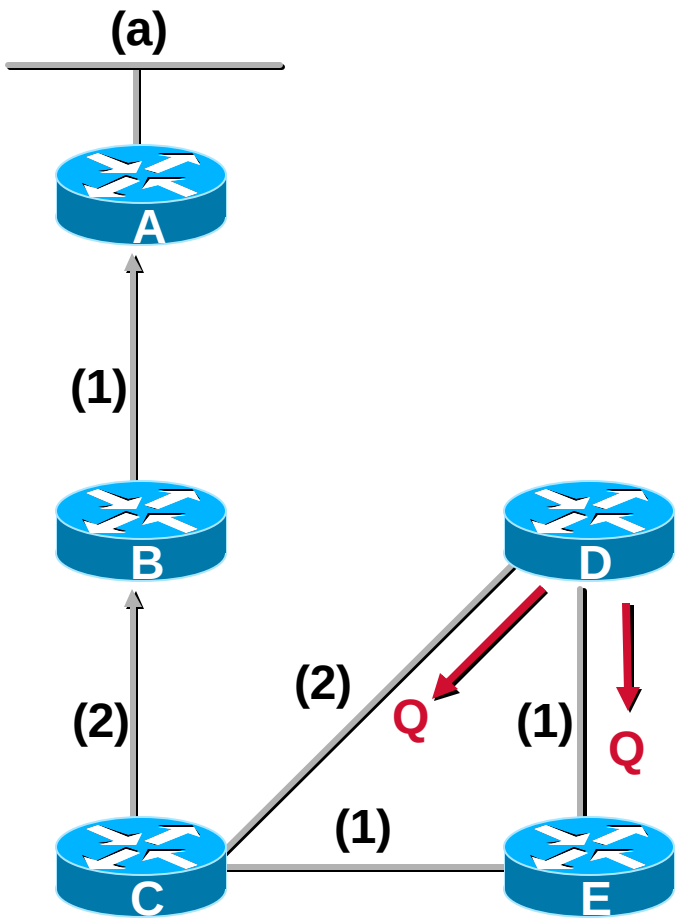


C	EIGRP	FD	AD	Topology
(a)		3		(fd)
	via B	3	1	(Successor)
	via D	4	2	(fs)
	via E	4	3	

D	EIGRP	FD	AD	Topology
(a)		2		(fd)
	~~via B~~	~~2~~	~~1~~	~~(Successor)~~
	via C	5	3	

E	EIGRP	FD	AD	Topology
(a)		3		(fd)
	via D	3	2	(Successor)
	via C	4	3	

DUAL Example (cont.)

