RIPv2

Routing Protocols and Concepts – Chapter 7

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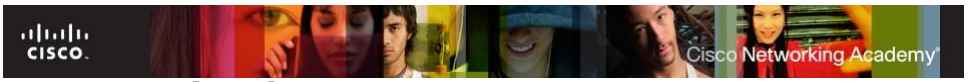
Objectives

- Encounter and describe the limitations of RIPv1's limitations.
- Apply the basic Routing Information Protocol Version 2 (RIPv2) configuration commands and evaluate RIPv2 classless routing updates.
- Analyze router output to see RIPv2 support for VLSM and CIDR
- Identify RIPv2 verification commands and common RIPv2 issues.
- Configure, verify, and troubleshoot RIPv2 in "hands-on" labs



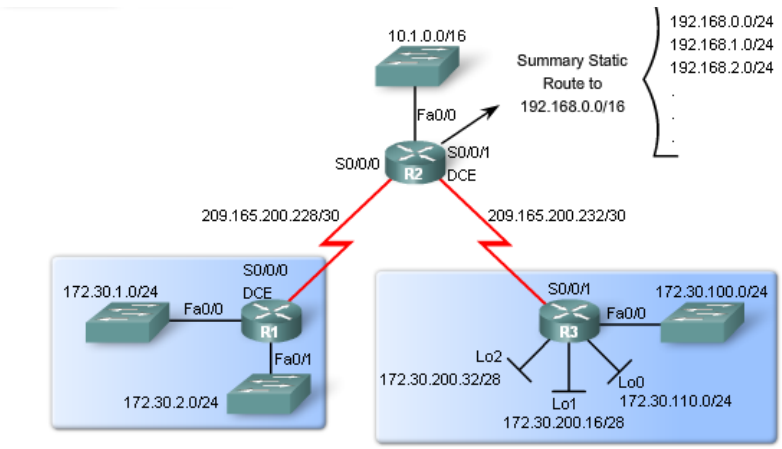
Introduction

- Chapter focus
  - -Difference between RIPv1 & RIPv2
    - RIPv1
      - -A classful distance vector routing protocol
      - -Does not support discontiguous subnets
      - -Does not support VLSM
      - -Does not send subnet mask in routing update
      - -Routing updates are broadcast
    - RIPv2
      - -A classless distance vector routing protocol that is an enhancement of RIPv1's features.
      - -Next hop address is included in updates
      - -Routing updates are multicast
      - -The use of authentication is an option

Introduction

- Similarities between RIPv1 & RIPv2
  - -Use of timers to prevent routing loops
  - -Use of split horizon or split horizon with poison reverse
  - -Use of triggered updates
  - -Maximum hop count of 15

Topology Example



Topology Example

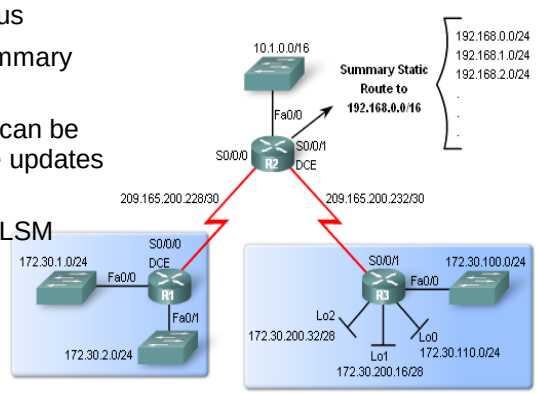
- The figure shows the topology and addressing scheme used in this chapter.
- This scenario is similar to the routing domain with three routers that was used at the end of Chapter 5, "RIPv1."
- Remember that both the R1 and R3 routers have subnets that are part of the 172.30.0.0/16 major classful network (class B).
- Also remember that R1 and R3 are connected to R2 using subnets of the 209.165.200.0/24 major classful network (class C).
- This topology is discontiguous and will not converge because 172.30.0.0/16 is divided by the 209.165.200.0/24.

