

# Configuration and Management of Networks

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# Configuration and Management of Networks

## Network Layer - Routing

- **Static:** The router learns routes when an administrator manually configures the static route. The administrator must manually update this static route entry whenever an internetwork topology change requires an update.
- **Dynamic:** The router dynamically learns routes after an administrator configures a routing protocol that helps determine routes.



describe the following information:

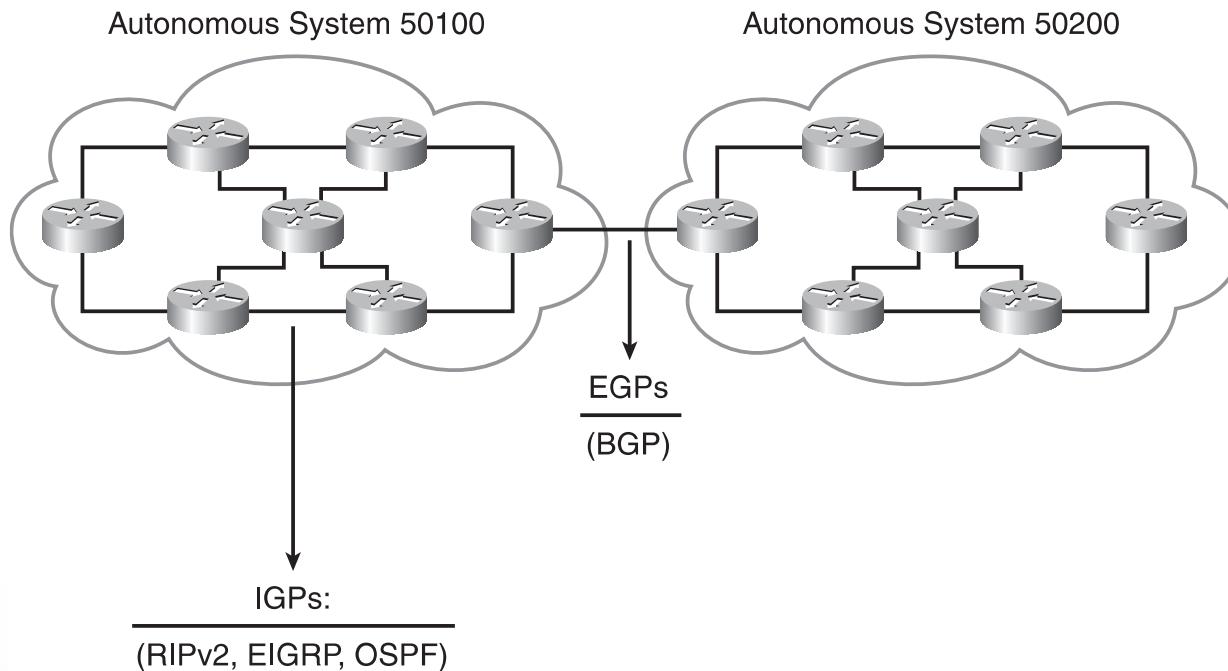
### Routing protocol

- How updates are conveyed
- What knowledge is conveyed
- When to convey the knowledge
- How to locate recipients of the updates

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## Network Layer – IGP and EGP

### *IGP Versus EGP*



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### Network Layer – IGP and EGP

- **Distance vector:** The distance vector routing approach determines the direction (vector) and distance (such as hops) to any link in the internetwork.
- **Link-state:** The link-state approach, which utilizes the shortest path first (SPF) algorithm, creates an abstraction of the exact topology of the entire internetwork, or at least of the partition in which the router is situated.
- **Advanced distance vector:** The advanced distance vector approach combines aspects of the link-state and distance vector algorithms. This is also sometimes referred to as a hybrid routing protocol.

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### Distance Vector protocols

Periodically advertise routes as vectors, where distance is a metric (or cost) such as hop count, and vector is the next-hop router's IP used to reach the destination

- Distance: The distance is the route metric to reach the network.
- Vector: The vector is the interface or direction to reach the network.

Routers determine least cost path (distance vector protocols implement a distributed Bellman-Ford algorithm) and advertise only those to neighbors