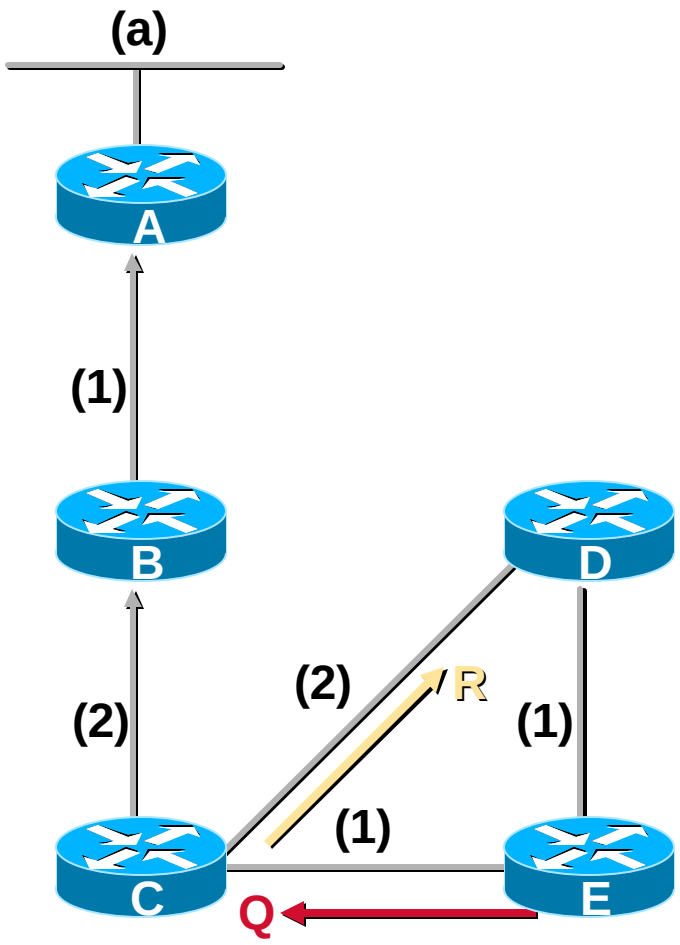


C	EIGRP	FD	AD	Topology
(a)		3		(fd)
	via B	3	1	(Successor)
	via D			
	via E	4	3	

D	EIGRP	FD	AD	Topology
(a)	**ACTIVE**	-1		(fd)
	via E			(q)
	via C	5	3	(q)

E	EIGRP	FD	AD	Topology
(a)		3		(fd)
	~~via D~~	~~3~~	~~2~~	~~(Successor)~~
	via C	4	3	

DUAL Example (cont.)

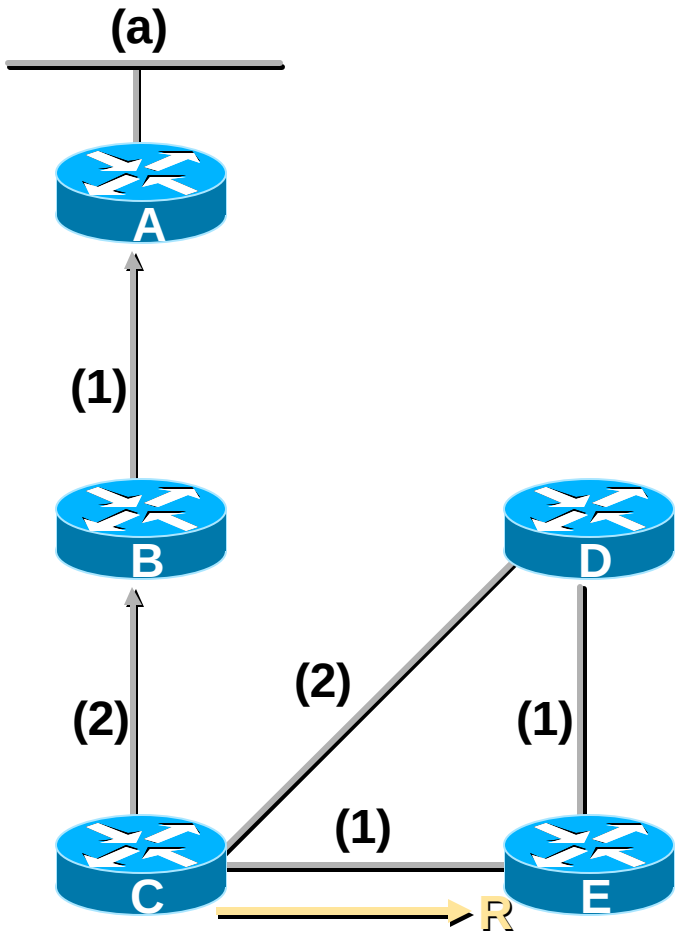


C	EIGRP	FD	AD	Topology
(a)		3		(fd)
	via B	3	1	(Successor)
	via D			
	via E			

D	EIGRP	FD	AD	Topology
(a)	**ACTIVE**	-1		(fd)
	via E			(q)
	via C	5	3	

E	EIGRP	FD	AD	Topology
(a)	**ACTIVE**	-1		(fd)
	via D			
	via C	4	3	(q)

DUAL Example (cont.)

