SWiN
BUR
NE

CENTRE FOR
ADVANCED
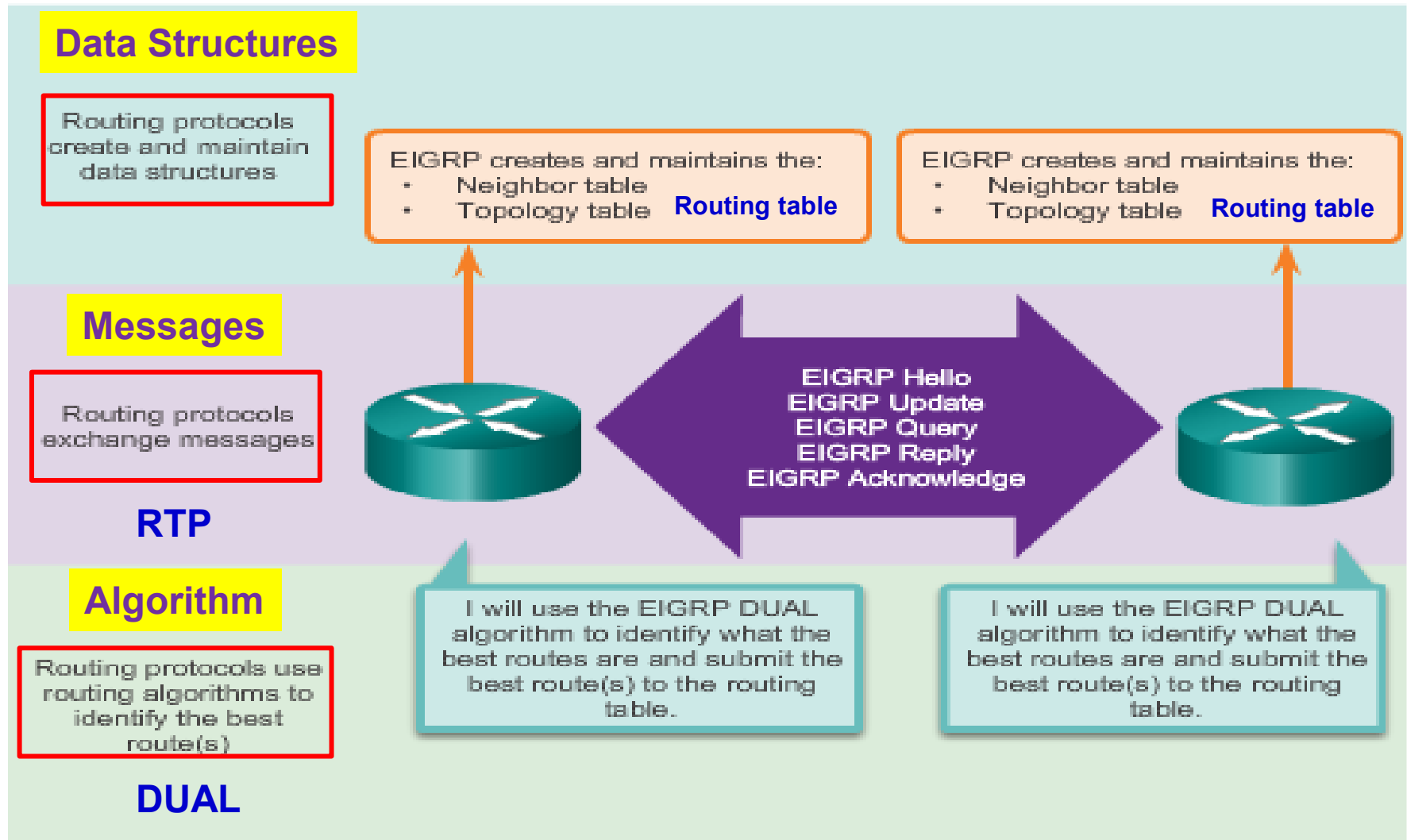INTERNET
ARCHITECTURES

TNE20002/TNE70003

Topic 4 EIGRP V1.1

EIGRP

Enhanced

Interior **G**ateway

Routing

Protocol

Components of Routing Protocol: EIGRP

Data Structures

Routing protocols create and maintain data structures

EIGRP creates and maintains the:
- Neighbor table
- Topology table **Routing table**

EIGRP creates and maintains the:
- Neighbor table
- Topology table **Routing table**

Messages

Routing protocols exchange messages

RTP

EIGRP Hello
EIGRP Update
EIGRP Query
EIGRP Reply
EIGRP Acknowledge

Algorithm

Routing protocols use routing algorithms to identify the best route(s)

DUAL

I will use the EIGRP DUAL algorithm to identify what the best routes are and submit the best route(s) to the routing table.

I will use the EIGRP DUAL algorithm to identify what the best routes are and submit the best route(s) to the routing table.

Data Structures: Three Tables

EIGRP Neighbor Table	
Next-Hop Router	Interface

List of directly connected **routers** with which a **router** has an **adjacency**

EIGRP Topology Table	
Destination	FD via Each Neighbor

List of all routes learned from each **neighbor**

EIGRP Routing Table	
Destination	Least Cost Route FD

List of all **least cost** routes from **Topology** Table

Messages

Reliable Transport Protocol (RTP)

used to deliver

Message Packets

to

Neighbors

EIGRP Packet Types - Messages

Packet Type	Description
Hello	Used to discover other EIGRP routers in the network.
Acknowledgement	Used to acknowledge the receipt of any EIGRP packet.
Update	Convey routing information to known destinations.
Query	Used to request specific information from a neighbor router.
Reply	Used to respond to a query.

EIGRP - Hello

- Used to discover EIGRP neighbors.

- Used to form and maintain EIGRP neighbor adjacencies.

- Sent as IPv4 or IPv6 multicasts.

  - IPv4 layer 3 multicast address 224.0.0.10

  - IPv6 layer 3 multicast address FF02::A.

- Hello Interval – default, send Hello every 5 seconds

- Hold timer

  - by default set to three times the Hello interval.

  - If have not received Hello from neighbor within 15 secs, declare neighbor unreachable.