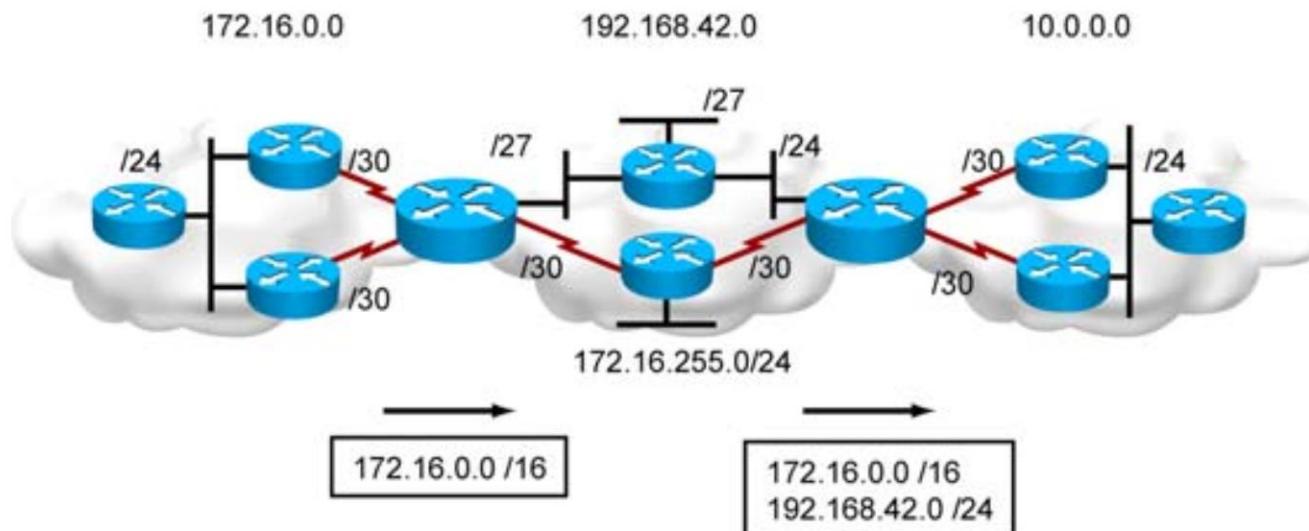
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## Distance Vector protocols - EIGRP

- Support for VLSM and discontiguous subnets
- Load balancing across equal- and unequal-cost pathways
- Easy configuration for WANs and LANs
- Manual summarization at any point
- Sophisticated metric

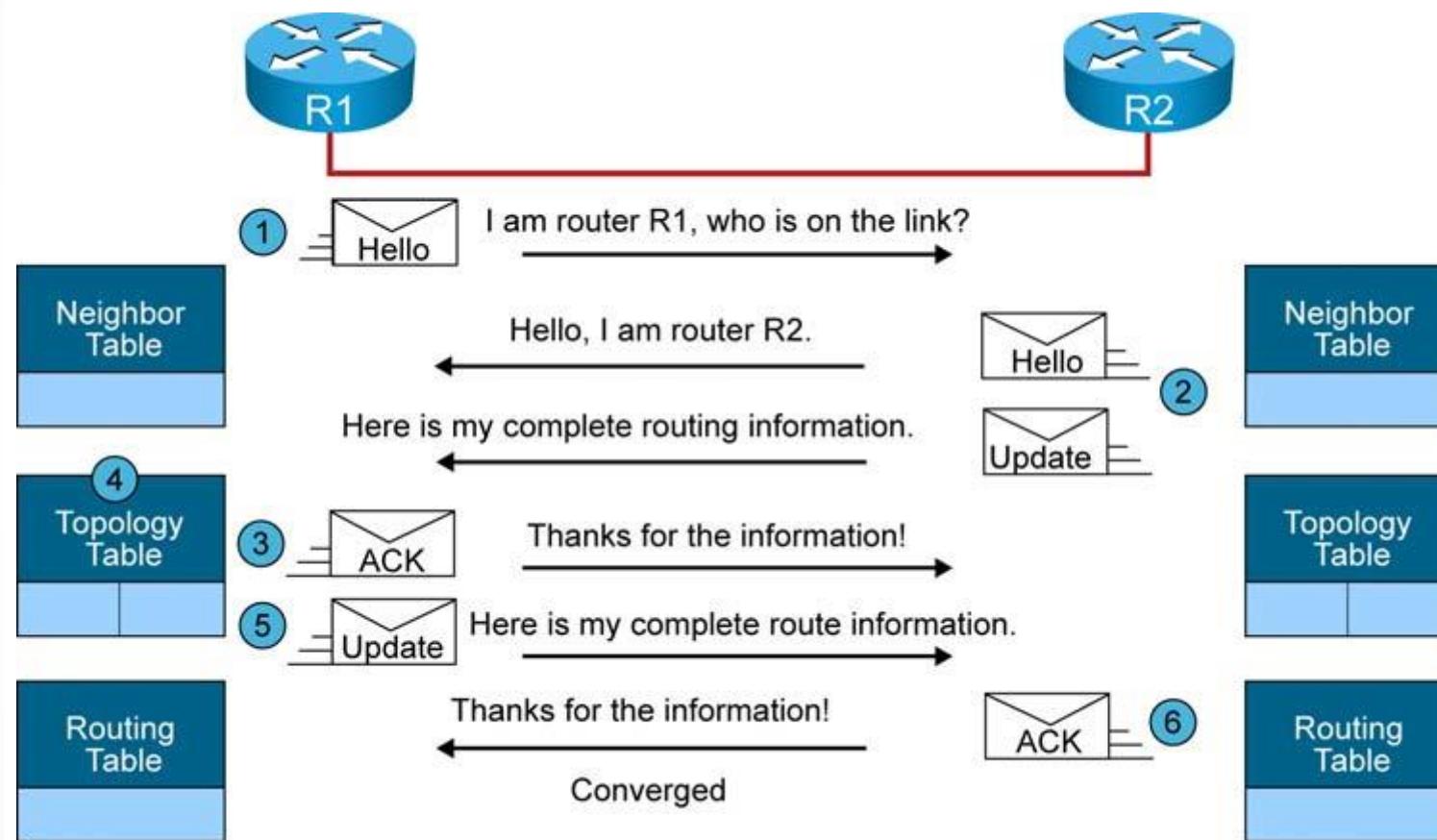
Non-Distance Vector Characteristics:

