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EIGRP

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Course Outline

EIGRP Adjacencies

EIGRP Best Path Selection

EIGRP General Operations

EIGRP Load balancing

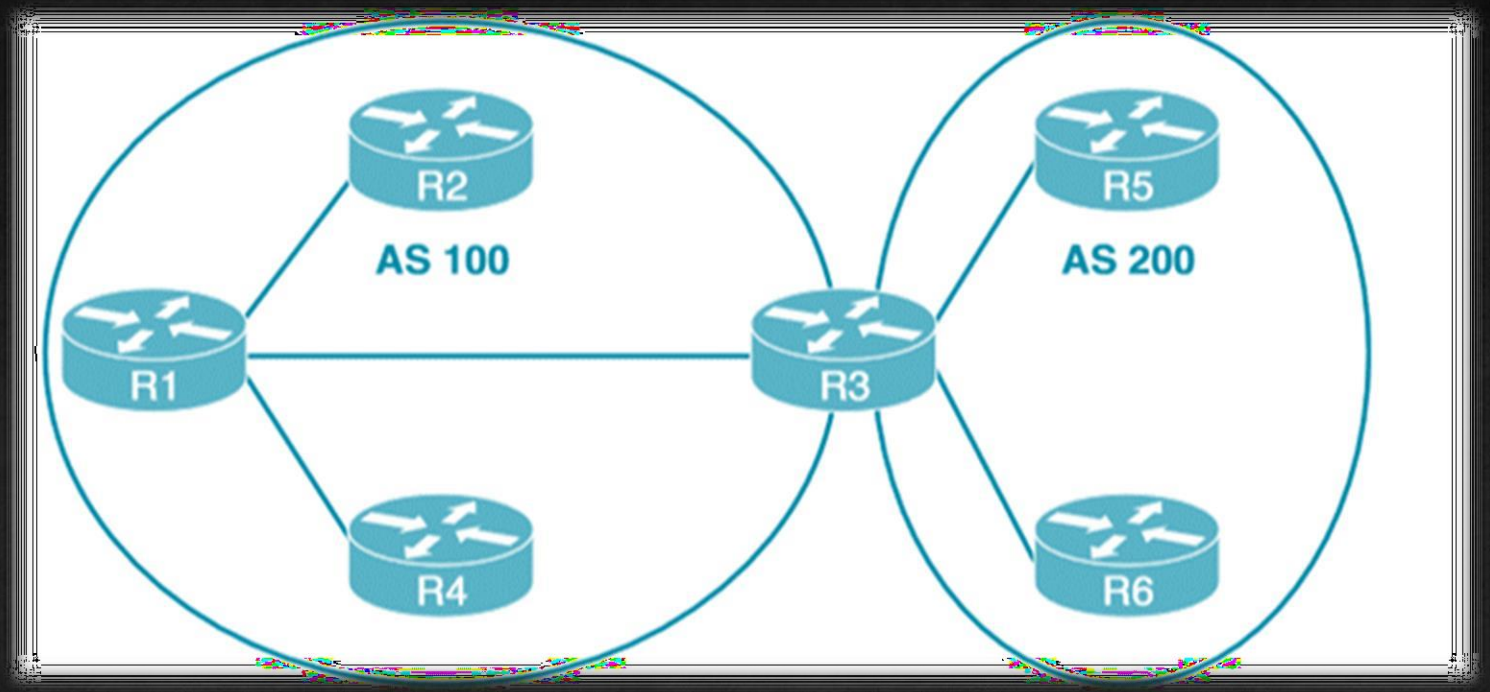
QnA

EIGRP Fundamental

- Enhanced distance vector
- Commonly found in enterprise networks
- EIGRP is a derivative of Interior Gateway Routing Protocol (IGRP)
- Variable-Length Subnet masking(VLSM)
- Initially, EIGRP was a cisco Proprietary Protocol
- It was released to the Internet engineering Task force (IETF) through RFC 7868, which was ratified in may 2016
- EIGRP uses a diffusing update algorithm (DUAL)
  - Route Flag: D (AD=90 (Internal EIGRP))
    D EX (AD=170 (External EIGRP)