- Unreliable Delivery - requires no response from recipient

EIGRP – Hello
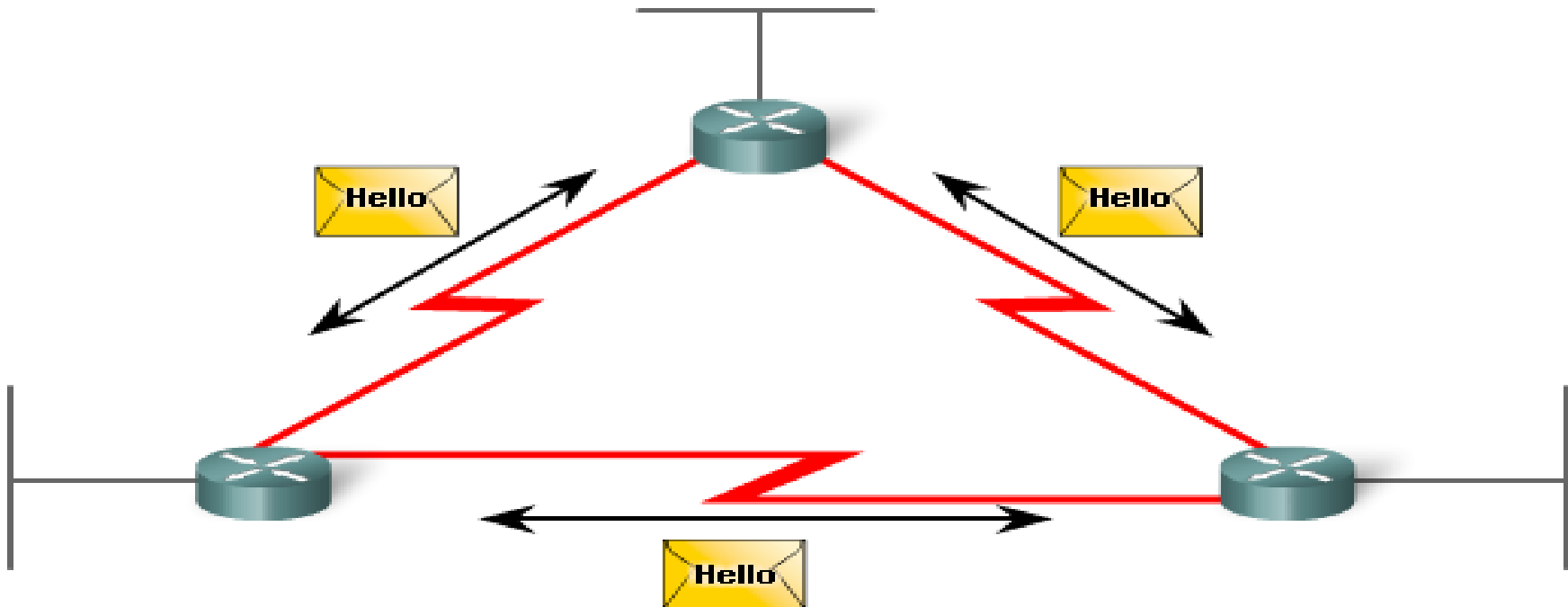
Used to discover and form adjacencies with neighbors
- show ip eigrp neighbors – verifies adjacency has been established

EIGRP Packet Types

Hello

Hello

Hello

Hello packet
- Use to discover neighbors & form adjacencies
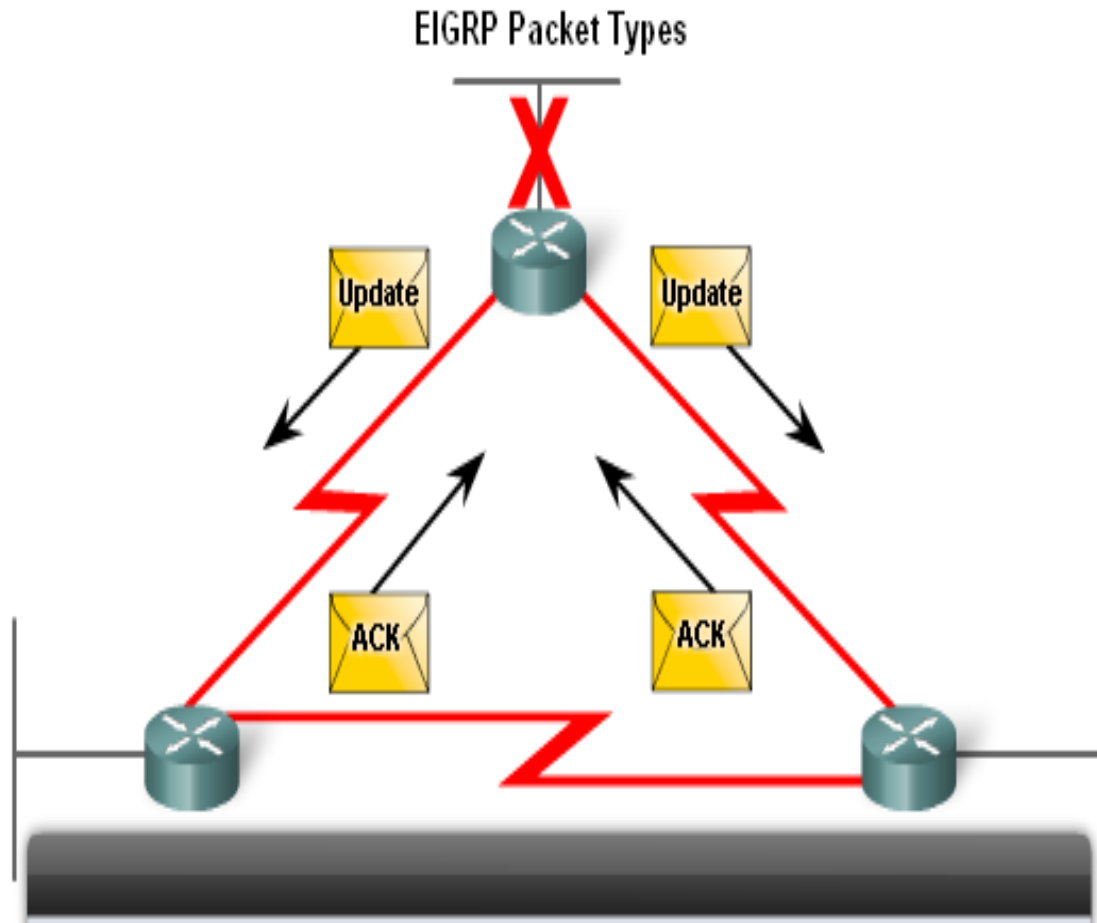- Unreliable so no response required from recipient