updates through neighbour relationships only when there is a change in the network



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## EIGRP – Initial Route Discovery



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### EIGRP – Neighbour Table

- The list of directly connected routers running EIGRP with which this router has an adjacency

IP EIGRP Neighbor Table	
Next-Hop Router	Interface

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### EIGRP – Topology table

- The list of all routes learned from each EIGRP neighbor
- **The source for the topology table: IP EIGRP Neighbor Table**

IP EIGRP Topology Table	
Destination 1	FD and AD via Each Neighbor

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## EIGRP – IP routing table

- The list of all best routes from the EIGRP topology table and other routing processes
- The source for the EIGRP routes in an IP routing table: IP EIGRP Topology Table

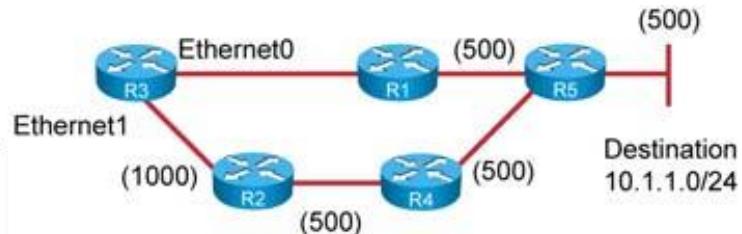
The IP Routing Table	
Destination 1	Best Route
[REDACTED]	[REDACTED]

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## EIGRP – Tables Example

### Example: EIGRP Tables

IP EIGRP Neighbor Table	
Next-Hop Router	Interface
Router R1	Ethernet 0
Router R2	Ethernet 1



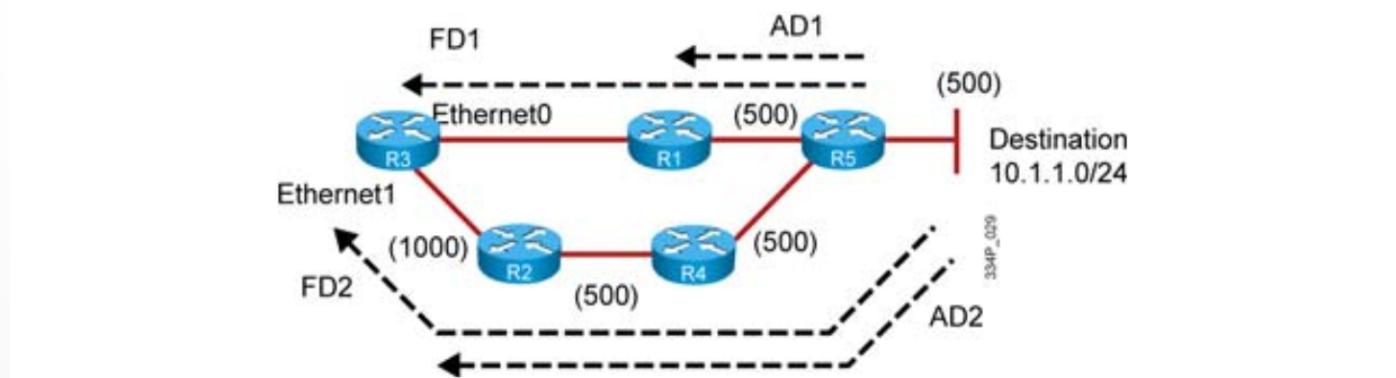
IP EIGRP Topology Table			
Network	Feasible Distance (EIGRP Metric)	Advertised Distance	EIGRP Neighbor
10.1.1.0 /24	2000	1000	Router R1 (E0)
10.1.1.0 /24	2500	1500	Router R2 (E1)

The IP Routing Table			
Network	Metric (Feasible Distance)	Outbound Interface	Next Hop (EIGRP Neighbor)
10.1.1.0 /24	2000	Ethernet 0	Router R1