Autonomous Systems

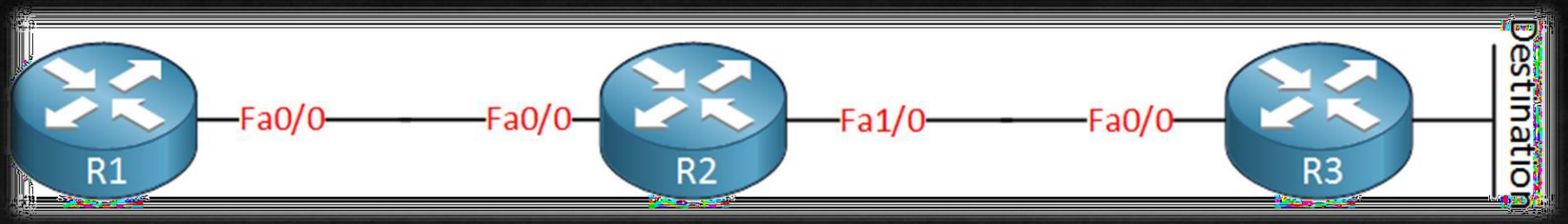
- A router can run multiple EIGRP processes. Each process operates under the context of an autonomous system.

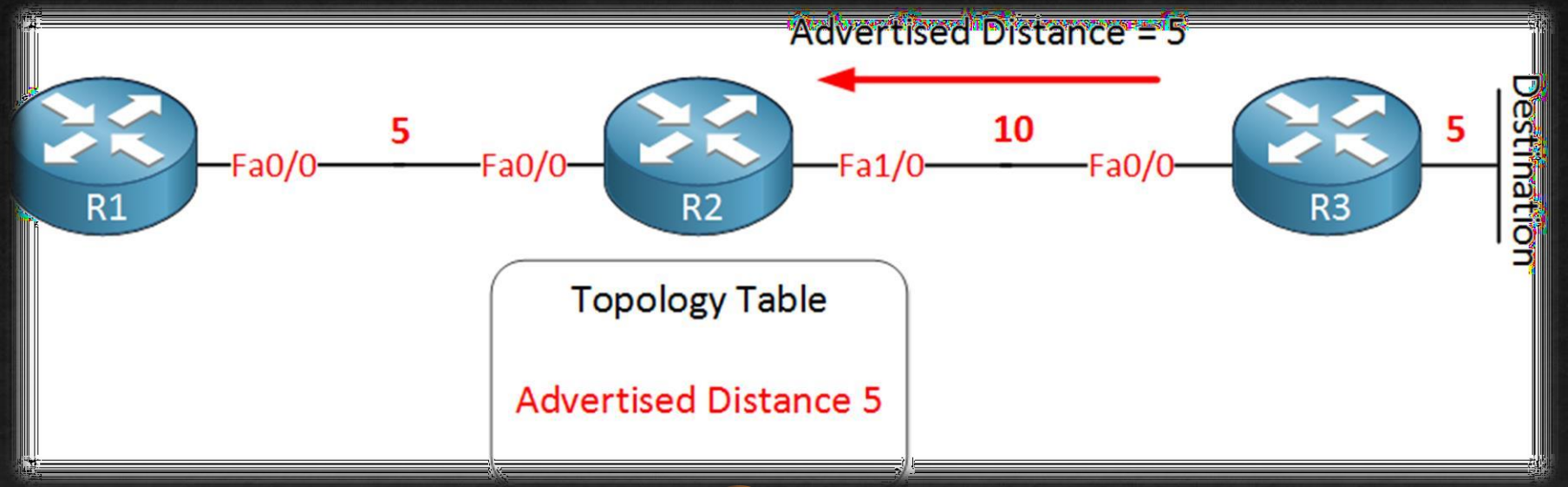


EIGRP Tables

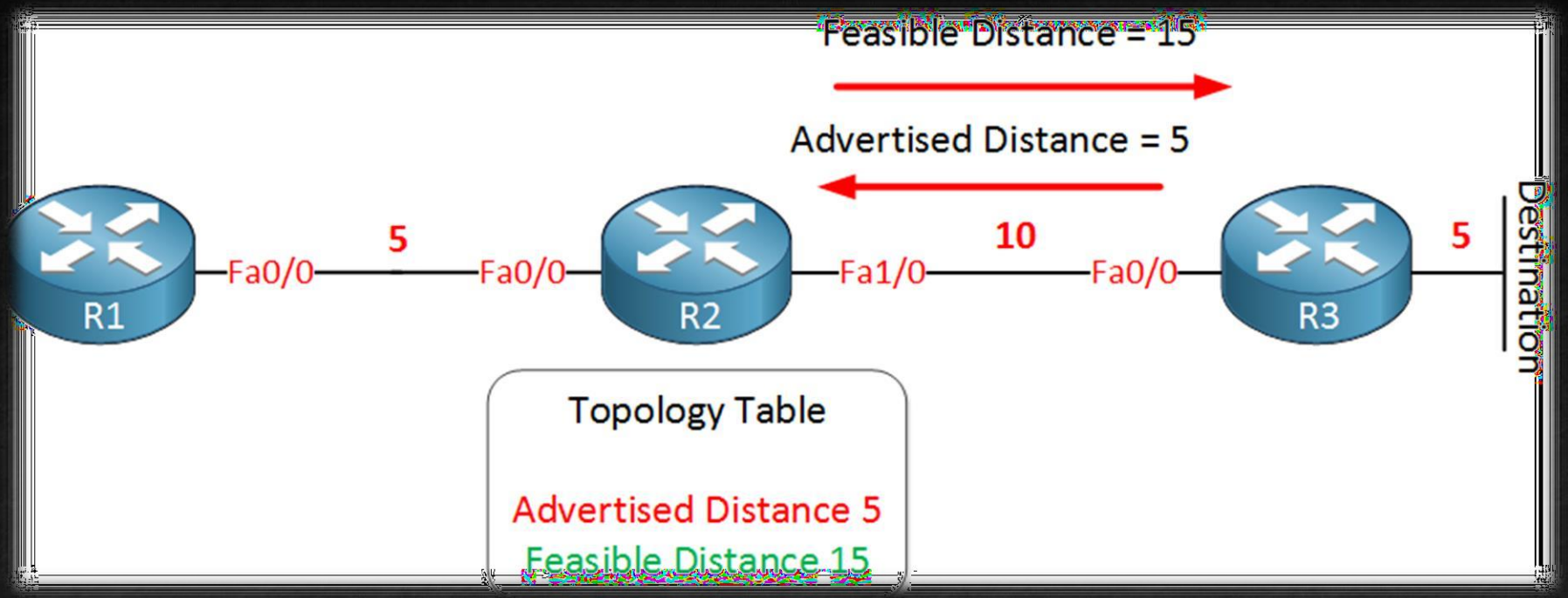
EIGRP Neighbor Table	• **Lists all directly connected neighbors** • **Next hop Router** • **Interface**
EIGRP Topology Table	• Lists all learned routes from all EIGRP neighbors • Destination • Metric
EIGRP Routing Table	• Best routes from EIGRP topology table will be copied to the routing table