EIGRP

EIGRP – Update

Update

- Used to propagate routing information
- Reliable Delivery

**ACK packets**

- Used to acknowledge receipt of update

EIGRP Packet Types

Update Packet

- Used to propagate routing information, after a change
- Acknowledged (ACK) by receiving router, reliable delivery
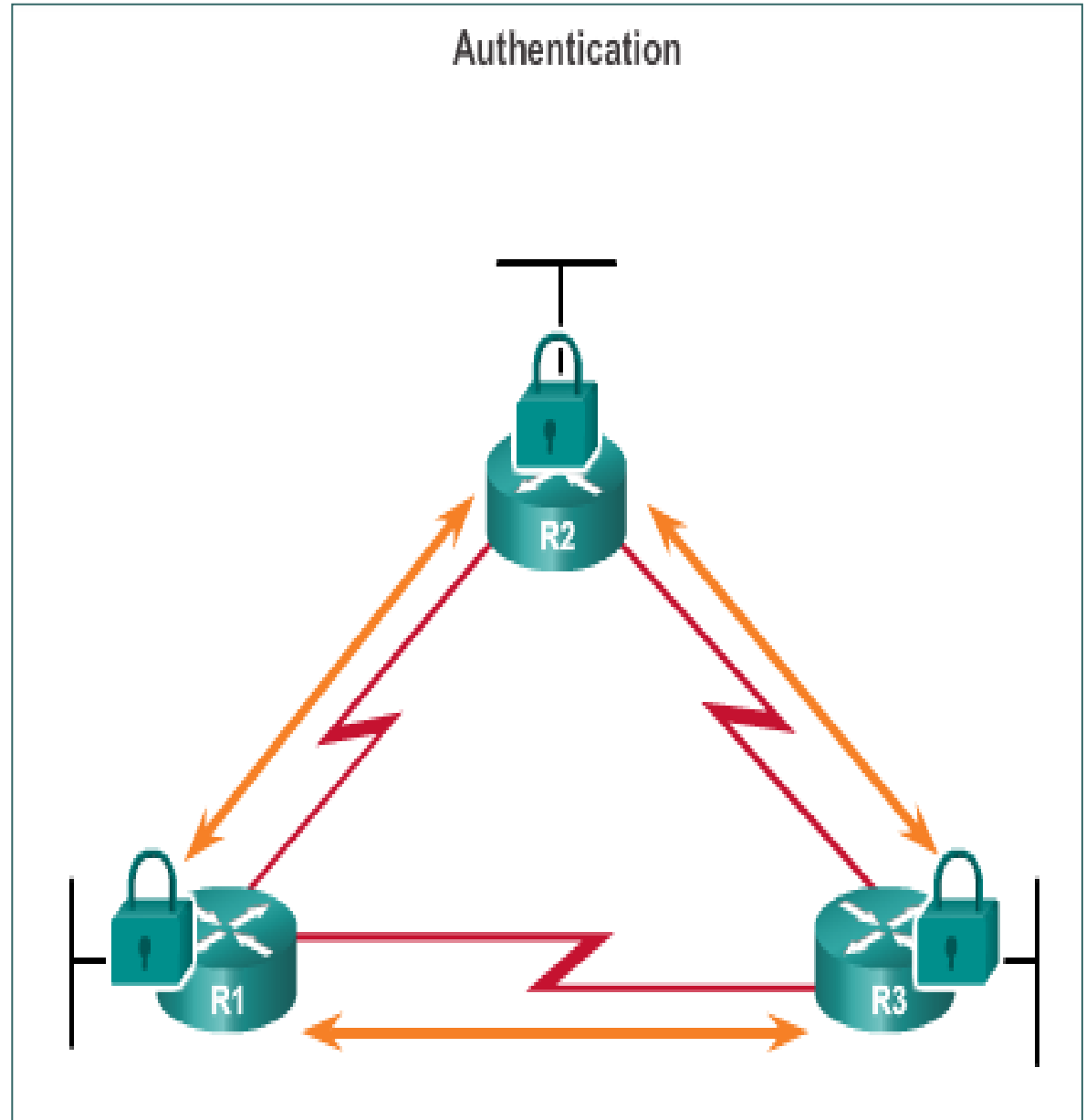
EIGRP