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## EIGRP – DUAL

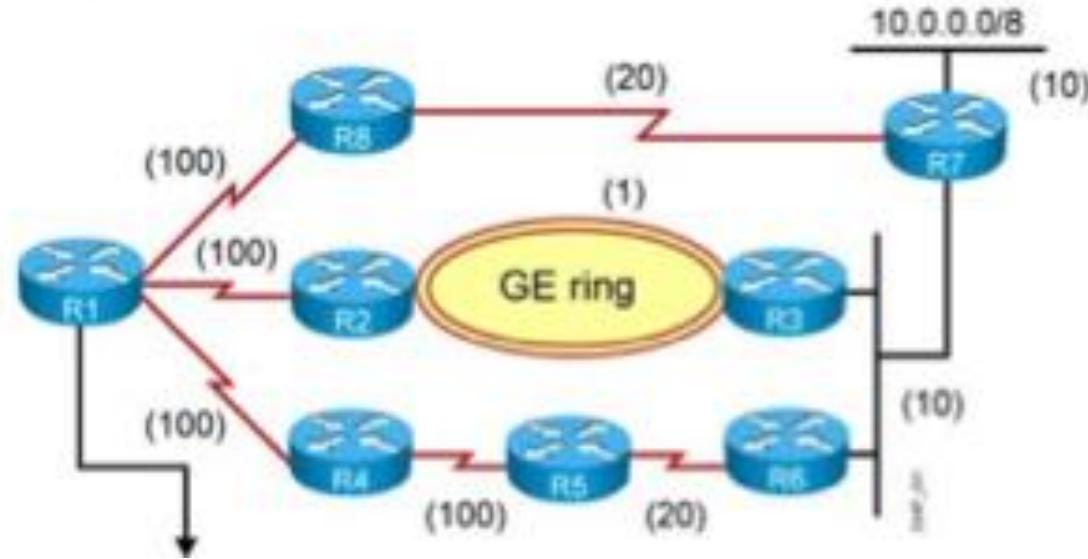
- Upstream and downstream router
- Selects lowest-cost loop-free paths to each destination
  - **Advertised Distance (AD)** = next-hop router-destination
  - **Feasible Distance (FD)** = local router cost + AD
  - **Lowest-cost** = lowest FD
  - **(Current) successor** = next-hop router with the lowest-FD-cost loop-free path
  - **Feasible successor** = backup router with loop-free path (its AD < current successor FD)



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### EIGRP – Example

- Advertised distance is the distance (metric) to a destination as advertised by an upstream neighbor

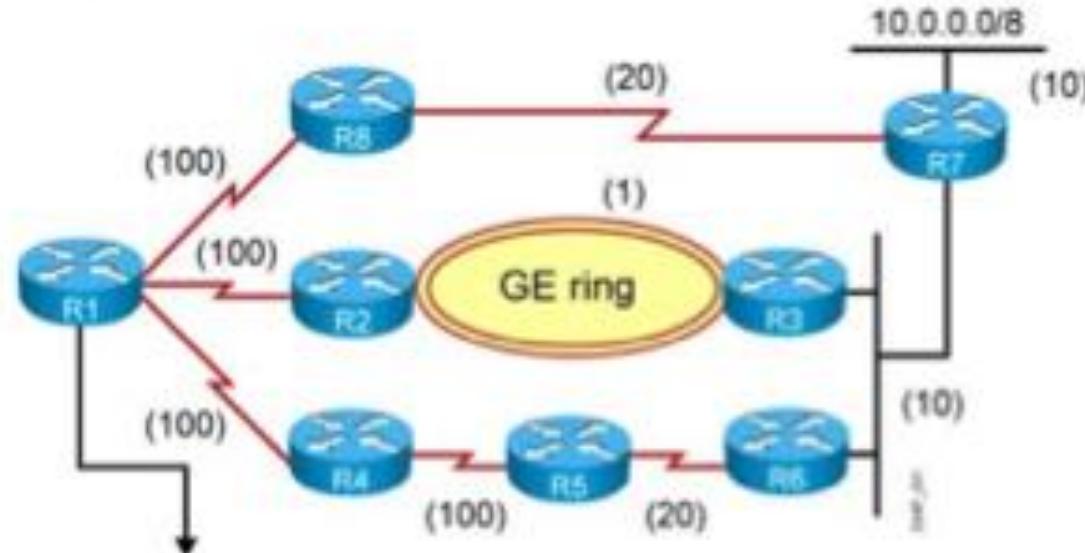


Neighbor	FD	AD
R8	130(100+30)	30=10+20
R2	121=(100+21)	21=10+10+1
R4	2140=(140+100)	140=10+10+20+100

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### EIGRP – Example

- Advertised distance is the distance (metric) to a destination as advertised by an upstream neighbor