Summary Route

- The topology shows that R2 has a static summary route to the 192.168.0.0/16 network. The configuration of this summary route will be displayed later in this section.
- The concept and configuration of static summary routes was discussed in Chapter 2, "Static Routing." We can inject static route information into routing protocol updates.
- This is called redistribution and will also be discussed later in this section.
- For now, understand that this summary route will cause problems with RIPv1 because 192.168.0.0/16 is not a major classful address and includes all of the /24 versions of 192.168.0.0/16, as shown in the topology.
- Finally, notice that the R1 and R3 routers contain VLSM networks and are sharing address space from the 172.30.0.0/16 major classful network. Next, we will look at the VLSM addressing scheme.

RIPv1 Limitations

- Lab Topology
- Scenario:
  - 3 router set up
  - Topology is discontiguous
  - There exists a static summary route
  - Static route information can be injected into routing table updates using redistribution.
  - Routers 1 & 3 contain VLSM networks

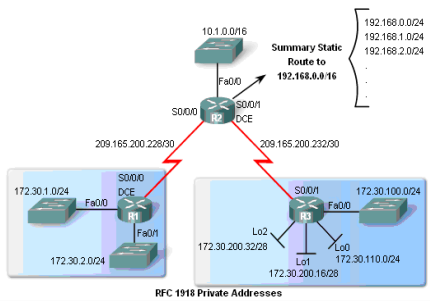


RIPv1 Limitations

- Scenario Continued
- VLSM

  -Recall this is sub netting the subnet
- Private IP addresses are on LAN links
- Public IP addresses are used on WAN links
- Loopback interfaces

  -These are virtual interfaces that can be pinged and added to routing table



RFC 1918 Private Addresses

Class	Prefix/Mask	Address Range
A	10.0.0.0/8	10.0.0.0 to 10.255.255.255
B	172.16.0.0/12	172.16.0.0 to 172.31.255.255
C	192.168.0.0/16	192.168.0.0 to 192.168.255.255

Used for private IP addressing

Cisco Example IP Addresses

Prefix/Mask	Address Range
209.165.200.224/27	209.165.200.224 to 209.165.200.255
209.165.201.0/27	209.165.201.0 to 209.165.201.31
209.165.202.128/27	209.165.202.128 to 209.165.202.159

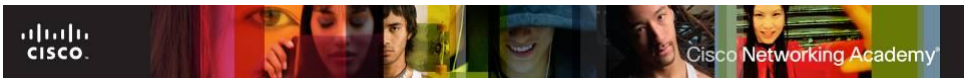
Used for public IP addressing when needed for example purposes.

VLSM Addressing Scheme

Assigned to	Subnet	Network	Host Range	Broadcast	
	0	172.30.0.0	172.30.0.1 to 172.30.0.254	172.30.0.255	
R1 Fa0/0	1	172.30.1.0	172.30.1.1 to 172.30.1.254	172.30.1.255	
R1 Fa0/1	2	172.30.2.0	172.30.2.1 to 172.30.2.254	172.30.2.255	
	3	172.30.3.0	172.30.3.1 to 172.30.3.254	172.30.3.255	
	4	172.30.4.0	172.30.4.1 to 172.30.4.254	172.30.4.255	
	.				
R3 Fa0/0	100	172.30.100.0	172.30.100.1 to 172.30.100.254	172.30.100.255	256 /24 subnets
	.				
R3 Lo0	110	172.30.110.0	172.30.110.1 to 172.30.110.254	172.30.110.255	
	.				
ubnetted Again	200	172.30.200.0	172.30.200.1 to 172.30.200.254	172.30.200.255	
	.				
	255	172.30.255.0	172.30.255.1 to 172.30.255.254	172.30.255.255	

Subnet	Network	Host Range	Broadcast	
0	172.30.200.0	172.30.200.1 to 172.30.200.14	172.30.200.15	
1	172.30.200.16	172.30.200.17 to 172.30.200.30	172.30.200.31	R3 Lo1
2	172.30.200.32	172.30.200.33 to 172.30.200.46	172.30.200.47	R3 Lo2
3	172.30.200.48	172.30.200.49 to 172.30.200.62	172.30.200.63	
.				
15	172.30.200.240	172.30.200.241 to 172.30.200.254	172.30.200.255	