EIGRP – Query

Query & Reply packets

- Used to request alternate path information from neighbors

EIGRP Packet Types

Query Packet
- Used by DUAL when searching for networks
- Reply packet sent in response to Query
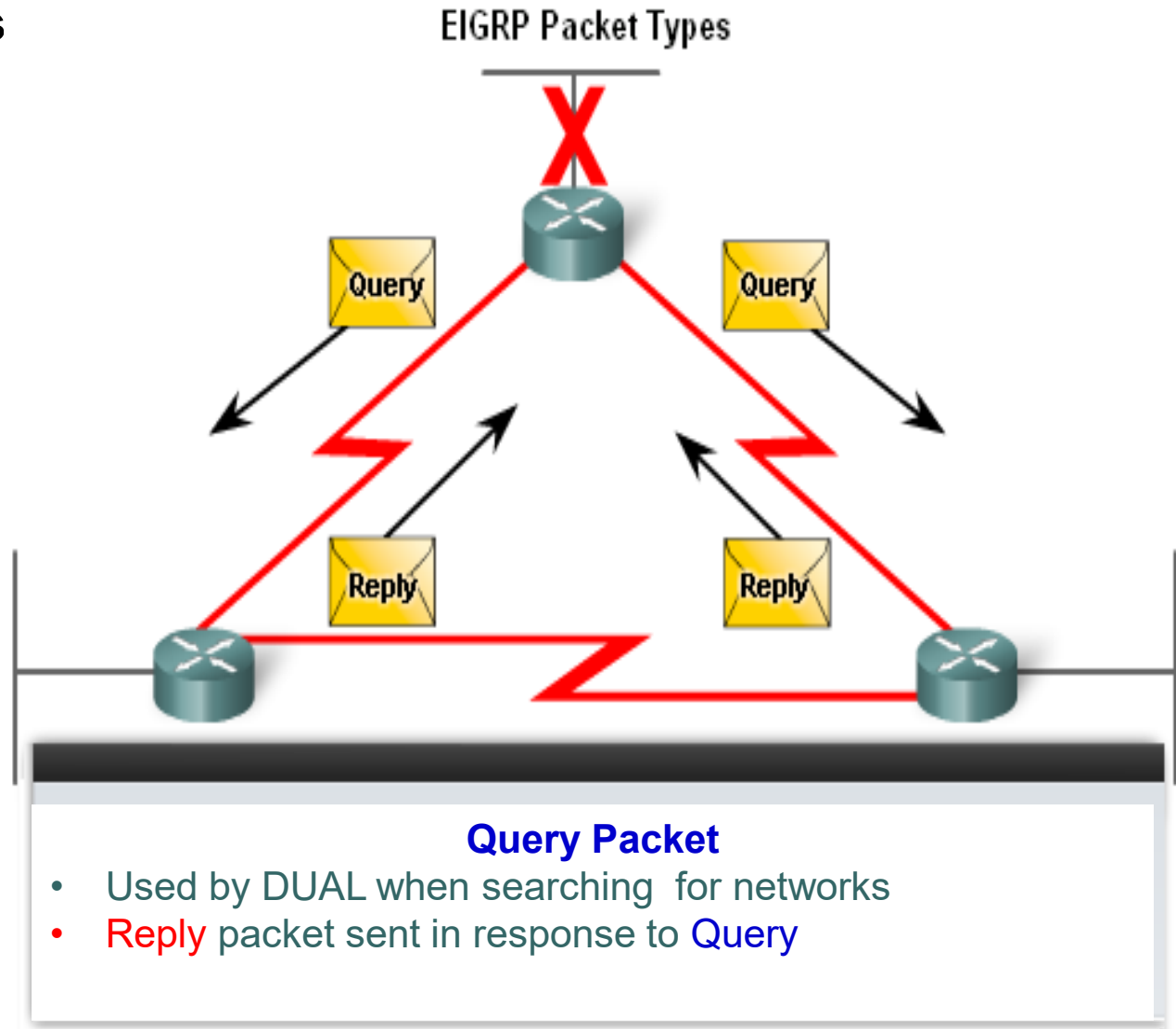
Authentication of Updates

- EIGRP can be configured to authenticate routing information.

- Ensures routers only accept updates from routers that have been configured with the correct authentication information.

- Default **NO** authentication

Authentication

EIGRP Configuration: ASN, Wildcard

Specifying which subnets should be advertised:

- The wildcard specifies a subnet within the network

- Wildcard is inverse of subnet mask

- Configuration:

```
router eigrp 1 <- Autonomous System Number (ASN)
 network 145.60.0.0     0.0.0.127 ← Wildcard inverse of mask 255.255.255.128
 network 145.60.0.128  0.0.0.63
 network 145.60.0.224  0.0.0.15
 network 145.60.0.240  0.0.0.3
```
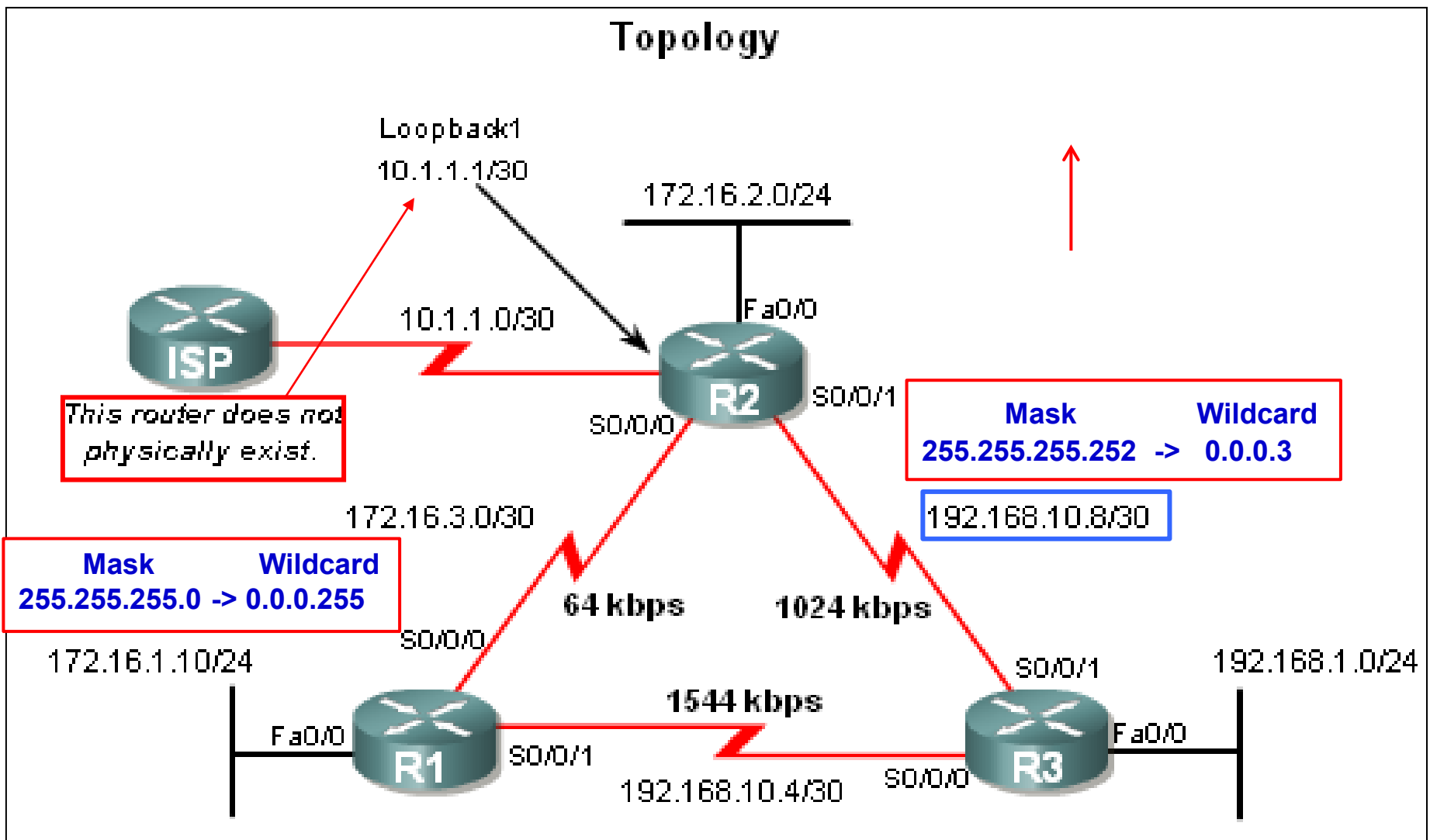
EIGRP

EIGRP – Wildcards

Topology

Loopback1
10.1.1.1/30

172.16.2.0/24

10.1.1.0/30

Fa0/0

ISP

This router does not physically exist.