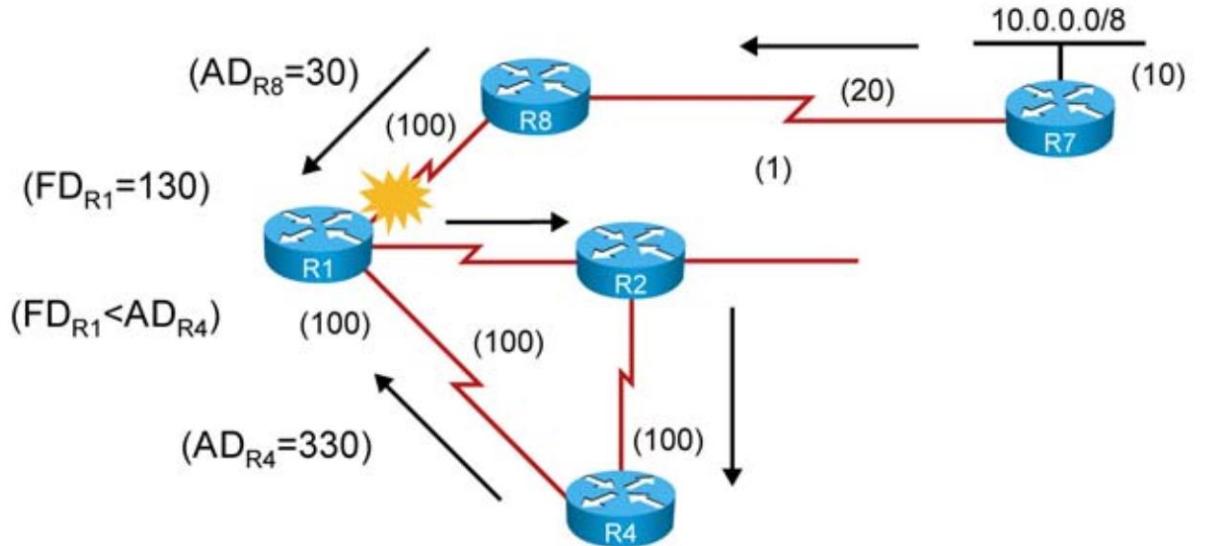


Neighbor	FD	AD	Status
R8	130(100+30)	30=10+20	Feasible Successor
R2	121=(100+21)	21=10+10+1	Successor
R4	2140=(140+100)	140=10+10+20+100	

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## EIGRP – Successor and Feasible Successor

- R1 receives information about 10.0.0.8 from R8 and R4
- FD on R1 is smaller than AD from R4 and the update from R4 is not FS



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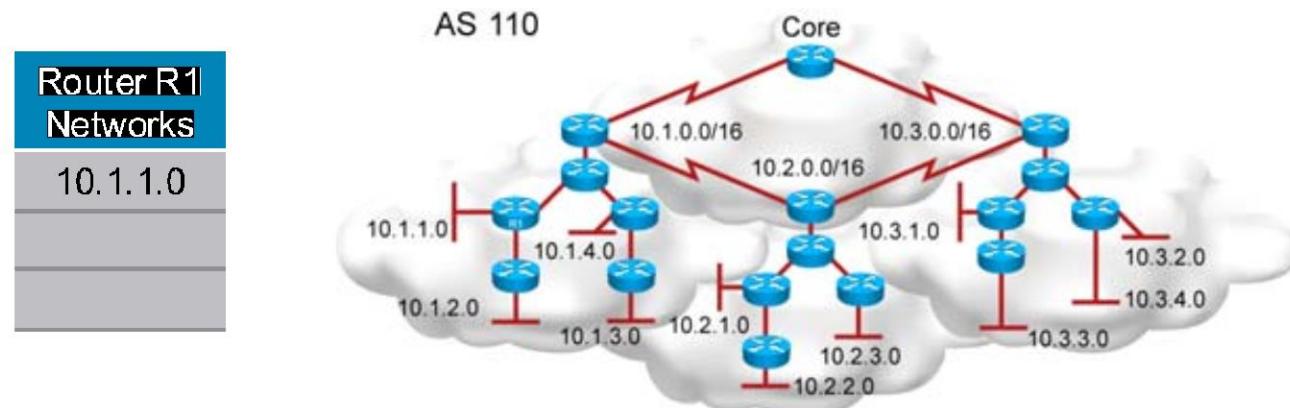
## EIGRP – Metrics

- The use of metric components is represented by K values
- Metric components are:
  - Bandwidth (K1)
  - Delay (K3)
  - Reliability (K4 and K5)
  - Loading (K2)
- MTU is included in the update but not used for metric calculation

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## EIGRP – Planning

- Verify and configure IP addressing
- Enable EIGRP using the correct AS number
- Define networks to include per router
- Define a special metric to influence path selection