EIGRP Best Path Selection

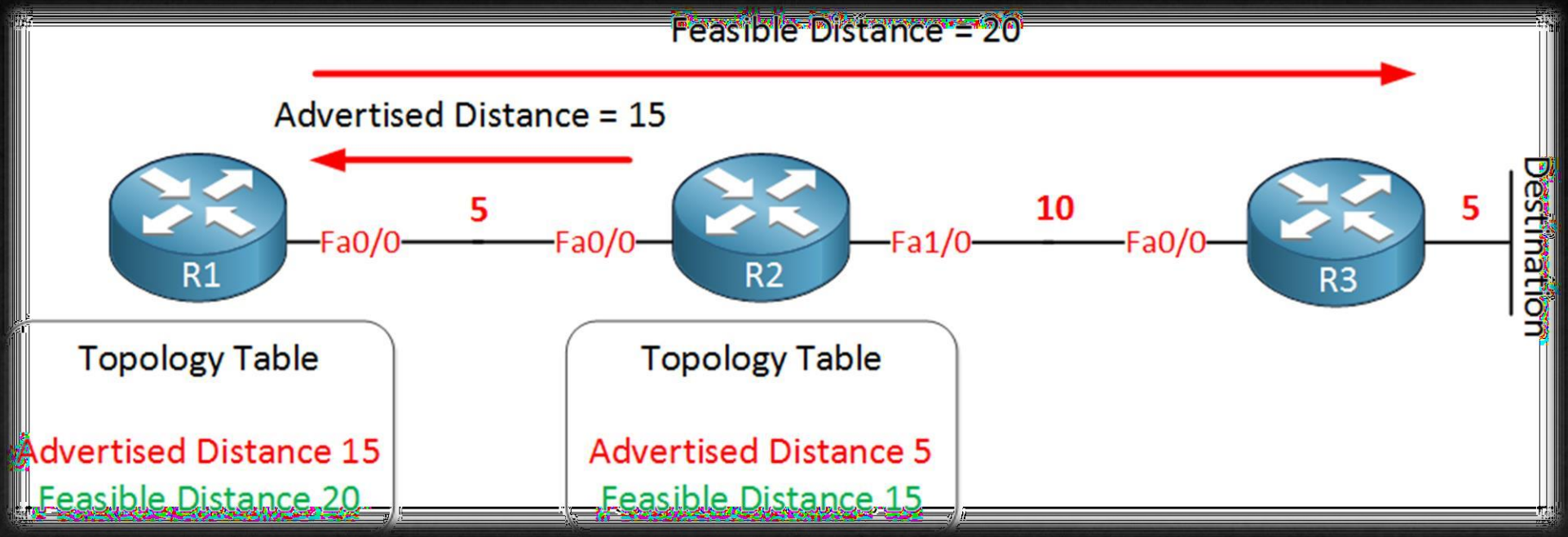




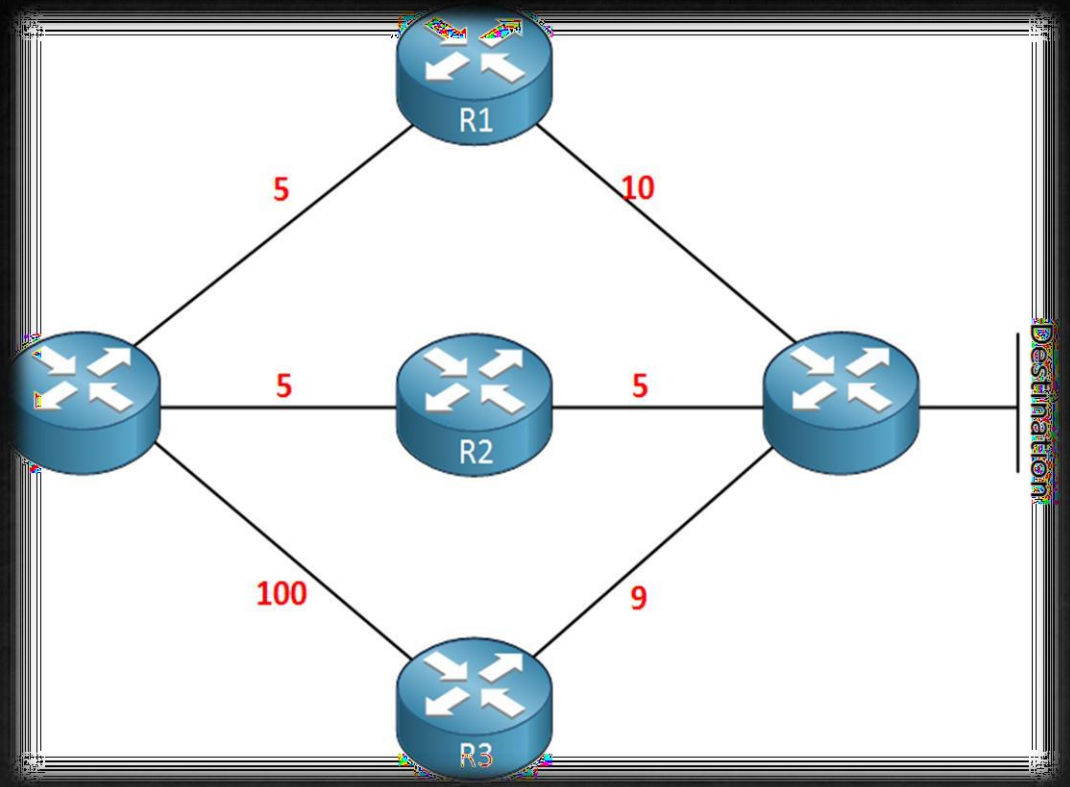
EIGRP Best Path Selection



EIGRP Best Path Selection



EIGRP Best Path Selection



Router	Advertise Distance	Feasible Distance	
R1			
R2			
R3			

EIGRP Terminology

- Successor route
  - The route with the lowest path metric to reach a destination.
- Successor:
  - The best path to the destination is called the successor.
- Feasible distance (FD):
  - The total distance to the destination.
- Reported distance (RD)
  - Total distance from the neighbor to the destination.
- Feasibility condition
  - Advertised distance of feasible successor < Feasible distance of successor.
- Feasible successor
  - A route with that satisfies the feasibility condition is maintained as a backup route.

EIGRP Packets

- Hello packets: are used for neighbor discovery
- Update packets: have routing information and are sent reliable to whatever router that requires this information.