R2

S0/0/1

S0/0/0

Mask	Wildcard
255.255.255.252 ->	0.0.0.3

192.168.10.8/30

172.16.3.0/30

Mask	Wildcard
255.255.255.0 ->	0.0.0.255

172.16.1.10/24

S0/0/0

64 kbps

1024 kbps

192.168.1.0/24

S0/0/1

Fa0/0

R1

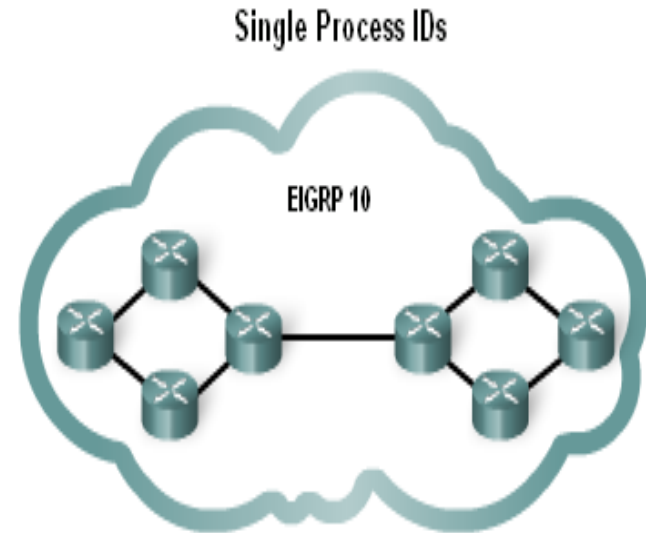S0/0/1

1544 kbps

S0/0/0

R3

Fa0/0

192.168.10.4/30

EIGRP – Autonomous System Number

Two Roles

- Acts as a Process ID representing an instance of the routing protocol running on a router

- Acts as Group ID - Only routers using the same AS number can exchange updates with each other

Single Process IDs

EIGRP 10

```
R1(config)#router eigrp ?
  <1-65535>  Autonomous system number
R1(config)#router eigrp 10
```

EIGRP – Wildcard, ASN

- Used to specify a subnet or range of subnet network addresses
- The wildcard mask is the inverse of the subnet mask
  - Swap all '0' bits for '1' and '1' bits for '0'
  - You can type in subnet mask, router will change to wildcard for you

```
R1(config)#router eigrp 1
R1(config-router)#network 172.16.0.0
R1(config-router)#network 192.168.10.0
```

R1,R2 and R3 are in Autonomous System 1

```
R2(config)#router eigrp 1
R2(config-router)#network 172.16.0.0
%DUAL-5-NBRCHANGE: IP-EIGRP 1: Neighbor 172.16.3.1 (Serial0/0/0) is up: new adjacency
R2(config-router)#network 192.168.10.8 0.0.0.3
```

255.255.255.252 -> 0.0.0.3

```
R3(config)#router eigrp 1
R3(config-router)#network 192.168.10.0
%DUAL-5-NBRCHANGE: IP-EIGRP 1: Neighbor 192.168.10.5 (Serial0/0/0) is up: new adjacency
R3(config-router)#
%DUAL-5-NBRCHANGE: IP-EIGRP 1: Neighbor 192.168.10.9 (Serial0/0/1) is up: new adjacency
R3(config-router)#network 192.168.1.0
```