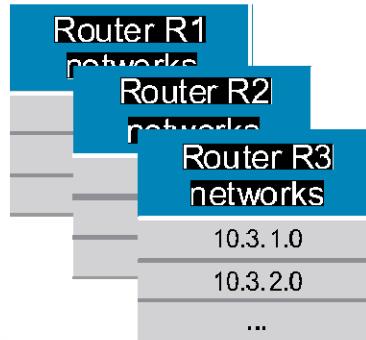


Router	Link	Metric
R1	Fa0	Bandwidth = 10 Mb/s

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## EIGRP – Documenting

- Documenting EIGRP
  - Topology—use topology map
  - AS numbering and IP addressing
  - Networks included in EIGRP per routers
  - Non-default metric applied

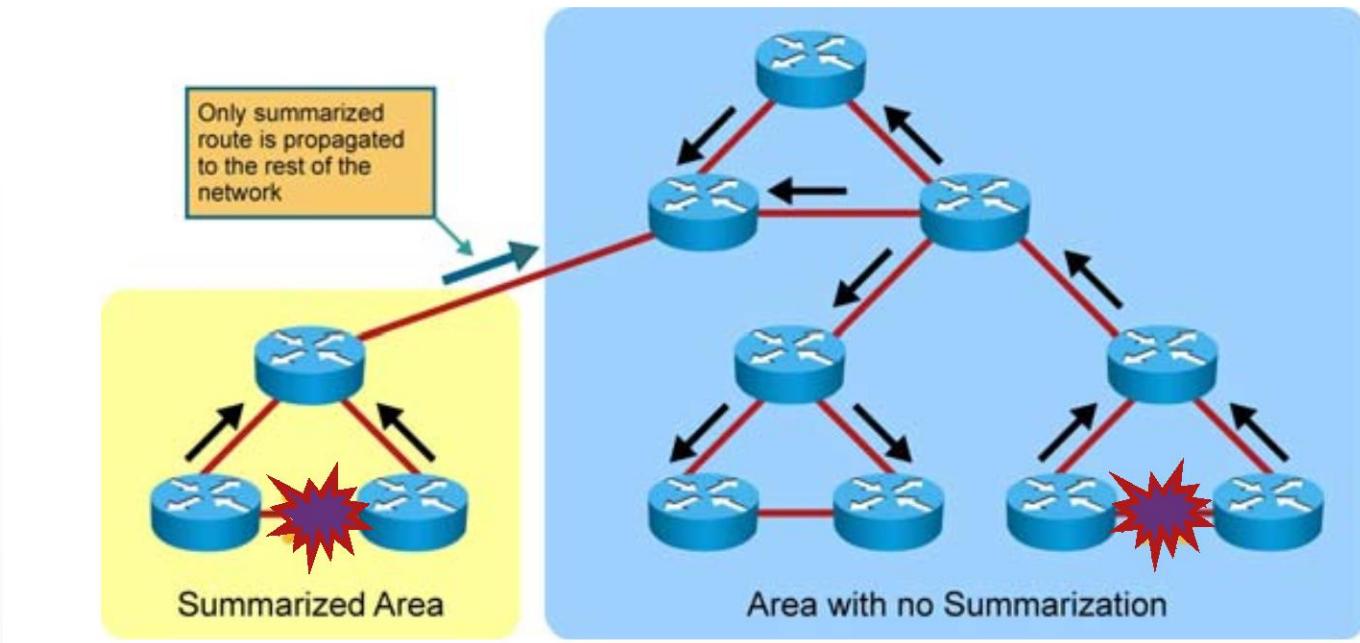


Router	Link	Metric
R1	Fa0	Bandwidth = 10 Mb/s
R2	Serial1	Delay = 100
R2	Serial2	Delay = 200
R2	Tunnel	Bandwidth = 2 Mb/s

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## EIGRP – Route Summarization

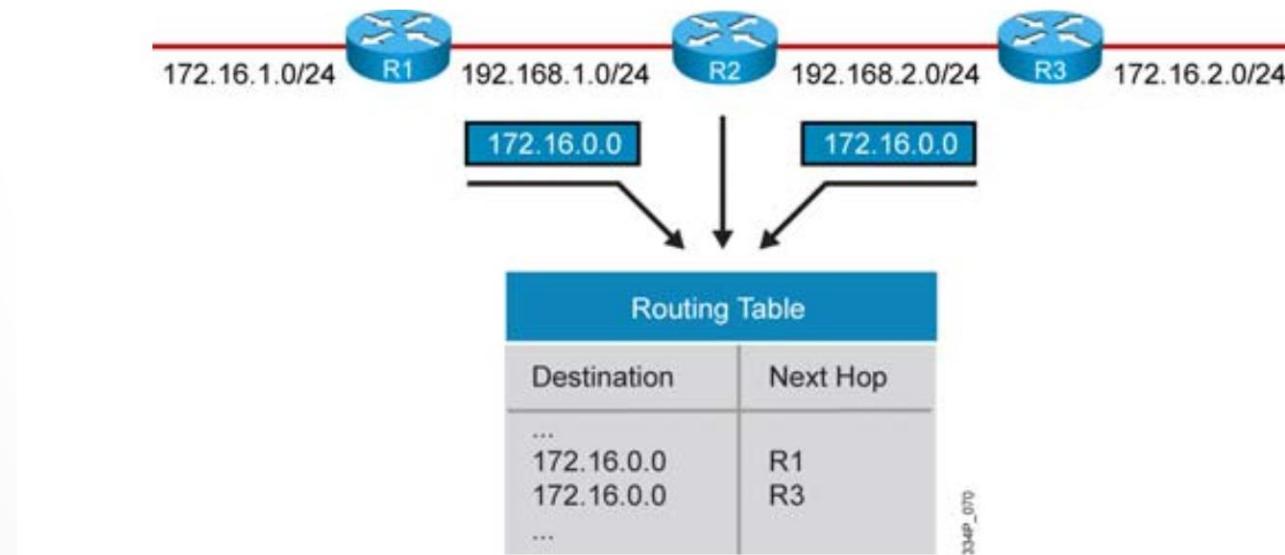
- Improves network scalability
  - Smaller routing tables
  - Fewer updates
- Should follow IP addressing