16 /28 subnets

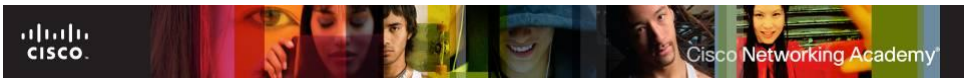


VLSM

- Review the VLSM addressing scheme in the figure.
- As shown in the top chart, both R1 and R3 have had the 172.30.0.0/16 network subnetted into /24 subnets.
- Four of these /24 subnets are assigned: two to R1 (172.30.1.0/24 and 172.30.2.0/24) and two to R3 (172.30.100.0/24 and 172.30.110.0/24).
- In the bottom chart, we have taken the 172.30.200.0/24 subnet and subnetted it again, using the first four bits for subnets and the last four bits for hosts.
- The result is a 255.255.255.240 mask or /28. Subnet 1 and Subnet 2 are assigned to R3.
- This means that the subnet 172.30.200.0/24 can no longer be used even though the remaining /28 subnets can be used.

Loopback Interfaces

- Notice that R3 is using loopback interfaces (Lo0, Lo1, and Lo2).
- A loopback interface is a software-only interface that is used to emulate a physical interface.
- Like other interfaces, it can be assigned an IP address. Loopback interfaces are also used by other routing protocols, such as OSPF, for different purposes.
- In a lab environment, loopback interfaces are useful in creating additional networks without having to add more physical interfaces on the router.
- A loopback interface can be pinged and the subnet can be advertised in routing updates. Therefore, loopback interfaces are ideal for simulating multiple networks attached to the same router.

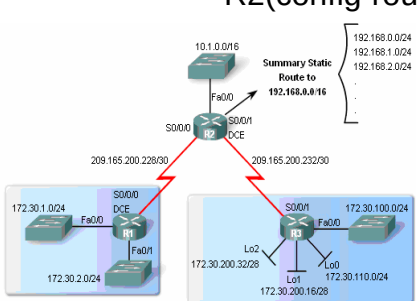


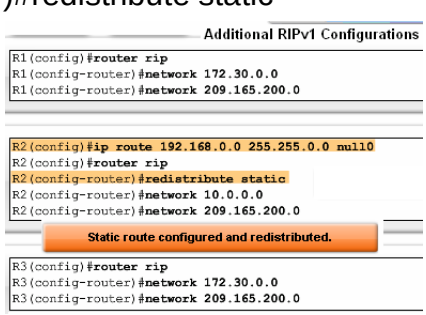
RIPv1 Limitations

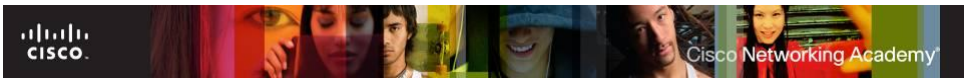
- **Null Interfaces**
  - This is a virtual interface that does not need to be created or configured
    - -Traffic sent to a null interface is discarded
    - -Null interfaces do not send or receive traffic
- **Static routes and null interfaces**
  - null interfaces will serve as the exit interface for static route
    - -Example of configuring a static supernet route with a null interface
    - -R2(config)#ip route 192.168.0.0 255.255.0.0 Null0

RIPv1 Limitations

- **Route redistribution**
  - -Redistribution command is way to disseminate a static route from one router to another via a routing protocol
  - -Example
    - R2(config-router)#redistribute static







RIPv1 Limitations

- Verifying and Testing Connectivity

  Use the following commands:

  - show ip interfaces brief
  - ping
  - traceroute

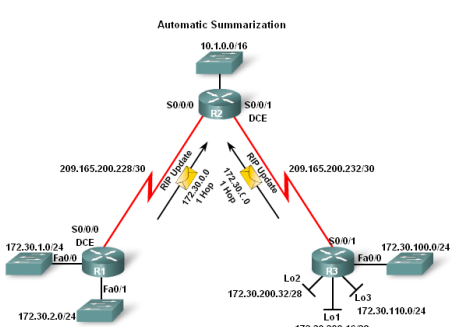
RIPv1 Limitations

- **RIPv1 –** a classful routing protocol

  -Subnet mask **are not sent** in updates

  -Summarizes networks at major network boundaries

  -if network is discontiguous and RIPv1 configured convergence
  will not be reached



RIPv1 Limitations

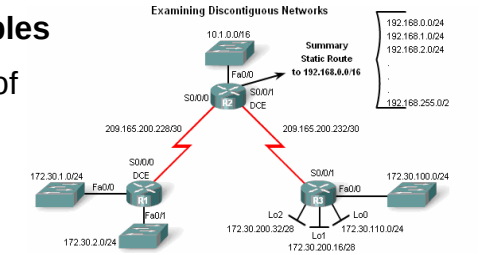
- **Examining the routing tables**

  -To examine the contents of routing updates use the

  debug ip rip command

  -If RIPv1 is configured then

  Subnet masks will not be included with the network address



R2 is not advertising 172.30.0.0 to R1 or R3.

```
R2#debug ip rip
RIP protocol debugging is on

RIP: received v1 update from 209.165.200.230 on Serial0/0/0
     172.30.0.0 in 1 hops
RIP: received v1 update from 209.165.200.234 on Serial0/0/1
     172.30.0.0 in 1 hops
R2#
RIP: sending v1 update to 255.255.255.255 via Serial0/0/0 (209.165.200.229)
RIP: build update entries
        network 10.0.0.0 metric 1
        subnet 209.165.200.232 metric 1
RIP: sending v1 update to 255.255.255.255 via Serial0/0/1 (209.165.200.233)
RIP: build update entries
        network 10.0.0.0 metric 1
        subnet 209.165.200.228 metric 1
```

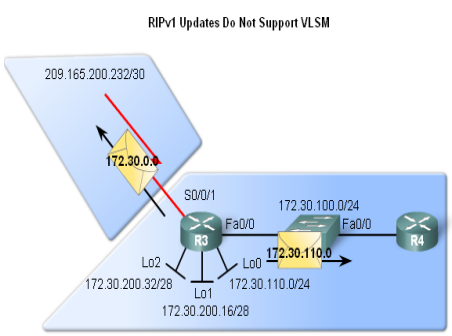

RIPv1 Limitations

- RIPv1 does not support VLSM

  Reason: RIPv1 does not send subnet mask in routing updates

- RIPv1 does summarize routes to the Classful boundary

  Or uses the Subnet mask of the outgoing interface to determine which subnets to advertise



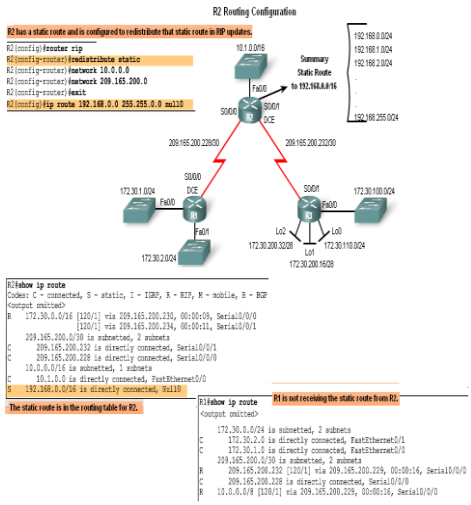

```
R3#debug ip rip
RIP protocol debugging is on
RIP: sending v1 update to 255.255.255.255 via FastEthernet0/0 (172.30.100.1)
RIP: build update entries
        network 10.0.0.0 metric 2
        subnet 172.30.110.0 metric 1
        network 209.165.200.0 metric 1
RIP: sending v1 update to 255.255.255.255 via Serial0/0/1 (209.165.200.234)
RIP: build update entries
        network 172.30.0.0 metric 1
```

Because 172.30.110.0 has the same subnet mask as the outgoing interface on 172.30.100.0, R3 includes 172.30.110.0 in updates to R4.