- Query packets: are used when your EIGRP router has lost information about a certain network and doesn't have any backup paths.
- Reply packets: are used in response to the query packets.
- ACK packets: are used to acknowledge the receipt of update, query and reply packets.

EIGRP Neighbor Table

- R1#show ip eigrp neighbors

```
IP-EIGRP neighbors for process 1
H   Address                 Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                            (sec)         (ms)       Cnt Num
0   192.168.12.2            Fa0/0             10 00:06:06   19   200  0  27
```

- H (Handle)
- Hold: (sec)
- Uptime
- SRTT (Smooth round-trip time)
- RTO (Retransmission timeout)
- Q Cnt (Q count)
- Seq Num (Sequence number)

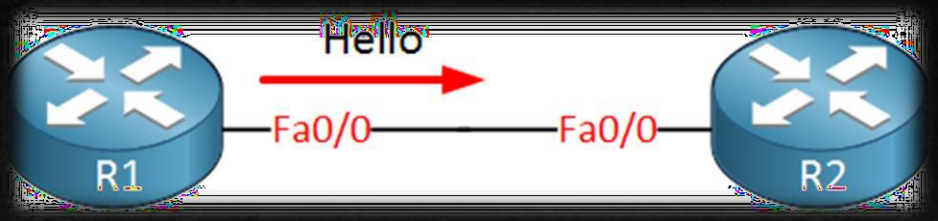
EIGRP Topology table

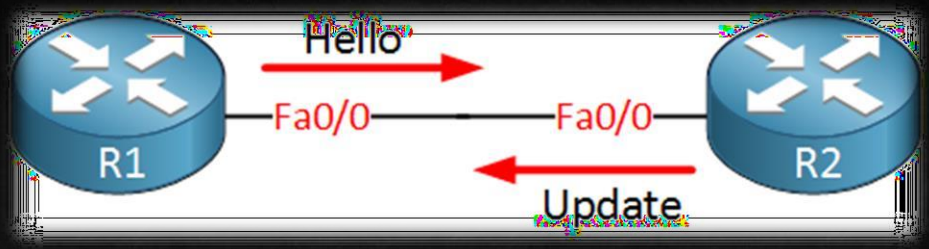
- R1#show ip eigrp topology

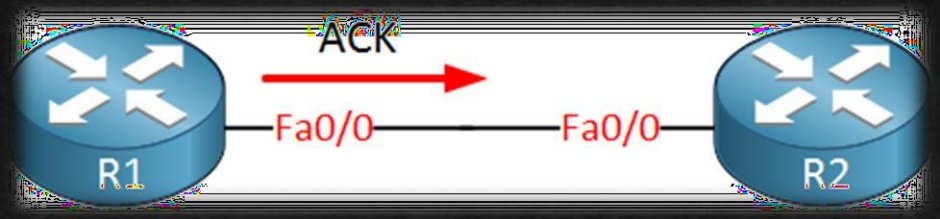
```
IP-EIGRP Topology Table for AS(1)/ID(1.1.1.1)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status
P 2.2.2.0/24, 1 successors, FD is 156160
   via 192.168.12.2 (156160/128256), FastEthernet0/0
```