The

Topology

Table

EIGRP Topology Table – R2 to 192.168.1.0

EIGRP Topology Table

172.16.2.0/24

Loopback 1
10.1.1.1/30

Internet ISP

This router does not physically exists

10.1.1.0/30

Backup

172.16.3.0/30

All successor routes

All feasible successor routes

.1 Fa0/0

S0/0/0 .2   .9

S0/0/1
DCE

Least Cost

192.168.10.8/30

64 kbps   1024 kbps

S0/0/0
DCE

.1

Fa0/0
.1

172.16.1.0/24

.5   1544 kbps
R1 S0/0/1

192.168.10.4/30

.10 S0/0/1

.6   Fa0/0
R3   .1

S0/0/0
DCE

192.168.1.0/24

```
R2#show ip eigrp topology
IP-EIGRP Topology Table for AS(1)/ID(10.1.1.1)

Codes: P - Passive, A - Active, U - Update, Q - Query, R -
Reply,
        r - reply Status, s - sia Status

(output omitted)
P 192.168.1.0/24, 1 successors, FD is 3014400
        via 192.168.10.10 (3014400/28160), Serial0/0/1
        via 172.16.3.1 (41026560/2172416), Serial0/0/0
P 192.168.10.8/30, 1 successors, FD is 3011840
        via Connected, Serial0/1
```
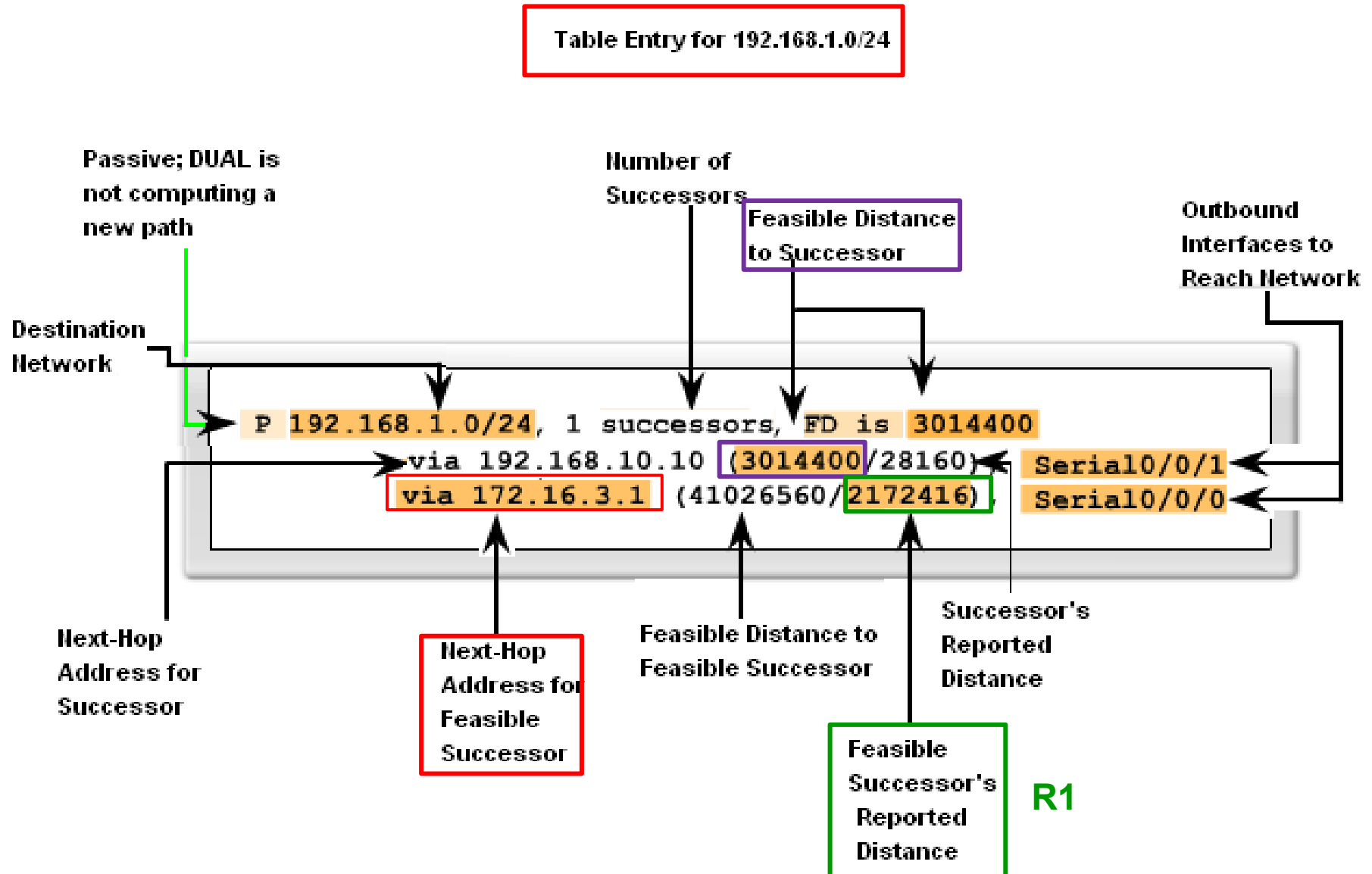
R2
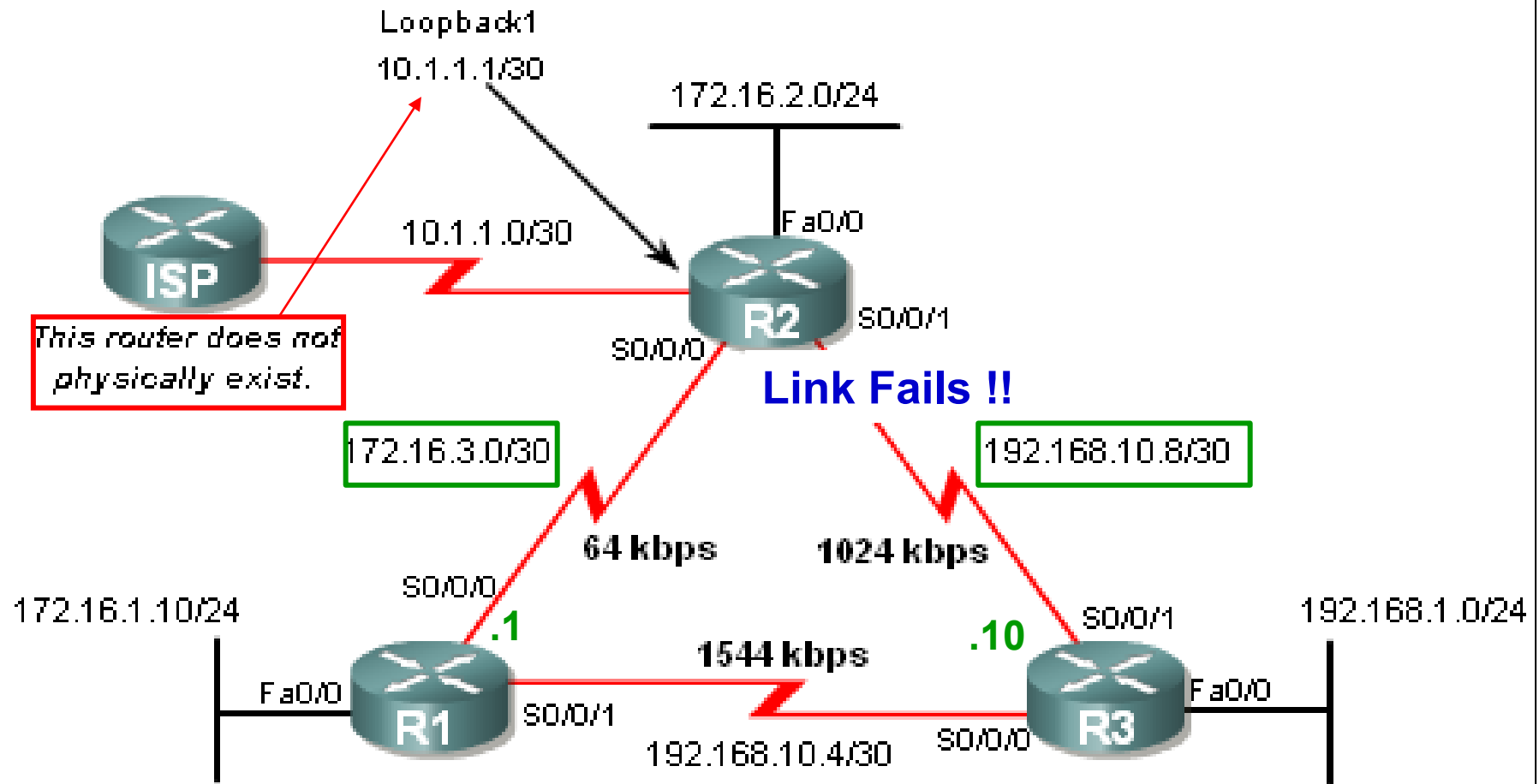
Successor
(Least Cost)