RIPv1 Limitations

- No CIDR Support
- In the diagram R2 will not include the static route in its update

  Reason: Classful routing protocols do not support CIDR routes that are summarized with a smaller mask than the classful subnet mask

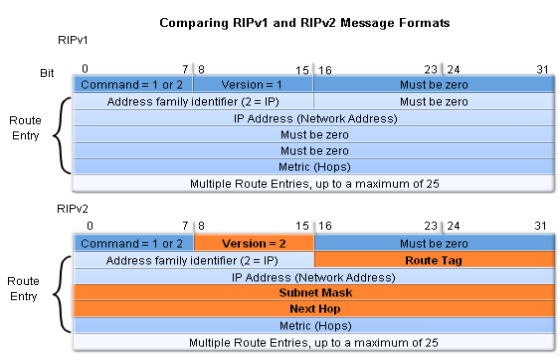


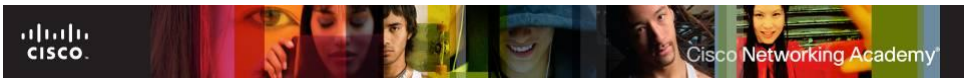
Configuring RIPv2

- **Comparing RIPv1 & RIPv2 Message Formats**

  -RIPv2 Message format is similar to RIPv1 but has 2 extensions

  - 1st extension is the subnet mask field
  - 2nd extension is the addition of next hop address





RIPv2 Extensions

1. The first extension in the RIPv2 message format is the subnet mask field that allows a 32 bit mask to be included in the RIP route entry. As a result, the receiving router no longer depends upon the subnet mask of the inbound interface or the classful mask when determining the subnet mask for a route.
2. The second significant extension to the RIPv2 message format is the addition of the Next Hop address. The Next Hop address is used to identify a better next-hop address - if one exists - than the address of the sending router. If the field is set to all zeros (0.0.0.0), the address of the sending router is the best next-hop address.

Configuring RIPv2

- Enabling and Verifying RIPv2
- Configuring RIP on a Cisco router

  By default it is running RIPv1

Configuring RIPv2

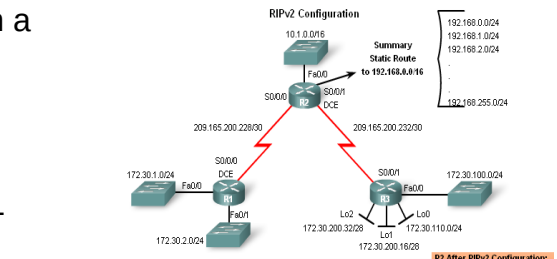
- Configuring **RIPv2** on a Cisco router

  -Requires using the ***version 2*** command

  -RIPv2 ignores RIPv1 updates

- To verify RIPv2 is configured use the

  show ip protocols command



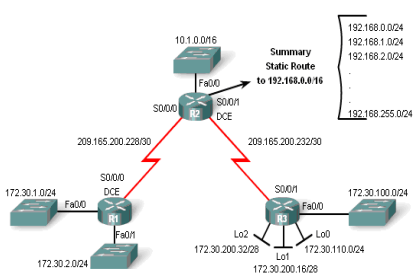

```
R1(config)#router rip
R1(config-router)#version 2

R2(config)#router rip
R2(config-router)#version 2

R3(config)#router rip
R3(config-router)#version 2
```