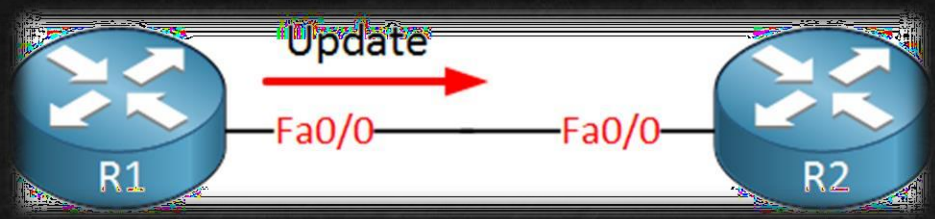
- Passive
- Active
- Reply Status
- Sia Status (Stuck in Active)

EIGRP Neighbor Adjacency



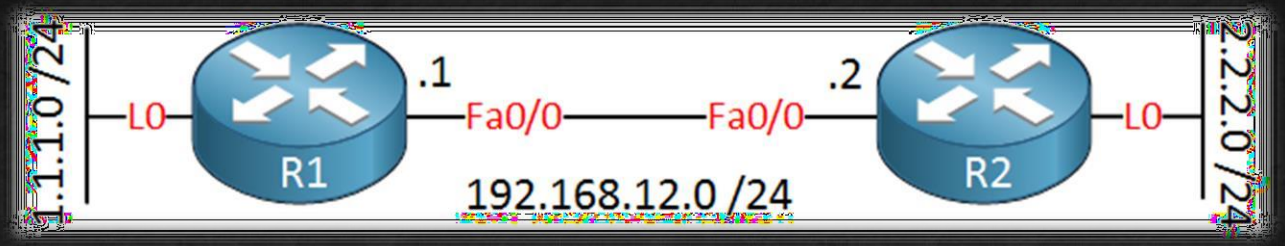






EIGRP Neighbor Adjacency

- Neighborship Condition
  - Same AS Number
  - Same Subnet Number
  - Authentication [Optional] > MD5
  - Same K Values



Basic EIGRP Config

- EIGRP
  - Classic/Traditional
  - Named

- Classic:

```
router(config)# router eigrp ASN
router(config-router)# network INTERFACE_IP [WC-MASK]
router(config-router)# eigrp router-id A.B.C.D
```

- Named:

```
router(config)# router eigrp name
router(config-rotuer)# address-family ipv4 unicast autonomous-system ASN
router(config-router-af)# network INTERFACE_IP [WC_MASK]
router(config-router-af)#eigrp router-id A.B.C.D
router(config-router-af)#  exit-address-family
```

EIGRP Router ID

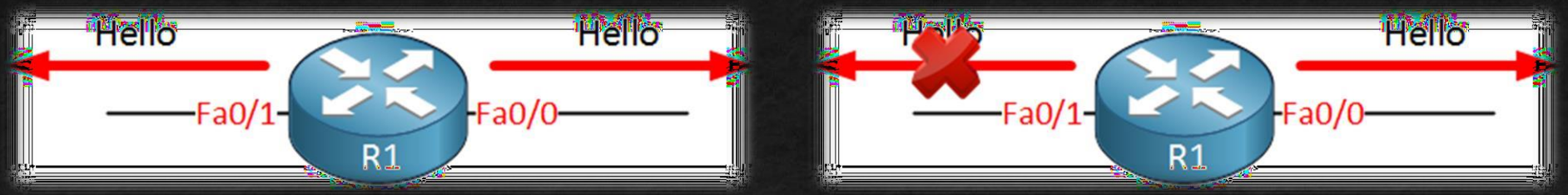
- The router ID (RID) is a 32-bit number that uniquely identifies an EIGRP router.
- The RID can be set dynamically, which is the default, or manually.

```
R1(config)# router eigrp 100
R1(config-router)# eigrp router-id 192.168.1.1
```

```
R2(config)# router eigrp EIGRP-NAMED
R2(config-router)# address-family ipv4 unicast autonomous-system 100
R2(config-router-af)# eigrp router-id 192.168.2.2
```

Passive Interfaces

- Some network topologies must advertise a network segment into EIGRP but need to prevent neighbors from forming adjacencies with other routers on that segment.
- In this scenario, we need to put the EIGRP interface in a passive state.
- Passive EIGRP interfaces do not send out or process EIGRP hellos, which prevents EIGRP from forming adjacencies on that interface.