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## EIGRP – Automatic Route Summarization

- Performed on major network boundaries
  - Subnetworks are summarized to a single classful (major) network.
  - Automatic summarization occurs by default.
- Could result in routing issues—disable auto summarization



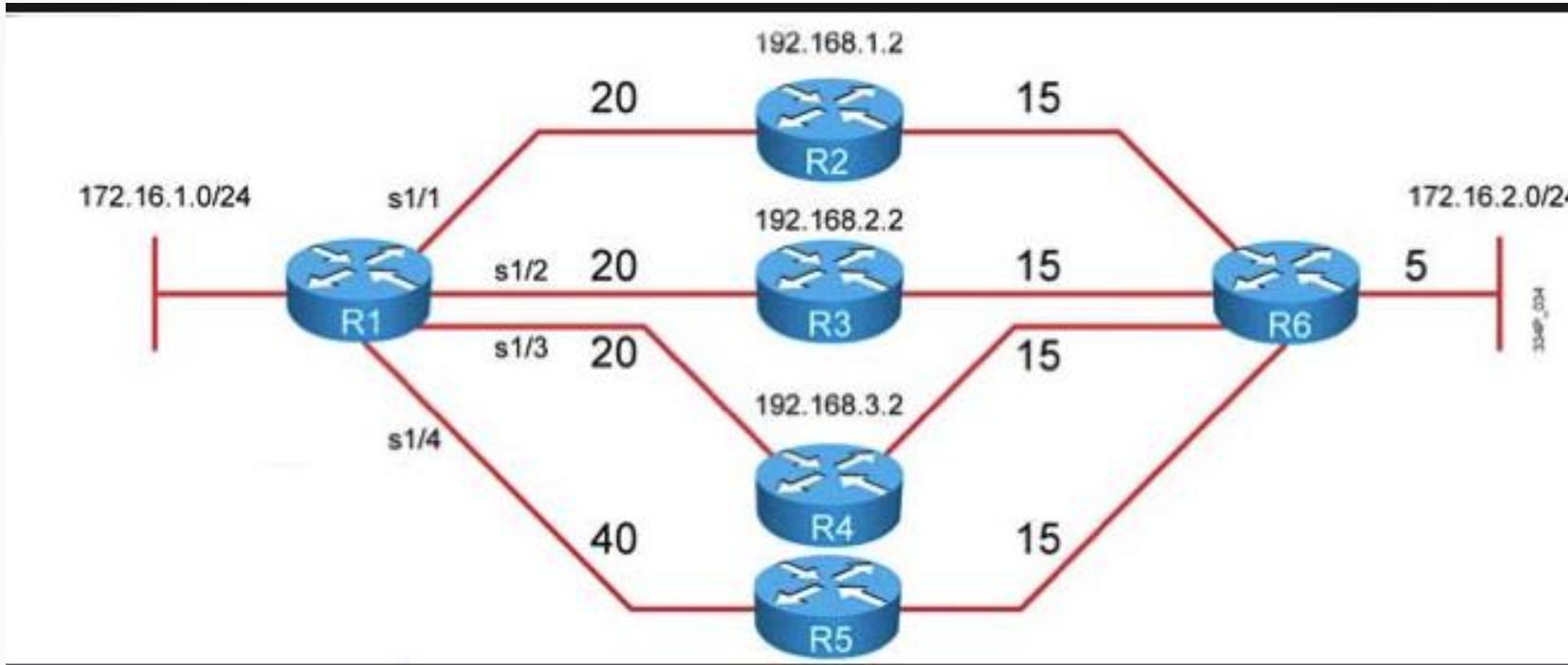
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### EIGRP – Load Balancing

- Routes with a metric equal to the minimum metric are installed in the routing table - equal-metric load balancing.
- Up to 16 entries can be in the routing table for the same destination (default is 4)
- Maximum number is configurable
- To disable load balancing, set the value to one.
- The maximum number of parallel routes that it can support.