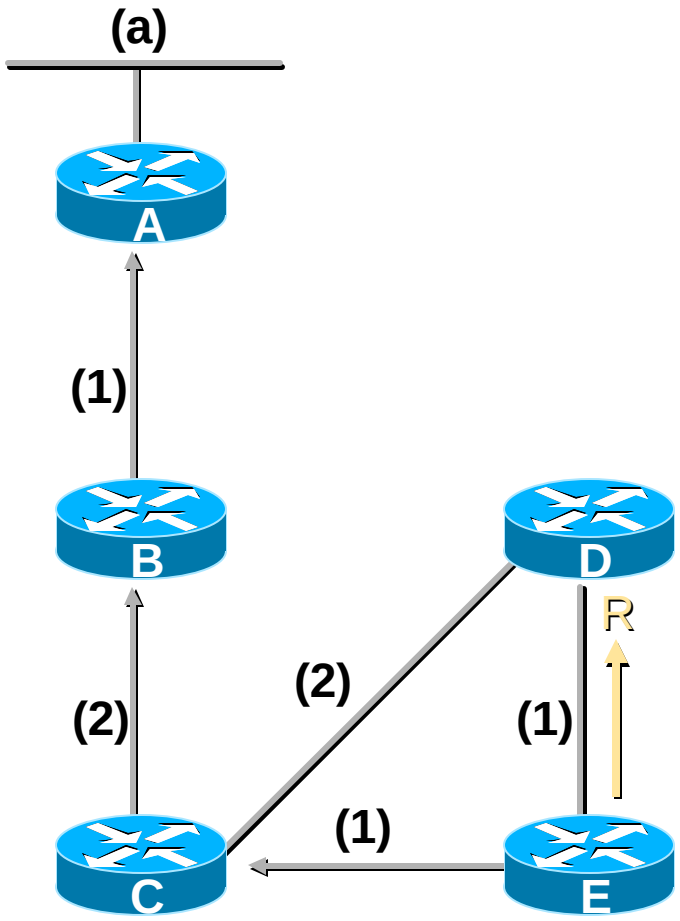


C	EIGRP	FD	AD	Topology
(a)		3		(fd)
	via B	3	1	(Successor)
	via D			
	via E			

D	EIGRP	FD	AD	Topology
(a)	**ACTIVE**	-1		(fd)
	via E			(q)
	via C	5	3	

E	EIGRP	FD	AD	Topology
(a)		4		(fd)
	via C	4	3	(Successor)
	via D			

DUAL Example (cont.)

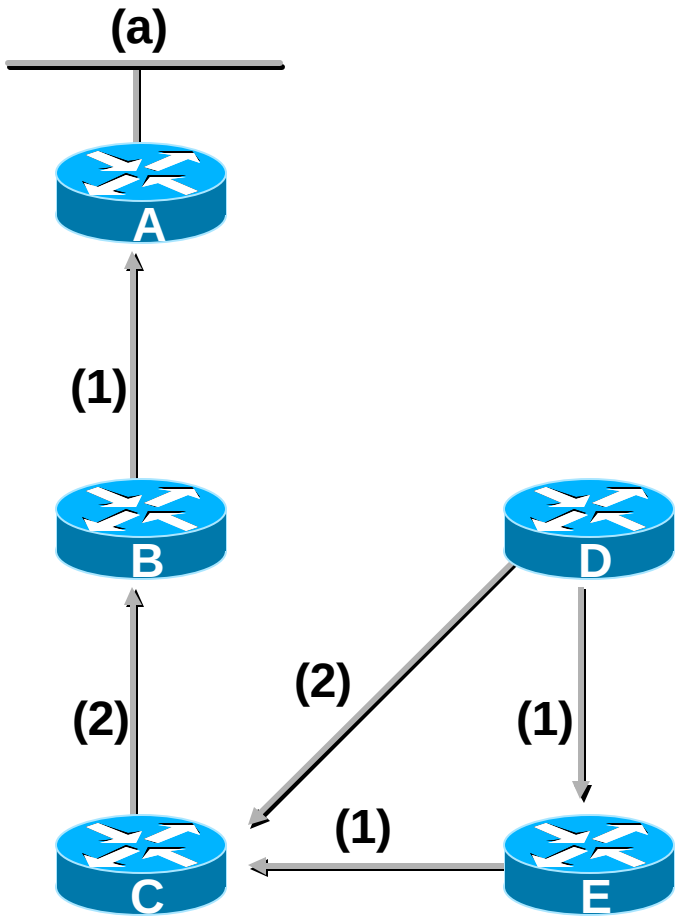


C	EIGRP	FD	AD	Topology
(a)		3		(fd)
	via B	3	1	(Successor)
	via D			
	via E			

D	EIGRP	FD	AD	Topology
(a)		5		(fd)
	via C	5	3	(Successor)
	via E	5	4	(Successor)

E	EIGRP	FD	AD	Topology
(a)		4		(fd)
	via C	4	3	(Successor)
	via D			

DUAL Example (cont.)