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Passive Interfaces(Cont.)

```
R1# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)# router eigrp 100
R1(config-router)# passive-interface g10/2
```

```
R1(config)# router eigrp 100
R1(config-router)# passive-interface default
04:22:52.031: %DUAL-5-NBRCHANGE: EIGRP-IPv4 100: Neighbor 10.12.1.2 (GigabitEther-
net0/1) is down: interface passive
R1(config-router)# no passive-interface g10/1
*May 10 04:22:56.179: %DUAL-5-NBRCHANGE: EIGRP-IPv4 100: Neighbor 10.12.1.2 (Giga-
bitEthernet0/1) is up: new adjacency
```

```
R2# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)# router eigrp EIGRP-NAMED
R2(config-router)# address-family ipv4 unicast autonomous-system 100
R2(config-router-af)# af-interface g10/2
R2(config-router-af-interface)# passive-interface
```

```
R2(config)# router eigrp EIGRP-NAMED
R2(config-router)# address-family ipv4 unicast autonomous-system 100
R2(config-router-af)# af-interface default
R2(config-router-af-interface)# passive-interface
04:28:30.366: %DUAL-5-NBRCHANGE: EIGRP-IPv4 100: Neighbor 10.12.1.1
(GigabitEthernet0/1) is down: interface passiveex
R2(config-router-af-interface)# exit-af-interface
R2(config-router-af)# af-interface g10/1
R2(config-router-af-interface)# no passive-interface
R2(config-router-af-interface)# exit-af-interface
*May 10 04:28:40.219: %DUAL-5-NBRCHANGE: EIGRP-IPv4 100: Neighbor 10.12.1.1
(GigabitEthernet0/1) is up: new adjacency
```

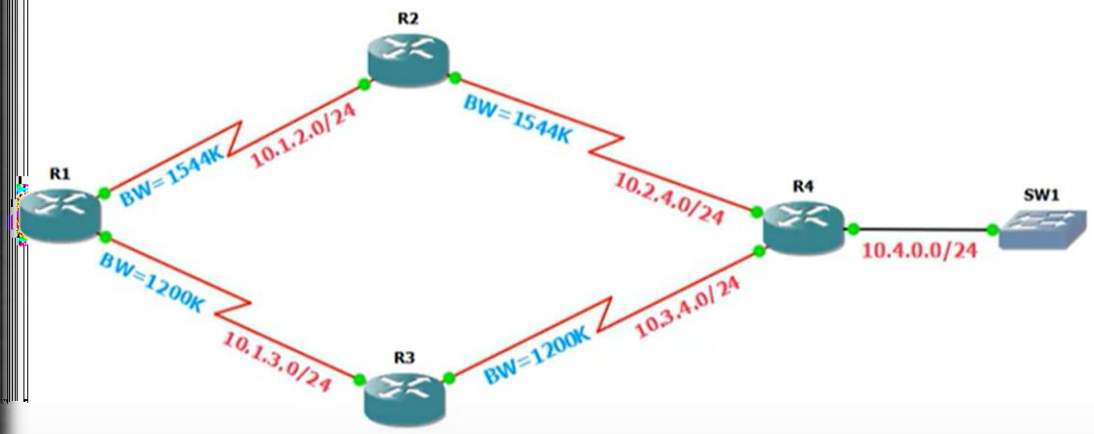
EIGRP Authentication

- Authentication is a mechanism for ensuring that only authorized routers are eligible to become EIGRP neighbors.
- Authentication prevents adding a router to a network and introducing invalid routes, accidentally or maliciously.

```
R1(config)# key-chain EIGRPKEY
R1(config-keychain)# key 2
R1(config-keychain-key)# key-string CISCO
R1(config)# interface g10/1
R1(config-if)# ip authentication mode eigrp 100 md5
R1(config-if)# ip authentication key-chain eigrp 100 EIGRPKEY
```

```
R2(config)# key chain EIGRPKEY
R2(config-keychain)# key 2
R2(config-keychain-key)# key-string CISCO
R2(config-keychain-key)# router eigrp EIGRP-NAMED
R2(config-router)# address-family ipv4 unicast autonomous-system 100
R2(config-router-af)# af-interface default
R2(config-router-af-interface)# authentication mode md5
R2(config-router-af-interface)# authentication key-chain EIGRPKEY
```