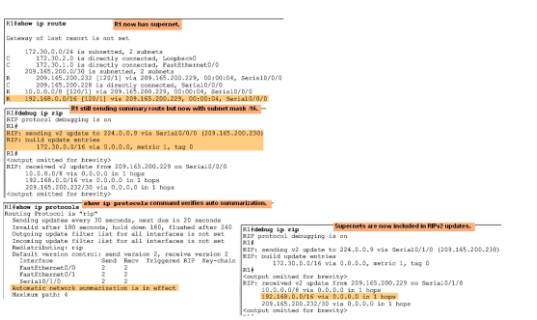
R2 After RIPv2 Configuration:
RIPv2 ignores RIPv1 updates

```
R2#show ip protocols
Routing Protocol is "rip"
  Sending updates every 30 seconds, next due in 1 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Outgoing update filter list for all interfaces is
  Incoming update filter list for all interfaces is
  Redistributing: static, rip
  Default version control: send version 2, receive version 2
    Interface              Send  Recv  Triggered RIP  Key-chain
    Serial0/0/0            2     2
    Serial0/0/1            2     2
  Automatic network summarization is in effect
  Routing for Networks:
    10.0.0.0
    209.165.200.0
  Passive Interface(s):
    FastEthernet0/0
  Routing Information Sources:
    Gateway         Distance      Last Update
    209.165.200.234         120      00:00:03
    209.165.200.230         120      00:00:17
  Distance: (default is 120)
```


Configuring RIPv2

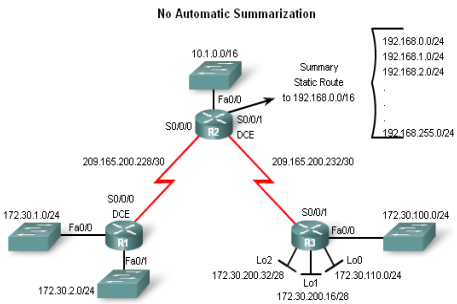
- Auto-Summary & RIPv2
- RIPv2 will automatically summarize routes at major network boundaries and can also summarize routes with a subnet mask that is smaller than the classful subnet mask





Configuring RIPv2

- Disabling Auto-Summary in RIPv2
- To disable automatic summarization issue the *no auto-summary* command




```
R1(config)#router rip
R1(config-router)#no auto-summary
R1(config-router)#end
R1#show ip protocols
Routing Protocol is "rip"
<output omitted for brevity>
  Default version control: send version 2, receive version 2
    Interface              Send  Recv  Triggered RIP  Key-chain
    FastEthernet0/0        2     2
    FastEthernet0/1        2     2
    Serial0/1/0            2     2
  Automatic network summarization is not in effect
  <output omitted for brevity>
```

```
R2(config)#router rip
R2(config-router)# no auto-summary
```

```
R3(config)#router rip
R3(config-router)#no auto-summary
```


Configuring RIPv2

- Verifying RIPv2 Updates
- When using RIPv2 with automatic summarization turned off

  Each subnet and mask has its own specific entry, along with the exit interface and next-hop address to reach that subnet.
- To verify information being sent by RIPv2 use the

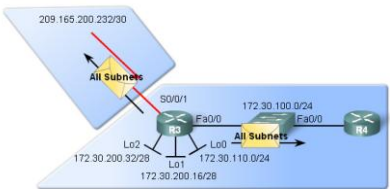
  debug ip rip command

VLSM & CIDR

- RIPv2 and VLSM
- Networks using a VLSM IP addressing scheme

  Use classless routing protocols (i.e. RIPv2) to disseminate network addresses and their subnet masks

R3 Debug Output



R3 Debug Output

```
R3#debug ip rip
RIP protocol debugging is on
R3#
RIP: received v2 update from 209.165.200.233 on Serial0/0/1
     10.1.0.0/16 via 0.0.0.0 in 1 hops
     172.30.1.0/24 via 0.0.0.0 in 2 hops
     172.30.2.0/24 via 0.0.0.0 in 2 hops
     192.168.0.0/16 via 0.0.0.0 in 1 hops
     209.165.200.228/30 via 0.0.0.0 in 1 hops
R3#
RIP: sending v2 update to 224.0.0.9 via FastEthernet0/0 (172.30.100.1)
RIP: build update entries
        10.1.0.0/16 via 0.0.0.0, metric 2, tag 0
        172.30.1.0/24 via 0.0.0.0, metric 3, tag 0
        172.30.2.0/24 via 0.0.0.0, metric 3, tag 0
        172.30.110.0/24 via 0.0.0.0, metric 1, tag 0
        172.30.200.16/28 via 0.0.0.0, metric 1, tag 0
        172.30.200.32/28 via 0.0.0.0, metric 1, tag 0
        192.168.0.0/16 via 0.0.0.0, metric 2, tag 0
        209.165.200.228/30 via 0.0.0.0, metric 2, tag 0
        209.165.200.232/30 via 0.0.0.0, metric 1, tag 0
RIP: sending v2 update to 224.0.0.9 via Serial0/0/1 (209.165.200.234)
RIP: build update entries
        172.30.100.0/24 via 0.0.0.0, metric 1, tag 0
        172.30.110.0/24 via 0.0.0.0, metric 1, tag 0
        172.30.200.16/28 via 0.0.0.0, metric 1, tag 0
        172.30.200.32/28 via 0.0.0.0, metric 1, tag 0
```