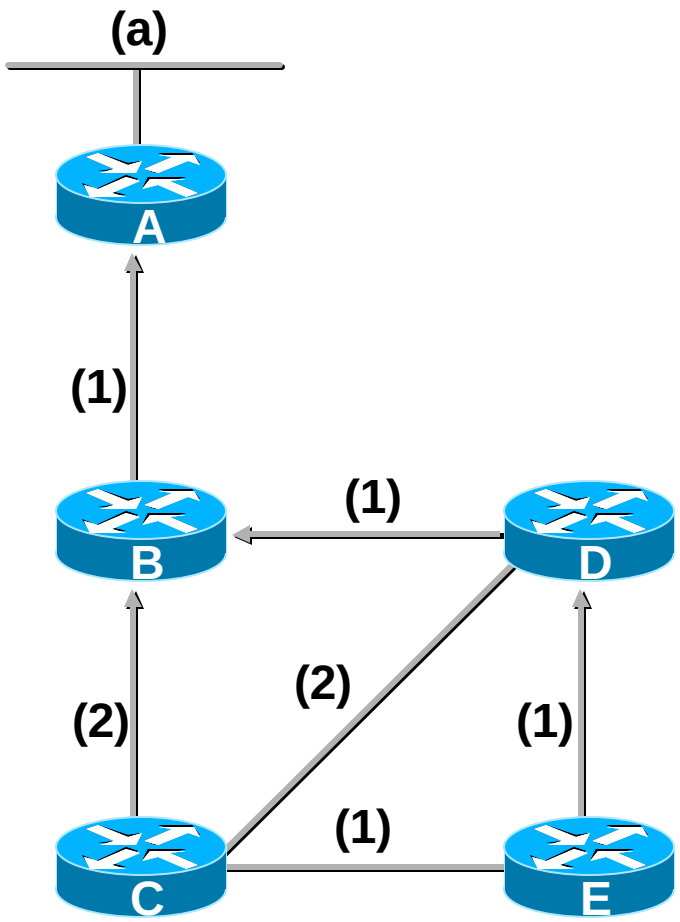


C	EIGRP	FD	AD	Topology
(a)		3		(fd)
	via B	3	1	(Successor)
	via D			
	via E			

D	EIGRP	FD	AD	Topology
(a)		5		(fd)
	via C	5	3	(Successor)
	via E	5	4	(Successor)

E	EIGRP	FD	AD	Topology
(a)		4		(fd)
	via C	4	3	(Successor)
	via D			

DUAL Example (Start)

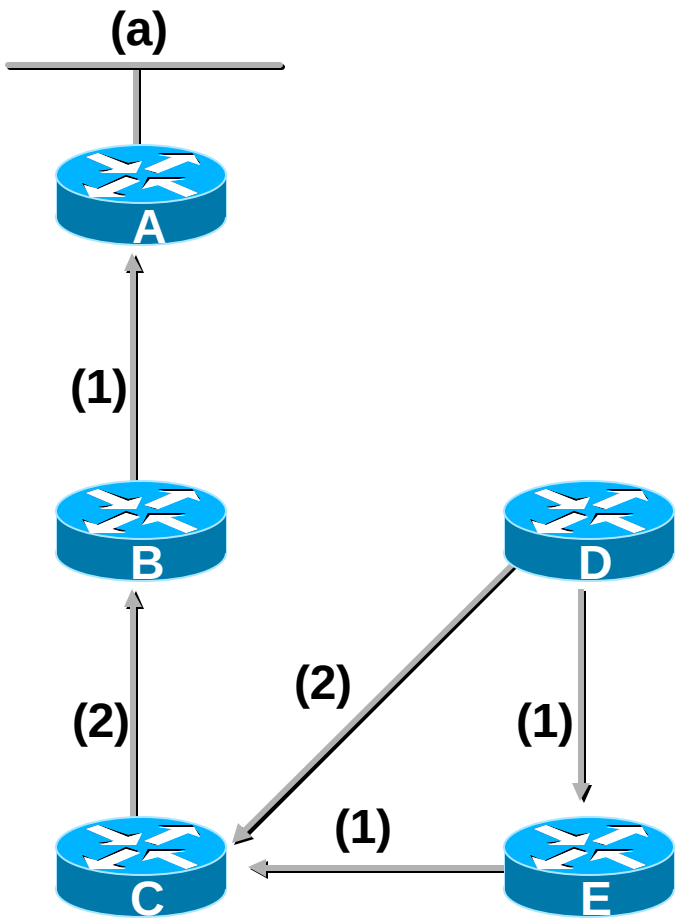


C	EIGRP	FD	AD	Topology
(a)		3		(fd)
	via B	3	1	(Successor)
	via D	4	2	(fs)
	via E	4	3	

D	EIGRP	FD	AD	Topology
(a)		2		(fd)
	via B	2	1	(Successor)
	via C	5	3	

E	EIGRP	FD	AD	Topology
(a)		3		(fd)
	via D	3	2	(Successor)
	via C	4	3	

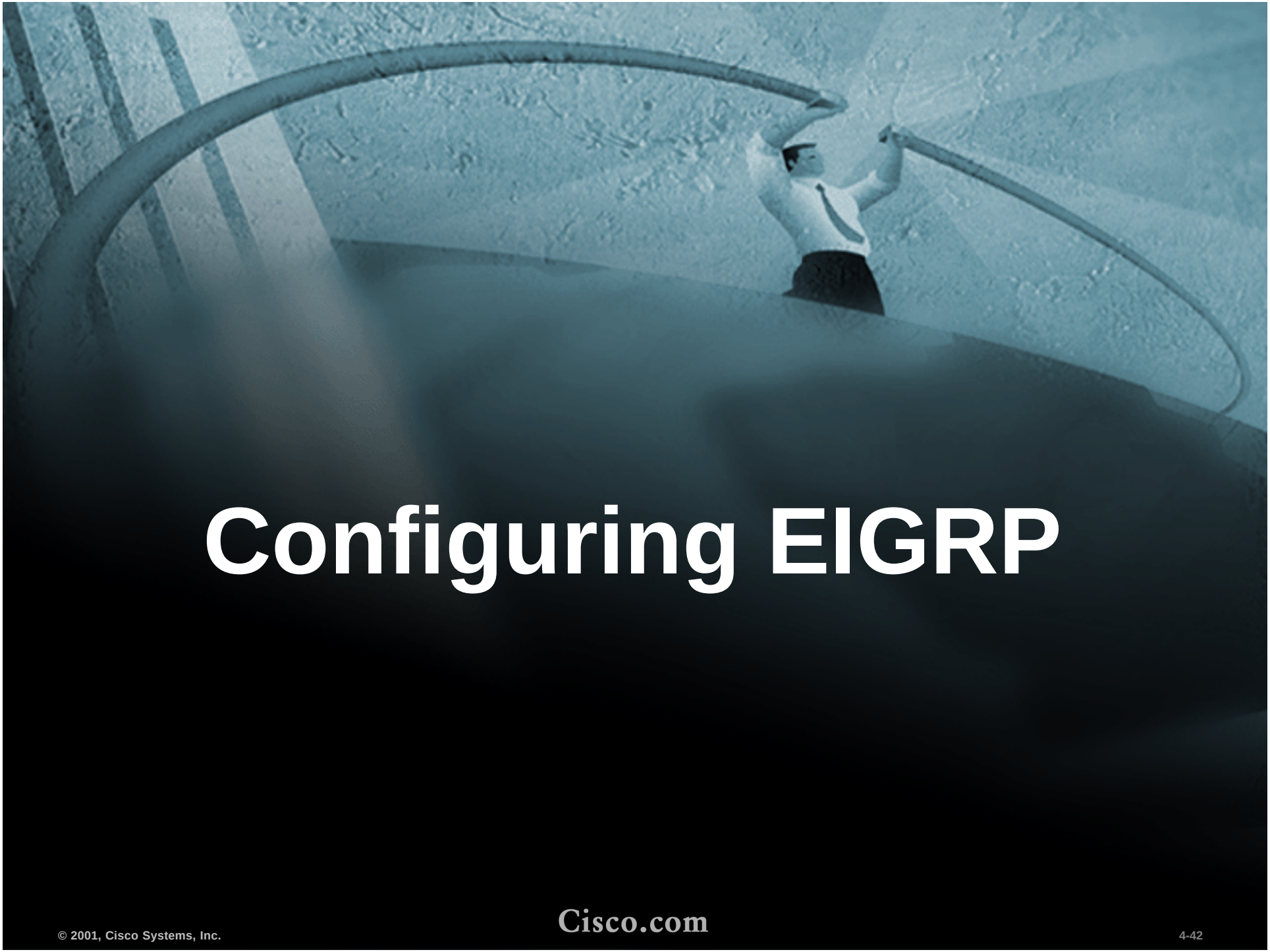
DUAL Example (End)



C	EIGRP	FD	AD	Topology
(a)		3		(fd)
	via B	3	1	(Successor)
	via D			
	via E			

D	EIGRP	FD	AD	Topology
(a)		5		(fd)
	via C	5	3	(Successor)
	via E	5	4	(Successor)

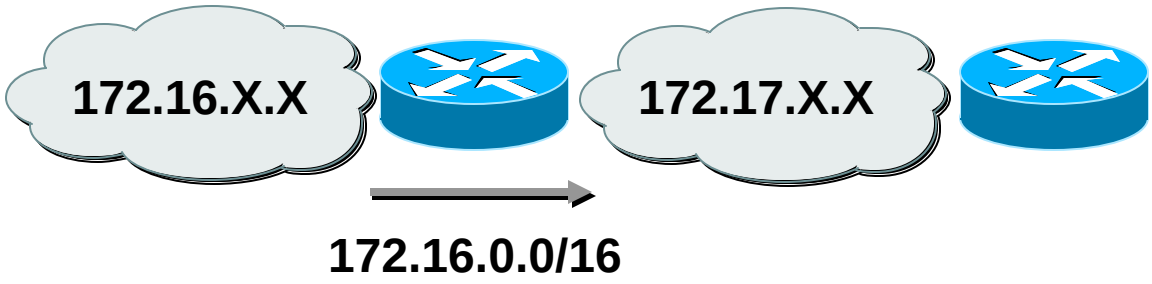
E	EIGRP	FD	AD	Topology
(a)		4		(fd)
	via C	4	3	(Successor)
	via D			



Configuring EIGRP

EIGRP Summarization—Automatic

- **Purpose: Smaller routing tables, smaller updates, query boundary**
- **Autosummarization:**
  - **On major network boundaries, subnetworks are summarized to a single classful (major) network**
  - **Autosummarization is turned on by default**



EIGRP Summarization—Manual

Manual summarization

- Configurable on a per-interface basis in any router within network
- When summarization is configured on an interface, the router immediately creates a route pointing to Null0
  - Loop prevention mechanism
- When the last specific route of the summary goes away, the summary is deleted
- The minimum metric of the specific routes is used as the metric of the summary route

Configuring Summarization

(config-router)#

```
no auto-summary
```

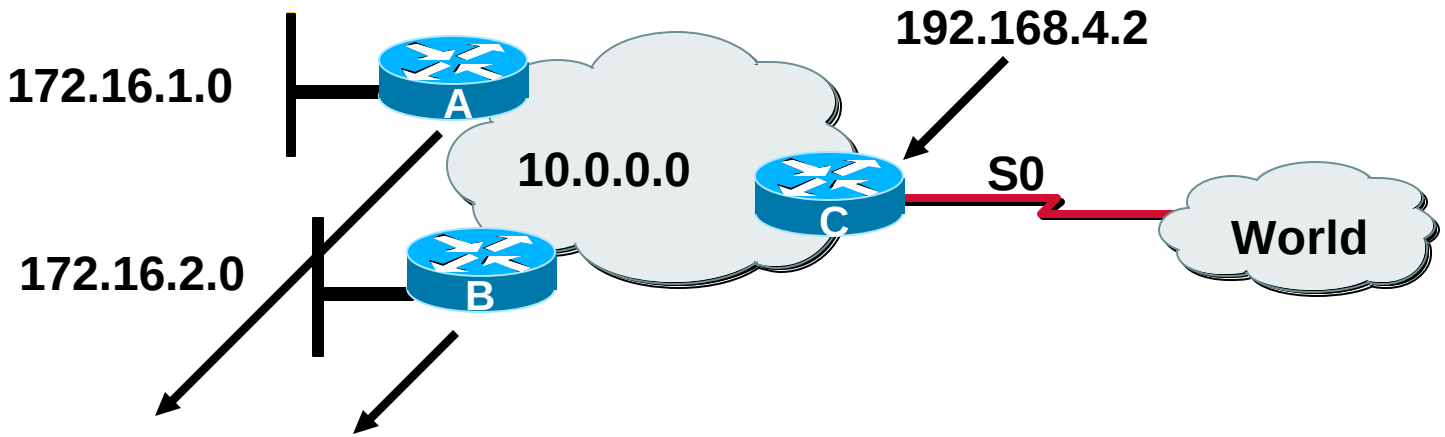
- Turns off autosummarization for the EIGRP process