Feasible Successor
(Backup)

Routes for 192.168.1.0/24

EIGRP Topology Table – R2

Table Entry for 192.168.1.0/24

Passive; DUAL is not computing a new path

Number of Successors

Feasible Distance to Successor

Outbound Interfaces to Reach Network

Destination Network

```
P 192.168.1.0/24, 1 successors, FD is 3014400
  via 192.168.10.10 (3014400/28160)   Serial0/0/1
  via 172.16.3.1 (41026560/2172416)   Serial0/0/0
```

Next-Hop Address for Successor

Next-Hop Address for Feasible Successor

Feasible Distance to Feasible Successor

Successor's Reported Distance

Feasible Successor's Reported Distance

R1

EIGRP

18
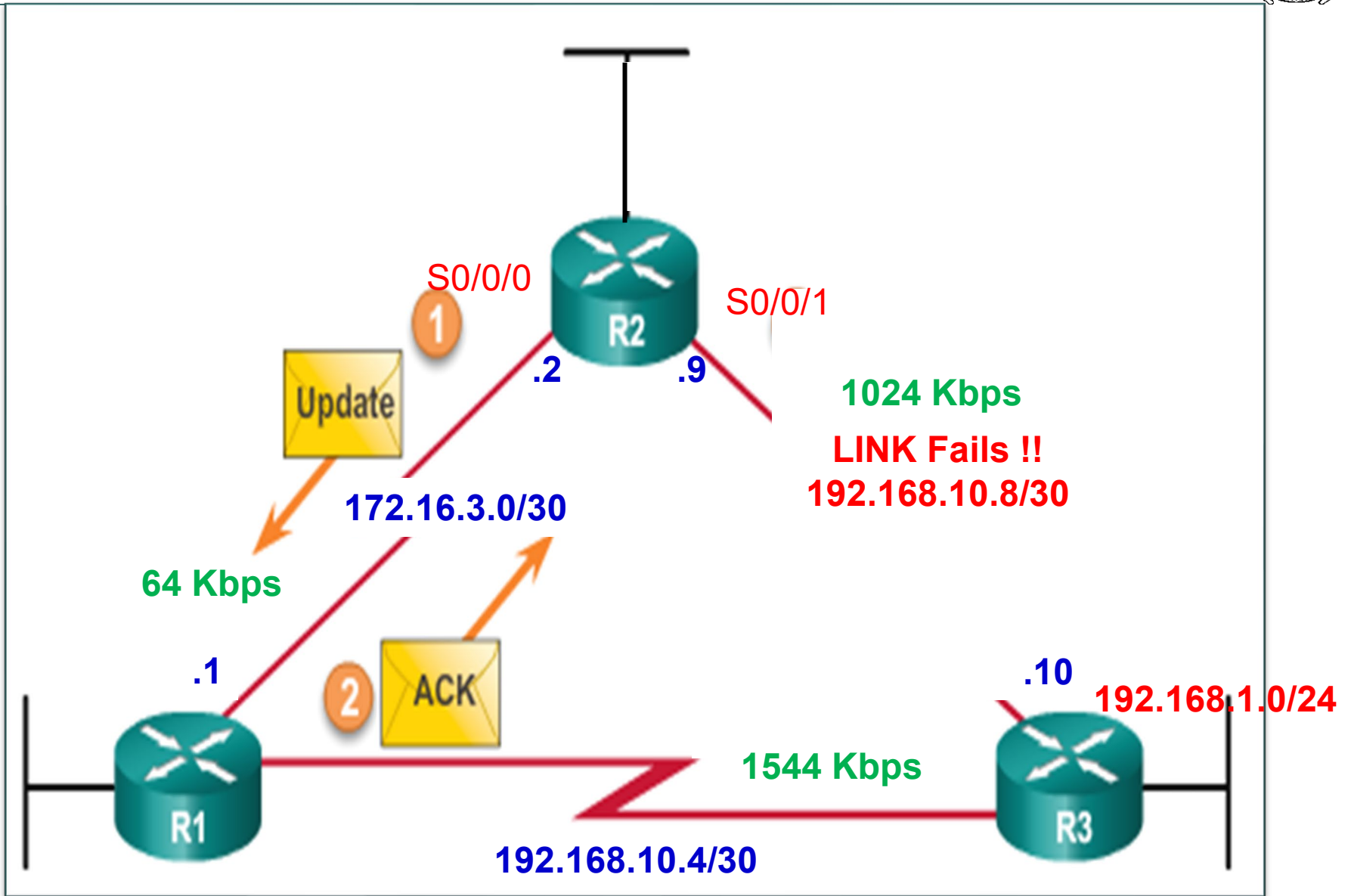
How

EIGRP

Handles

a

Link Failure

Topology

Link Fails - EIGRP Update

- A link failure will trigger an update

- **It is a Partial** update, it includes only the route information that has changed – the whole routing table is NOT sent

EIGRP

R2

Checks

Topology Table

for

Feasible Successor

Topology Table

Table Entry for 192.168.1.0/24

Passive; DUAL is not computing a new path

Number of Successors

Feasible Distance to Successor

Outbound Interfaces to Reach Network

Destination Network

```
P 192.168.1.0/24, 1 successors, FD is 3014400
  via 192.168.10.10 (3014400/28160)    Serial0/0/1
  via 172.16.3.1 (41026560/2172416),   Serial0/0/0
```

Next-Hop Address for Successor

Next-Hop Address for Feasible Successor

Feasible Distance to Feasible Successor

Successor's Reported Distance

Feasible Successor's Reported Distance

R1

R2

Feasible Successor Found

Place In

Routing Table

OR If no Feasible Successor

R2

Queries

Neighbor
for
New route

Query

1

Reply

2

LINK Fails !!
192.168.10.8/30

172.16.3.0/30

192.168.1.0/24

R2

R1

R3
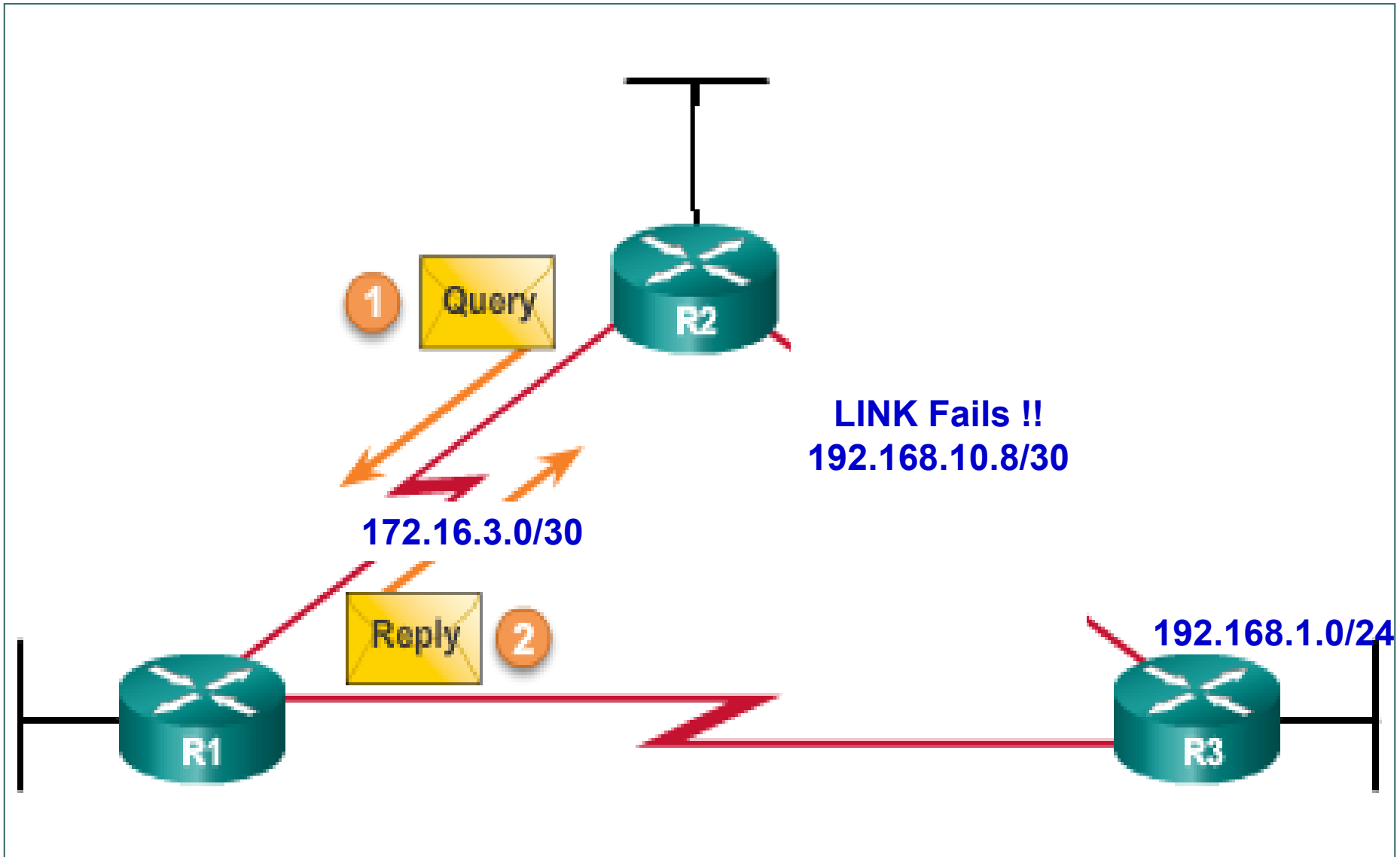
EIGRP

the

Neighbor Table

The Neighbor Table – R2 Neighbors

- EIGRP routers must establish adjacencies with their neighbors before any updates can be sent or received
- First check to see what routers have established communication
  - ***show ip eigrp neighbors***

```
R2#show ip eigrp neighbors
IP-EIGRP neighbors for process 1
H   Address                    Interface    Hold  Uptime    SRTT   RTO   Q   Seq
                                            (sec)           (ms)         Cnt Num
1   192.168.10.10              Se0/0/1        10  00:01:41    20   200   0   7
0   172.16.3.1                 Se0/0/0        10  00:09:49    25   200   0   28
```

The Neighbor Table

Address of neighbors

Interface connected to neighbor

Amount of time left before neighbor is considered "down"

Amount of time since adjacency was established

- To see when last update was received on each interface
  - ***show ip protocols***

EIGRP

The Neighbor Table – R2 Neighbors

- SRTT – Smooth Round Trip Time
  - The average number of msecs it takes for an EIGRP packet to be sent to this neighbor and for the local router to receive an ACK

- RTO – Retransmit Timeout
  - The amount of time, in ms that a router waits for an ACK before retransmitting a reliable packet to a neighbor

- Q – Queue Count
  - The number of EIGRP packets waiting in the queue to be sent out. If this value is constantly higher than 0, a congestion problem might exist

- Seq – The sequence number of the last update, query, or reply EIGRP packet that was received from this neighbor

EIGRP

Redistributing Static Routes

- Use command redistribute static:

> router eigrp 65
>
> redistribute static

- Redistributes static default route on gateway router, to internal routers

EIGRP Metrics used in determining Least Cost

Bandwidth

- Most serial interfaces use a default bandwidth value of 1.544Mbps (T1)
- Can be modified using the **bandwidth** command for each interface
- Is a logical value that **does not change** the link's physical bandwidth – only the value used in routing protocol calculations

Signal Delay

- The measure of time it takes for a packet to traverse a route
- Value based on the link type

Delay Values in Microseconds

Media	Delay
100M ATM	100 µS
Fast Ethernet	100 µS
FDDI	100 µS
1HSSI	20,000 µS
16M Token Ring	630 µS
Ethernet	1,000 µS
T1 (Serial Default)	20,000 µS
512K	20,000 µS
DS0	20,000 µS
56K	20,000 µS

EIGRP

EIGRP Summary

- First released in 1992 as a Cisco proprietary protocol.

- 2013 basic functionality of EIGRP released to IETF as an open standard, RFC7868

- Authentication

- Diffusing Update ALgorithm (DUAL) used to calculate the cost to a destination network

- Establishes Neighbor Adjacencies.

- Reliable Transport Protocol (RTP) used to provide delivery of EIGRP packets to neighbors.

- Partial Updates

- Load Balancing - supports Equal and Unequal

The End

EIGRP Video CertBros

https://www.youtube.com/watch?v=QyymIFWDEgM

EIGRP