EIGRP Metric Calculation



$$\text{Metric} = 256 * \left[\left(K_1 * \frac{10^7}{\text{Min. Bandwidth}} + \frac{K_2 * \text{Min. Bandwidth}}{256 - \text{Load}} + K_3 * \text{Total Delay} \right) * \frac{K_5}{K_4 + \text{Reliability}} \right]$$

EIGRP Classic Metric Formula

$$\text{Metric} = 256 * \left[\left(1 * \frac{10^7}{\text{Min. Bandwidth}} + \frac{0 * \text{Min. Bandwidth}}{256 - \text{Load}} + 1 * \text{Total Delay} \right) * \frac{0}{0 + \text{Reliability}} \right]$$

Equals

$$\text{Metric} = 256 * \left(\frac{10^7}{\text{Min. Bandwidth}} + \text{Total Delay} \right)$$

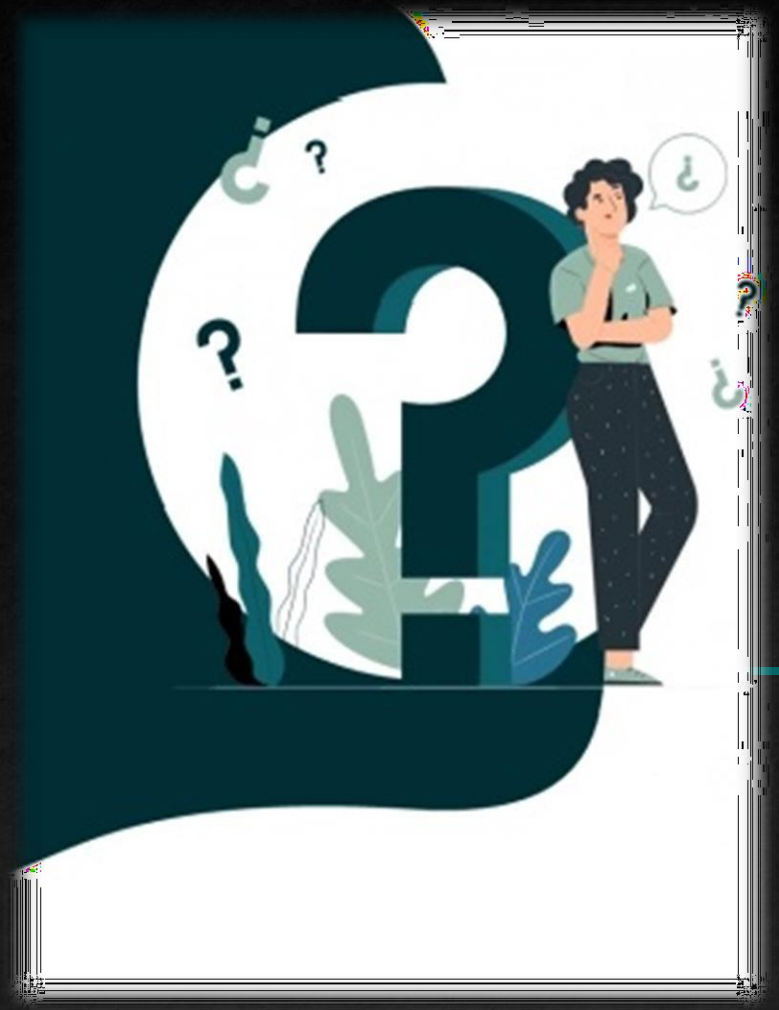
EIGRP Classic Metric Formula with Defaul K Values

Load Balancing

- EIGRP allows multiple successor routes (with the same metric) to be installed into the RIB. Installing multiple paths into the RIB for the same prefix is called equal-cost multipathing (ECMP) routing.
- The default maximum ECMP is four routes.

```
R1# show run | section router eigrp
router eigrp 100
 maximum-paths 6
 network 0.0.0.0
```

```
R2# show run | section router eigrp
router eigrp EIGRP-NAMED
 !
 address-family ipv4 unicast autonomous-system 100
  !
  topology base
   maximum-paths 6
  exit-af-topology
  network 0.0.0.0
  eigrp router-id 192.168.2.2
 exit-address-family
```



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