(config-if)#

```
ip summary-address eigrp [as-number]
  [address] [mask]
```

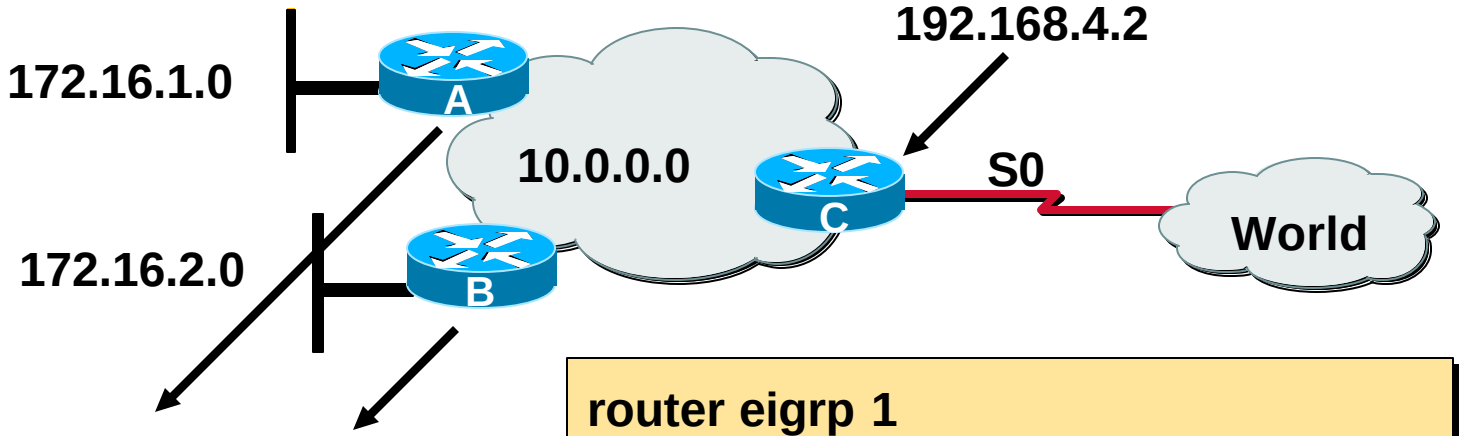
- Creates a summary address to be generated by this interface

Summarizing EIGRP Routes




```
router eigrp 1
network 10.0.0.0
network 172.16.0.0
no auto-summary
```

Summarizing EIGRP Routes (cont.)




```
router eigrp 1
network 10.0.0.0
network 172.16.0.0
no auto-summary
```

```
router eigrp 1
network 10.0.0.0
network 192.168.4.0
!
int s0
ip address 192.168.4.2 255.255.255.0
ip summary-address eigrp 1
172.16.0.0 255.255.0.0
```

EIGRP Load Balancing

- Routes with metric equal to the minimum metric will be installed in the routing table (equal-cost load balancing)
- Up to six entries in the routing table for the same destination
  - Number of entries is configurable
  - Default is four

Verifying EIGRP Operation

Verifying EIGRP Operation

Router#
```
show ip eigrp neighbors
```

Router#
```
show ip eigrp topology
```

Router#
```
show ip route eigrp
```

Router#
```
show ip protocols
```

Router#
```
show ip eigrp traffic
```

- Displays the neighbors discovered by IP EIGRP
- Displays the IP EIGRP topology table
- Displays current EIGRP entries in the routing table
- Displays the parameters and current state of the active routing protocol process
- Displays the number of IP EIGRP packets sent and received

Verifying EIGRP Operation (cont.)

Router#
```
debug eigrp packets
```

Router#
```
debug eigrp neighbors
```

Router#
```
debug ip eigrp
```

Router#
```
debug ip eigrp summary
```

- Displays all types of EIGRP packets, both sent and received
- Displays the EIGRP neighbor interaction
- Displays advertisements and changes EIGRP makes to the routing table
- Displays a brief report of the EIGRP routing activity