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## EIGRP – Load Balancing



Neighbor	FD	AD	Status
R2	$40 = (20+20)$	$20 = 15+5$	Feasible Successor (LB)
R2	$40 = (20+20)$	$20 = 15+5$	Successor
R4	$40 = (20+20)$	$20 = 15+5$	Feasible Successor (LB)
R5	$60 = (40+20)$	$20 = 15+5$	Feasible Successor (LB)

LB depending on Variance

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### EIGRP – Load Balancing Unequal-Cost

- The router can balance traffic across multiple routes that have different metrics to a destination
  - Successor is always used
  - Feasible successors are used if the cost is less than (minimum cost \* variance)
    - Variance is only a multiplier, not a max-path parameter
  - The maximum number of paths is limited by the **maximum-paths** command
    - Variance opens the gate for unequal-cost load balancing

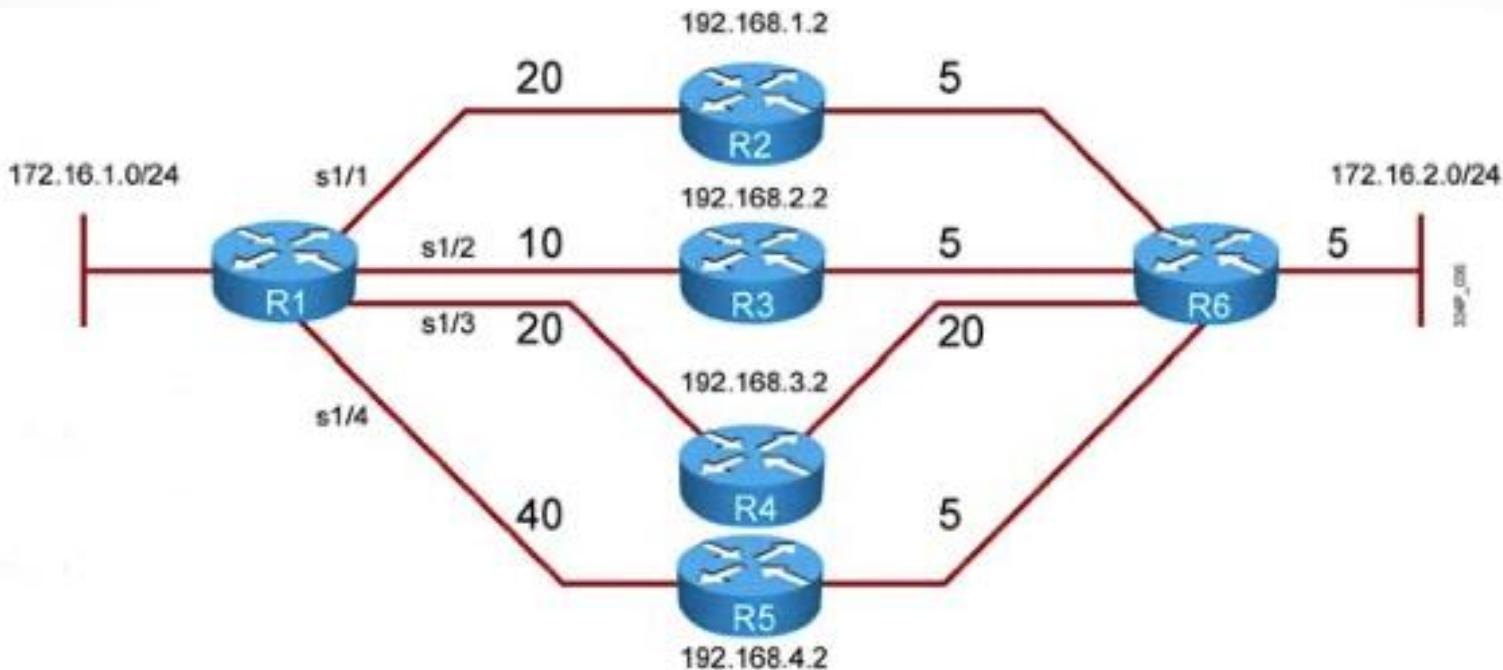
```
R1(config) #
```

```
router eigrp 110
  variance 2
```

- To control load balancing in an internetwork based on EIGRP

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## EIGRP – Load Balancing Unequal-Cost



Neighbor	FD	AD	Status
R2	$30 = (20+10)$	$10 = 5+5$	Feasible Successor (LB)
R2	$20 = (10+10)$	$10 = 5+5$	Successor
R4	$65 = (20+25)$	$25 = 20+5$	$AD > FD_{successor}$
R5	$50 = (40+10)$	$10 = 5+5$	$FD > 2 * FD_{successor}$