RIPv2 supports VLSM

VLSM & CIDR

- CIDR uses Supernetting

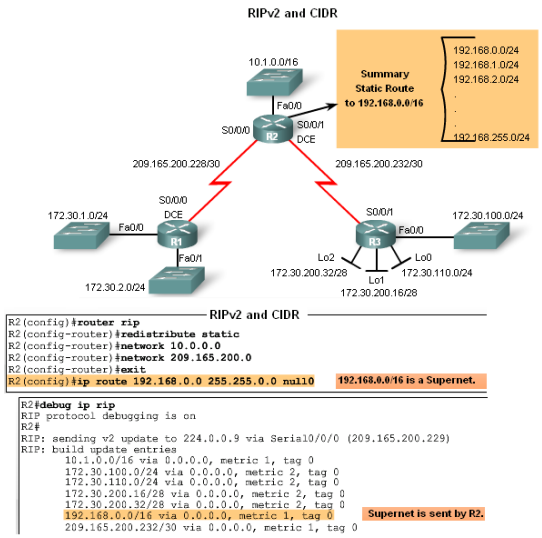
  Supernetting is a bunch of contiguous classful networks that is addressed as a single network.

VLSM & CIDR

- To **verify** that **supernets** are being sent and received use the following commands

  -Show ip route

  -Debug ip rip



Verifying & Troubleshooting RIPv2

- **Basic Troubleshooting** steps

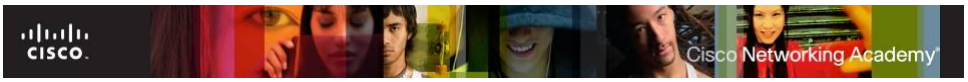
  -Check the status of all links

  -Check cabling

  -Check IP address & subnet mask configuration

  -Remove any unneeded configuration commands

- Commands used to verify proper operation of RIPv2
  - Show ip interfaces brief
  - Show ip protocols
  - Debug ip rip
  - Show ip route



Verifying & Troubleshooting RIPv2

- Common RIPv2 Issues
- When trouble shooting RIPv2 examine the following issues:
  - Version

    Check to make sure you are using version 2
  - Network statements

    Network statements may be incorrectly typed or missing
  - Automatic summarization

    If summarized routes are not needed then disable automatic summarization

Verifying & Troubleshooting RIPv2

- Reasons why it's good to authenticate routing information

  -Prevent the possibility of accepting invalid routing updates

  -Contents of routing updates are encrypted
- Types of routing protocols that can use authentication

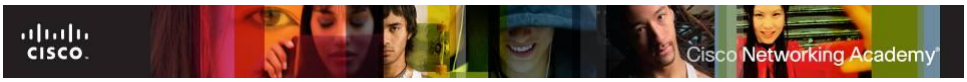
  -RIPv2

  -EIGRP

  -OSPF

  -IS-IS

  -BGP



Summary

Routing Protocol	Distance Vector	Classless Routing Protocol	Uses Hold-Down Timers	Use of Split Horizon or Split Horizon w/ Poison Reverse	Max Hop count = 15	Auto Summary	Support CIDR	Supports VLSM	Uses Authen-tication
RIPv1	Yes	No	Yes	Yes	Yes	Yes	No	No	No
RIPv2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes