Cabrillo College

CCNP – Advanced Routing
Ch. 3 Routing Overview

Rick Graziani, Instructor

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Note

- This chapter is just a brief overview of some routing concepts.
- Most of these will be discussed further when discussing specific routing protocols.
- There are several concepts I discuss here which are not part of the CCNP curriculum but which will help the student understand route processing.
- **Instructors**: If you have any questions or comments, please email me, Rick Graziani, at graziani@cabrillo.cc.ca.us

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Topics

- Commands and interfaces for CCNP
- Routing Table – show ip route
  - See presentation: **The Routing Table – Structure, Lookup Process and the ip classless command**
- Static Routing
  - Configuring
  - Recursive Lookups
  - Rule of Thumb
    - Point-to-point links
    - Broadcast links
  - Static Routes and the permanent option
  - Processing of Static Routes
  - Advantages and Disadvantages of Static Routing
  - Advantages and Disadvantages of Dynamic Routing
  - Final Note on Static Routes
- Default Routes
  - Quad-zero routes
  - ip default-network command
- Floating Static Routes
- ip default-gateway command
- Discard Routes – Avoiding Routing Loops (separate presentation)

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Nice to know commands and interface specifics...

Some of you may be new to our lab so let's review some commands to make life a little easier for you and also take a look at the interfaces on the 1700 and 2600 series routers.

- **logging synchronous command**
- **exec-timeout 0 0 command**
- **Fastethernet interfaces**
- **Serial interfaces**
- **clock rate command**
- **no keepalive command**
- **show ip interface brief command**

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logging synchronous Command

Making it easier to view debug and error messages

- **This command will keep debug messages and other messages from interrupting your command input.**

```
Router(config)#line con 0
Router(config-line)#logging synchronous
Router(config-line)#
```

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Example:

```
Router# debug ip packet
IP: s=172.16.13.44 (Fddi0), d=10.125.254.1 (Serial2), g=172.16.16.2, forward
IP: s=172.16.1.57 (Ethernet4), d=10.36.125.2 (Serial2), g=172.16.16.2, forward
RouIP: s=172.16.1.6 (Ethernet4), d=255. ter>255.255.255, rcvd 2
IP: s=172.16.1.55 (Ethernet4), d=172.16.2.42 (Fddi0), g=172.16.13.6, forward
IP: s=172.16.89.33 (Ethernet2), ud=10.130.2.156n (Serial2), g=172.16.16.2, forward
IP: des=172.16.1.27 (Ethernet4), d=172.16.43.126 (Fddi1), g=172.16.23.5, forward
IP: s=172.16.1.27 (Ethernet4), d=172.16.43.126 (Fddi0), g=172.16.13.6, forward
IP: s=172.16.20.32 (Ethernet2), d=255.255.255.255, rcvd 2
IP: s=172.16.1.57 (Ethebugrnet4), d=10.36.125.2 (Serial2), g=172.16.16.2, access
    denied
IP: s=172.16.13.44 (Fddi0), d=10.125.254.1 (Serial2), g=172.16.16.2, forward
IallP: s=172.16.1.57 (Ethernet4), d=10.36.125.2 (Serial2), g=172.16.16.2, forward
IP: s=172.16.1.6 (Ethernet4), d=255.255.255.255, rcvd 2
Router#
```

- We are entering the command “undebug all”
- The debug output continuously interrupt and mixes in with our command-line input.
- This does not affect our input, but makes it more difficult to do.

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Example:

```
Router(config)#line con 0
Router(config-line)#logging synchronous
Router(config-line)#end
Router# debug ip packet
IP: s=172.16.13.44 (Fddi0), d=10.125.254.1 (Serial2), g=172.16.16.2, forward
IP: s=172.16.1.57 (Ethernet4), d=10.36.125.2 (Serial2), g=172.16.16.2, forward
Router>
IP: s=172.16.1.6 (Ethernet4), d=255. 255.255.255, rcvd 2
IP: s=172.16.1.55 (Ethernet4), d=172.16.2.42 (Fddi0), g=172.16.13.6, forward
IP: s=172.16.89.33 (Ethernet2), d=10.130.2.156 (Serial2), g=172.16.16.2, forward
Router> und
IP: s=172.16.1.27 (Ethernet4), d=172.16.43.126 (Fddi1), g=172.16.23.5, forward
IP: s=172.16.1.27 (Ethernet4), d=172.16.43.126 (Fddi0), g=172.16.13.6, forward
Router> undebug
IP: s=172.16.20.32 (Ethernet2), d=255.255.255.255, rcvd 2
IP: s=172.16.1.57 (Ethernet4), d=10.36.125.2 (Serial2), g=172.16.16.2, access denied
Router> undebug all
IP: s=172.16.13.44 (Fddi0), d=10.125.254.1 (Serial2), g=172.16.16.2, forward
IP: s=172.16.1.57 (Ethernet4), d=10.36.125.2 (Serial2), g=172.16.16.2, forward
IP: s=172.16.1.6 (Ethernet4), d=255.255.255.255, rcvd 2
Router#
```

- With logging synchronous.
- I suggest having this command as part of every standard router config.

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exec-timeout 0 0 command

```
Router(config)#line con 0
Router(Config-line)#exec-timeout 0 0
```

- This is not a good idea for a production router but is helpful in a lab environment.
- This will keep the router from exiting to user mode or exiting out completely if there hasn't been any command-line input after a certain amount of time.
- The paramaters after the command are <*minutes*> <*seconds*>.

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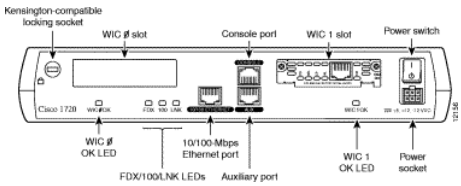
Fastethernet interfaces - 1700




```
Router(config)#interface fastethernet 0
Router(config-if)#
```

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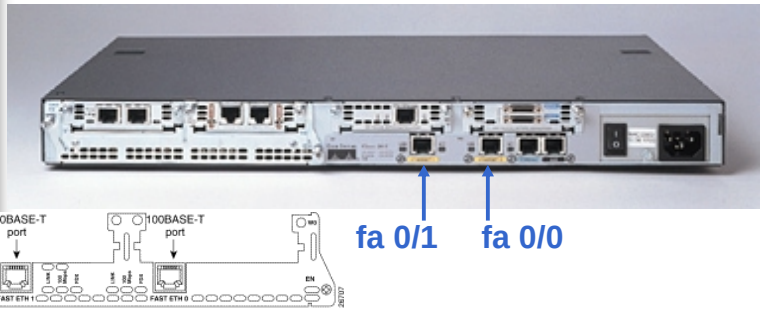
Fastethernet interfaces - 2600



Cisco 2600's have fastethernet interfaces (10/100 Mbps)

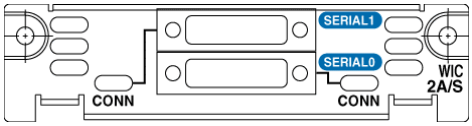
- The first slot is slot 0, with ports 0 and 1

```
Router(config)#interface type slot/port
```

Cisco 2600 (2620: fa 0/0, 2621: fa 0/0 and fa 0/1)

```
Router(config)#interface fastethernet 0/0
Router(config-if)#
Router(config)#interface fastethernet 0/1
Router(config-if)#
```

Serial interfaces - 1700




```
Router(config)#interface serial 0
Router(config-if)#
Router(config)#interface serial 1
Router(config-if)#
```

Note: If there two WIC 2A/S cards, the second card contains serial 2 and serial 3.

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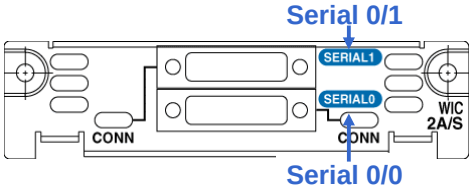
Serial interfaces - 2600




```
Router(config)#interface type slot/port

Router(config)#interface serial 0/0
Router(config-if)#
Router(config)#interface serial 0/1
Router(config-if)#
```

Note: If there two WIC 2A/S cards, the second card contains serial 0/2 and serial 0/3.

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WIC 2A/S Cables

Our WIC 2A/S interfaces have "smart serial" connectors.

Make sure the wider side is up when connecting to the router!

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Serial Interfaces and clock rate

Lab

Real world

- In a real-world network, your router's serial interface would be connected to a CSU/DSU or perhaps have it already imbedded in the router's interface.
- A DCE cable would then be connected between the serial interface and the CSU/DSU.
- In our labs, we are not using a CSU/DSU, so one end of the cable will be a DCE cable.
- The router which has the DCE cable attached to it must provide the clocking for both ends.
- To do this the, the router with the DCE cable must use the clock rate command on that interface.
- This will be discussed in further detail in Semester 4 and CCNP Remote Access.

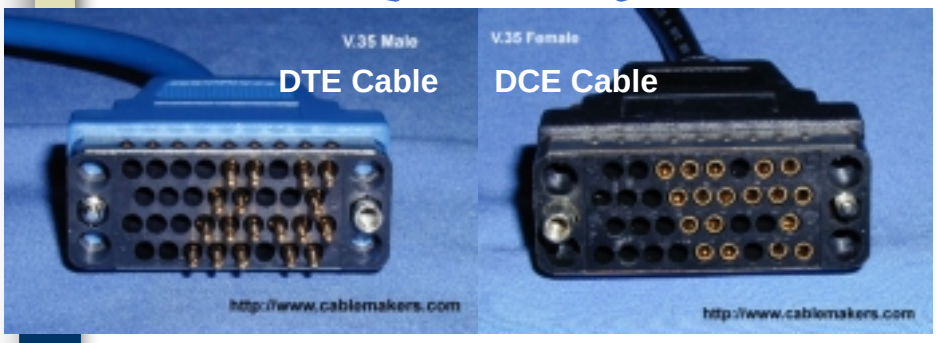
Serial Interfaces and clock rate


```
RouterB(config)#inter serial 1
RouterB(config-if)#clock rate ?
        Speed (bits per second)
  1200
  2400
  4800
  9600
  19200
  38400
  56000
  64000
  <text omitted>
  2000000
  4000000

  <300-4000000>    Choose clockrate from list above

RouterB(config-if)#clock rate 64000
RouterB(config-if)#
```

Serial Interfaces and clock rate



How can you tell which end is the DTE and which end is the DCE?

- Look at the label on the cable.
- Look at the connecter between the two cables - The DTE cable will always be male and the DCE cable will always be female.

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Serial Interfaces and clock rate


```
RouterA#show controllers serial 0
HD unit 0, idb = 0xECA4C, driver structure at 0xF1EC8
buffer size 1524  HD unit 0, V.35 DTE cable
cpb = 0x62, eda = 0x403C, cda = 0x4050
RX ring with 16 entries at 0x624000
00 bd_ptr=0x4000 pak=0x0F5704 ds=0x62FFB8 status=80 pak_size=22
```

This is one of few commands where there must be a space between the interface type and the port.

```
RouterB#show controllers serial 0
buffer size 1524  HD unit 0, V.35 DCE cable, clockrate 64000
cpb = 0x62, eda = 0x408C, cda = 0x40A0
RX ring with 16 entries at 0x624000
00 bd_ptr=0x4000 pak=0x0F2F04 ds=0x627908 status=80 pak_size=22
```

How can you tell which end is the DTE and which end is the DCE?

- Use the show controllers command!
- It will also tell you the type of cable, in our labs we will be using a V.35 cable.

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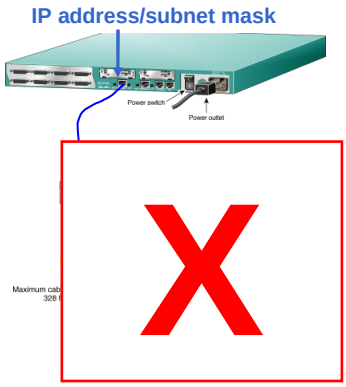
no keepalive command




```
Router(config)#inter fa 0/0
Router(config-if)#no keepalive
Router(config-if)#ip add ...
Router(config-if)#no shutdown
```

- For a LAN interface to be “up” and “up” it must be connected to a hub or switch.
- However, **for lab purposes only** we can use the no keepalive command instead of using a hub or switch (only on ethernet and fastethernet interfaces – **not serial interfaces**).
- This only works if you do not plan on having any hosts attached to this LAN.

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show ip interface command

```
Router# show ip interface brief
```

Great command!

```
Interface    IP-Address      OK?  Method     Status                  Protocol
Ethernet0    131.108.1.11    YES  manual     up                      up
Serial0      198.135.2.49    YES  manual     administratively down   down
```

Notes

- A great command to show the status of all the router's interfaces!
- A serial interface will not show "up" and "up" unless both ends are properly configured.
- If one router's configuration looks okay, check the other router's configuration.

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Routing Table – show ip route

- See presentation: **The Routing Table – Structure, Lookup Process and the ip classless command**
- **Instructors** – This presentation is on the CCNP Instructor Portal or accessed via my web site: http://www.cabrillo.cc.ca.us/~rgraziani/courses/ccnp_sem5.html

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Routing

Routes enter the routing table via:

- **static routing** - Administrator manually defines routes to a destination network.
- **dynamic routing** - Routers follow rules defined by a routing protocol to exchange routing information and independently select the best path.

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Static Routing

- Most of this should be a review from CCNA.
- We will mention a few concepts which might not have been discussed in your CCNA class.
- We will look at static routes again when we discuss default routing and floating static routes.

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Configuring Static Routes

RTR(config)# ip route *prefix mask* {*address* | *interface*} [*distance*] [**tag** *tag*] [**permanent**]

- **prefix** IP route prefix for the destination.
- **mask** Prefix mask for the destination.
- **address** IP address of the “next hop” that can be used to reach that network.
- **interface** Network interface to use (exit-interface)
- **distance** (Optional) An administrative distance.
- **tag** *tag* (Optional) Tag value that can be used as a "match" value for controlling redistribution via route maps. (CCNP Advanced Routing)
- **Permanent** (Optional) Specifies that the route will not be removed, even if the interface shuts down. (CCNP Advanced Routing)

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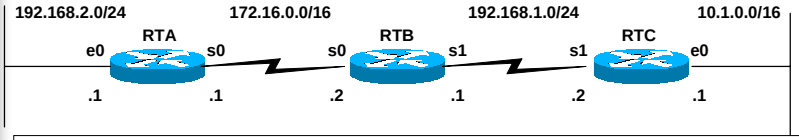
Configuring Static Routes




```
RTA(config)#ip route 192.168.1.0 255.255.255.0 172.16.0.2
```

Network/subnet route

Intermediate-Address (usually “next-hop”)

```
RTA#show ip route
Codes: C - connected, S - static,
C    172.16.0.0/16 is directly connected, Serial0
S    192.168.1.0/24 [1/0] via 172.16.0.2
C    192.168.2.0/24 is directly connected, Ethernet0
```

Basic static route example

- Be sure to use the proper subnet mask!

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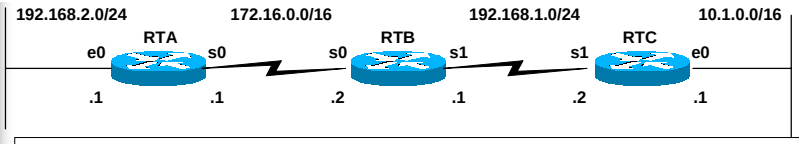
Configuring Static Routes




```
RTA(config)#ip route 192.168.1.0 255.255.255.0 172.16.0.2

RTA#show ip route
Codes: C - connected, S - static,
C    172.16.0.0/16 is directly connected, Serial0
S    192.168.1.0/24 [1/0] via 172.16.0.2
C    192.168.2.0/24 is directly connected, Ethernet0
```

Basic static route example (continued)

- **[1/0] – [Administrative Distance / Metric]**
- **Administrative Distance** – This is the "trustworthiness" of the routing information. The default administrative distance of static routes is 1.
- The Administrative Distance of a directly connected route is 0.
- Lower the AD the more trustworthy.
- If the router learns about a route to a network from more than one source, it will install the route with the lower administrative distance in the routing table.

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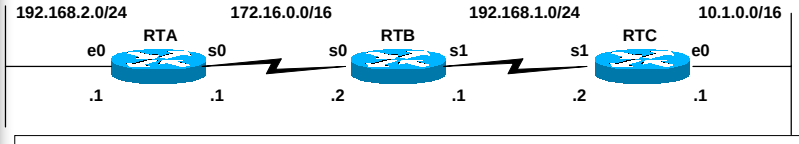
Configuring Static Routes




```
RTA(config)#ip route 192.168.1.0 255.255.255.0 172.16.0.2

RTA#show ip route
Codes: C - connected, S - static,
C    172.16.0.0/16 is directly connected, Serial0
S    192.168.1.0/24 [1/0] via 172.16.0.2
C    192.168.2.0/24 is directly connected, Ethernet0
```

Basic static route example (continued)

- **[1/0] – [Administrative Distance / Metric]**
- **Metric** – This is the "cost" of getting to this route, I.e. how far away this network is.
- The lower the cost, the closer the network.
- Static routes always show a cost of "0" even if it was configured with the intermediate address is multiple-hops away.
- **Much more later**.

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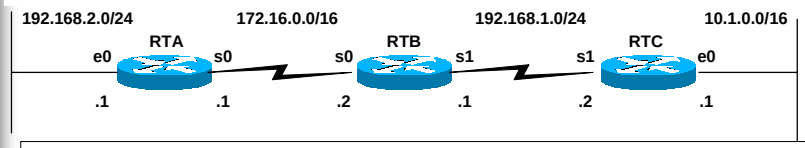
Configuring Static Routes




```
RTA(config)#ip route 192.168.1.0 255.255.255.0 172.16.0.2

RTA#show ip route
Codes: C - connected, S - static,
C    172.16.0.0/16 is directly connected, Serial0
S    192.168.1.0/24 [1/0] via 172.16.0.2
C    192.168.2.0/24 is directly connected, Ethernet0
```

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Recursive Lookup

- The router knows it can get to 192.168.1.0/24 network by forwarding the packets to the router at the ip address of 172.16.0.2
- How does the router know how to get to the ip address 172.16.0.2?
- It does a recursive lookup – first (1) by looking up the 192.168.1.0/24 network and finding it needs to forward the packet to 172.16.0.2 – the router then (2) looks up the 172.16.0.0 network and sees it can forward it out the interface Serial 0.

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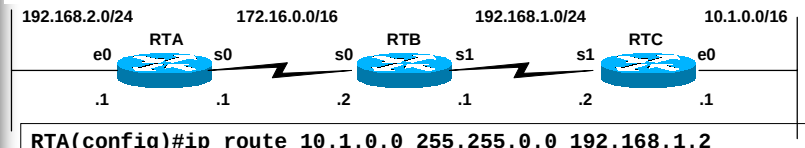
Configuring Static Routes




```
RTA(config)#ip route 10.1.0.0 255.255.0.0 192.168.1.2

RTA#show ip route
Codes: C - connected, S - static,
C    172.16.0.0/16 is directly connected, Serial0
S    192.168.1.0/24 [1/0] via 172.16.0.2
S    10.1.0.0/16 [1/0] via 192.168.1.2
C    192.168.2.0/24 is directly connected, Ethernet0
```

3
2
1

Recursive Lookup (continued)

- We can take this even further.
- One route can be used to resolve the route of another.
- It doesn't matter how the routes are resolved, whether they are directly connected, static or dynamic.
- Here is another example of recursive route lookups (Note: this configuration is used to demonstrate recursive route lookups and not necessarily how you would configure these routes.)
- Note: If an intermediate address cannot be resolved, that route and any routes it affects are not installed in the routing table.

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Note regarding recursive route lookups

- Every route that does not reference an exit-interface must finally be resolved via a route with an interface descriptor reference in the corresponding path descriptor – a route with an exit-interface.
- Static routes cannot be recursively resolved and will not be in the routing table.
- Consider these three static routes:

```
Route1:  ip route 10.1.0.0 255.255.0.0 20.1.1.1
Route2:  ip route 20.1.0.0 255.255.0.0 30.1.1.1
Route3:  ip route 30.1.0.0 255.255.0.0 10.1.1.1
```

- Route1 is resolved by Route2 which is resolved by Route3.
- None of these routes are finally resolved via a route with an exit-interface.
- This leads to endless recursion.
- The routing table process will not permit these static routes to be entered in the routing table.
- Note: Static default routes (coming soon) can never be resolved via another default route. (later)

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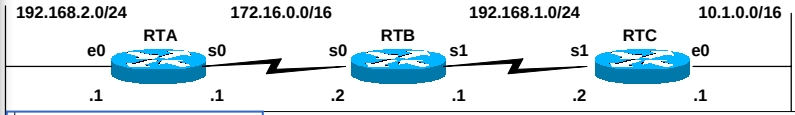
Configuring Static Routes




```
RTA#debug ip routing
IP routing debugging is on

RTA#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
RTA(config)#ip route 192.168.1.0 255.255.255.0 172.16.0.2
05:53:48: RT: add 192.168.1.0/24 via 172.16.0.2, static metric [1/0]

RTA(config)#ip route 10.1.0.0 255.255.0.0 172.16.0.2
05:54:38: RT: add 10.1.0.0/16 via 172.16.0.2, static metric [1/0]

RTA(config)#undebug all
```

Static Routes and the Routing Table Process

- Notice that the static route is entered into the routing table by the routing table process (debug ip routing) with a metric of 0.

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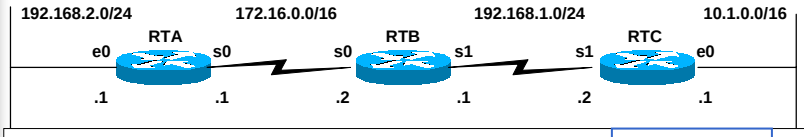
Static routes via point-to-point links




```
RTA(config)#ip route 192.168.1.0 255.255.255.0 serial 0

RTA#show ip route
Codes: C - connected, S - static,
C    172.16.0.0/16 is directly connected, Serial0
S    192.168.1.0/24 is directly connected, Serial0
C    192.168.2.0/24 is directly connected, Ethernet0
```

- Need only to use only an exit interface.
- For point-to-point serial interfaces, the next-hop address in the routing table is never used by the packet-delivery procedure, so it is not needed. (It could even reference a bogus IP address.)
- Notice that the static route appears in the routing table as **directly connected**, however it is still a static route with an administrative distance of 1.

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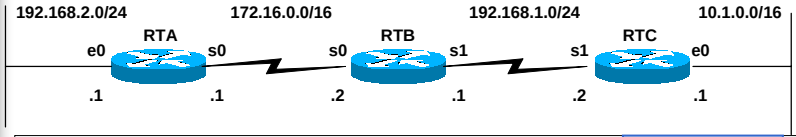
Configuring Static Routes




```
RTA(config)#ip route 192.168.1.0 255.255.255.0 172.16.0.2

RTA#show ip route
Codes: C - connected, S - static,
C    172.16.0.0/16 is directly connected, Serial0
S    192.168.1.0/24 [1/0] via 172.16.0.2
C    192.168.2.0/24 is directly connected, Ethernet0
```

2 → 1

Using an intermediate address instead of an exit-interface:

- If an intermediate address is used on a static route via a point-to-point link, it is only used to find the exit-interface,
- The router has to do a recursive lookup – first (1) by looking up the 192.168.1.0/24 network and finding it needs to forward the packet to 172.16.0.2 – the router then (2) looks up the 172.16.0.0 network and sees it can forward it out the interface Serial 0.
- This recursive lookup is unnecessary and takes extra processing.

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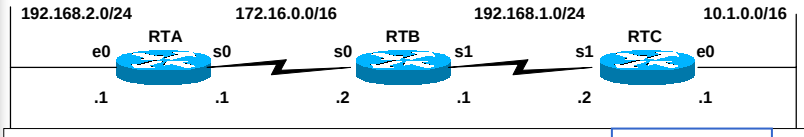
Static routes via point-to-point links




```
RTA(config)#ip route 192.168.1.0 255.255.255.0 serial 0

RTA#show ip route
Codes: C - connected, S - static,
C    172.16.0.0/16 is directly connected, Serial0
S    192.168.1.0/24 is directly connected, Serial0
C    192.168.2.0/24 is directly connected, Ethernet0
```

- **Note**: When using a dynamic routing protocol such as RIP or IGRP, static routes that show as “directly connected” will automatically be advertised to other routers as long as the appropriate network command (network 192.168.1.0) has been issued.
- Otherwise, a static route (one using an intermediate address) won’t be advertised without additional configuration (redistribute static command - later).

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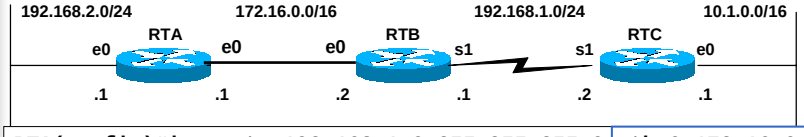
Static routes via broadcast links




```
RTA(config)#ip route 192.168.1.0 255.255.255.0 eth 0 172.16.0.2

RTA#show ip route
Codes: C - connected, S - static,
C    172.16.0.0/16 is directly connected, Serial0
S    192.168.1.0/24 [1/0] via 172.16.0.2 Ethernet0
C    192.168.2.0/24 is directly connected, Ethernet0
```

- Notice we changed 172.16.0.0 to an Ethernet link.
- Static routes via broadcast links, it is best to use both an exit interface and intermediate address.
- This saves the router from having to do a recursive route lookup for the intermediate address of 172.16.0.2, knowing the exit interface is Ethernet 0.

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Static Route Rule of Thumb

Static routes via point-to-point links

- It is best to configure static routes with only the exit interface.
- For point-to-point serial interfaces, the next-hop address in the routing table is never used by the packet-delivery procedure, so it is not needed. (It could even reference a bogus IP address.)

Static routes via broadcast networks such as Ethernet

- It is best to configure static routes with both the next-hop address and the exit-interface.

Using only an intermediate address

- "What about static routes referencing only intermediate network address? In short, try to avoid using them. The reason is that these static routes are not bound to any interface, rely on intermediate address resolvability, and thus converge more slowly. They can also create unexpected routing loops." *Alex Zinin, Cisco IP Routing*

NOTE: Most of our examples in this course do not follow either of these rules-of-thumb – but you may want to use it on your network.

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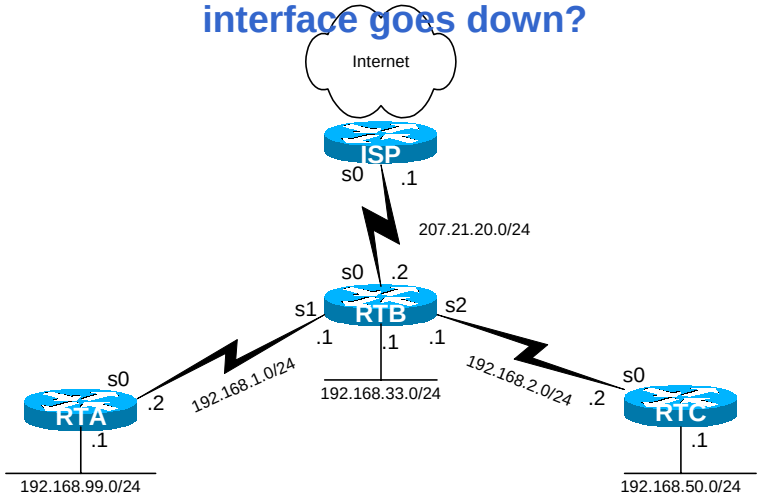
What happens to the static route when an interface goes down?

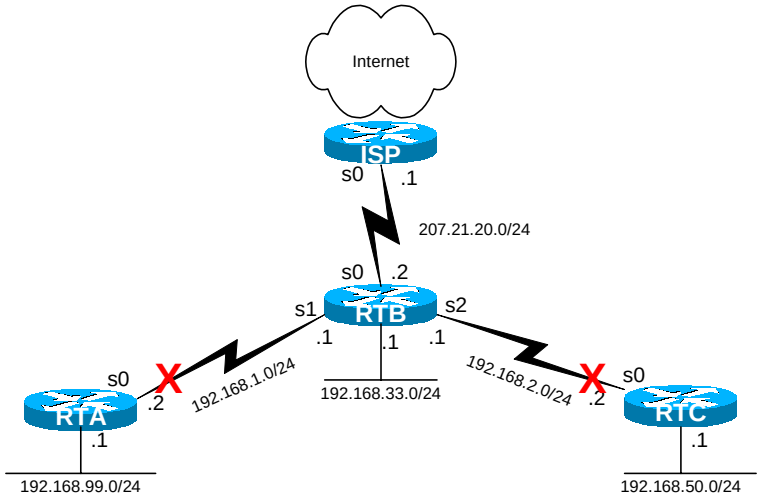



```
Router: RTB
ip route 192.168.50.0 255.255.255.0 Serial2
ip route 192.168.99.0 255.255.255.0 192.168.1.2
```

- Prior to any interfaces going down, the routing table looks like:

```
C    207.21.20.0/24 is directly connected, Serial0
S    192.168.99.0/24 [1/0] via 192.168.1.2
S    192.168.50.0/24 is directly connected, Serial2
C    192.168.1.0/24 is directly connected, Serial1
C    192.168.2.0/24 is directly connected, Serial2
C    192.168.33.0/24 is directly connected, FastEthernet0
```

RTA and RTC interfaces to RTB go down




```
Router: RTB
ip route 192.168.50.0 255.255.255.0 Serial2
ip route 192.168.99.0 255.255.255.0 192.168.1.2
```

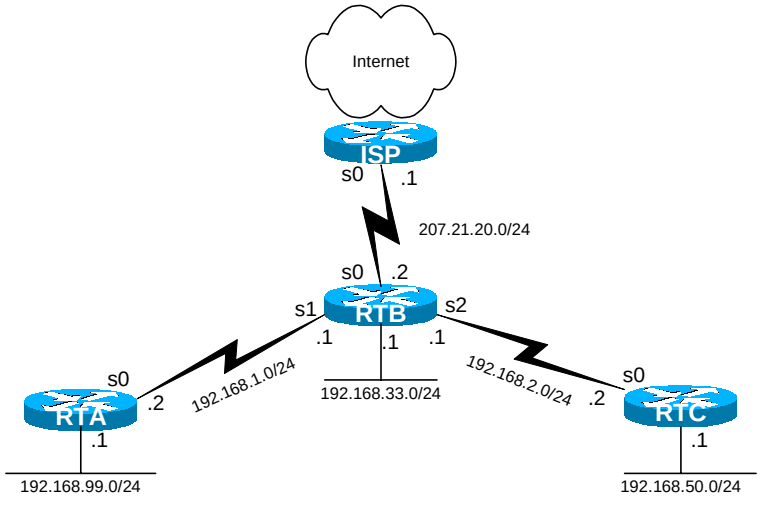
- When an interface goes down, all static routes mapped to that interface are removed from the IP routing table, along with the directly connected networks.

```
RTB#show ip route
C    207.21.20.0/24 is directly connected, Serial0
C    192.168.33.0/24 is directly connected, FastEthernet0
```

- If the interface comes back up the routes are returned, along with the directly connected networks.

```
C    207.21.20.0/24 is directly connected, Serial0
S    192.168.99.0/24 [1/0] via 192.168.1.2
S    192.168.50.0/24 is directly connected, Serial2
C    192.168.1.0/24 is directly connected, Serial1
C    192.168.2.0/24 is directly connected, Serial2
C    192.168.33.0/24 is directly connected, FastEthernet0
```

Using the permanent option




```
Router: RTB
ip route 192.168.50.0 255.255.255.0 Serial2 permanent
ip route 192.168.99.0 255.255.255.0 192.168.1.2 permanent
```

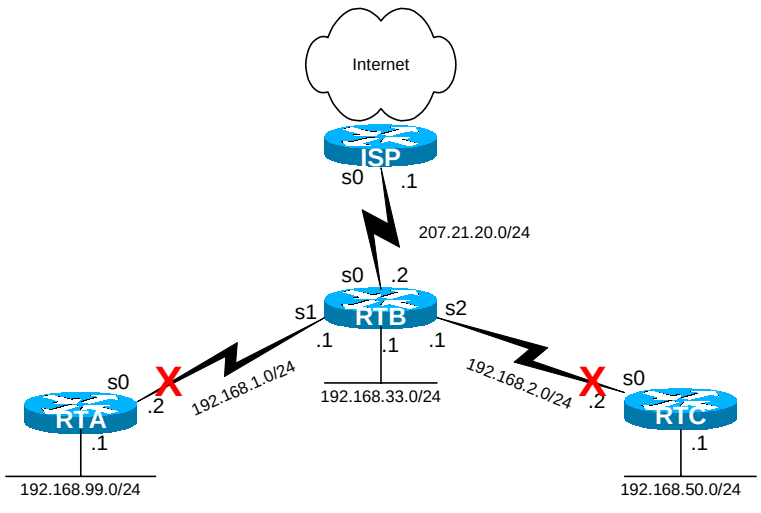
- The permanent option specifies that the route will not be removed, even if the interface shuts down.

- Static routes with the permanent option:

```
ip route 192.168.50.0 255.255.255.0 Serial2 permanent
ip route 192.168.99.0 255.255.255.0 192.168.1.2 permanent
```

```
RTB#show ip route
C    207.21.20.0/24 is directly connected, Serial0
S    192.168.99.0/24 [1/0] via 192.168.1.2
S    192.168.50.0/24 is directly connected, Serial2
C    192.168.1.0/24 is directly connected, Serial1
C    192.168.2.0/24 is directly connected, Serial2
C    192.168.33.0/24 is directly connected, FastEthernet0
```

RTA and RTC interfaces to RTB go down




```
Router: RTB
ip route 192.168.50.0 255.255.255.0 Serial2 permanent
ip route 192.168.99.0 255.255.255.0 192.168.1.2 permanent
```

- What does the routing table look like when the interfaces go down?
- Static routes are still in the routing table, but can you really get to those routes? - No.
- Notice that the directly connected networks of the downed interfaces are no longer in the routing table.

```
RTB#show ip route
C    207.21.20.0/24 is directly connected, Serial0
S    192.168.99.0/24 [1/0] via 192.168.1.2
S    192.168.50.0/24 is directly connected, Serial2
C    192.168.33.0/24 is directly connected, FastEthernet0
```

Processing of Static Routes

- A static route may be configured but not in the routing table if:
  - Reference an invalid or inactive interface
  - Reference an intermediate address which is irresolvable
  - Has a higher administrative distance than another route to the same network

Affects of a static route

- When a static route is added or deleted, all other static routes are processed in one second. (Prior to 12.0, it was 5 seconds)

Affects of a dynamic route

- Some static routes may become resolvable when a route enters the routing table from a dynamic routing protocol (or unresolvable when a route leaves the routing table from a dynamic routing protocol).
- "The routing table process invokes the static route processing function every minute to install or remove static routes according to the dynamically changing routing table." *Zinin, Cisco IP Routing*
- The process of a dynamic route deletion is the same.
- When the dynamic route is removed from the table, all static routes are processed the next time the one minute static route process is scheduled.

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Advantages and Disadvantages of Static Routing

Advantages

- Low processor overhead
- No bandwidth utilization
  - Secure operation don't inadvertently advertise networking information to an untrusted source
- Predictability (precise control)

Disadvantages

- High-maintenance configuration
- No adaptability (except for floating static routes)

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Advantages and Disadvantages of Dynamic Routing

Advantages

- High degree of adaptability
- Low-maintenance configuration

Disadvantages

- Increased processor overhead
- High bandwidth utilization

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Final Note on Static Routes

- The processing of static routes is actually more sophisticated than dynamic routing.
- There are several other issues regarding static routing which has not been discussed here, but will be included in the presentation: ***Static Routing – Additional Information***
- Some of these topics will include:
  - Static Route Processing Algorithm
  - PPP and installation of host routes
  - Coverage of static routes' address ranges – A static route is not installed in the routing table if the routing table already contains a route covering this address range with the same exit-interface and the static route is configured over an intermediate address. (Explained in the presentation: *Static Routing – Additional Information*)
  - Installation of a static route leading to its unresolvability

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Dynamic Routing Protocols

- Note: The material on IPX and Appletalk is FYI only and not part of my exam or the CCNP exam
- Read this section for now, but all of this material will be covered in much more detail in the coming weeks.
- We will concentrate on default routing and and floating static routes in this section

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Default Routing

- Quad-zero routes
- ip default-network command

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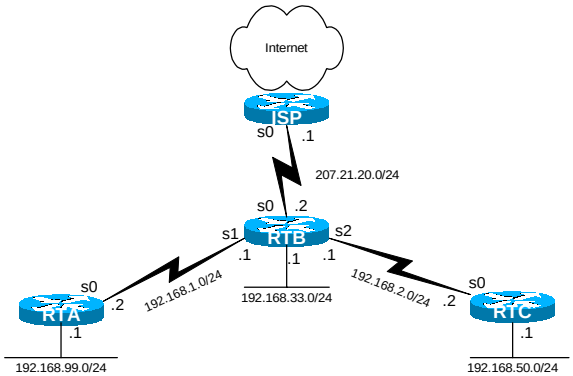
Default Routing

`ip route 0.0.0.0 0.0.0.0 [exit-inter|ip-address]`

- To the Cisco IOS this route has a special meaning as the “route of last resort”
- Automatically marked as a candidate default.
- Using our network diagram, and running RIP on all router except between RTB and ISP, lets look at the effect of a quad-zero default route



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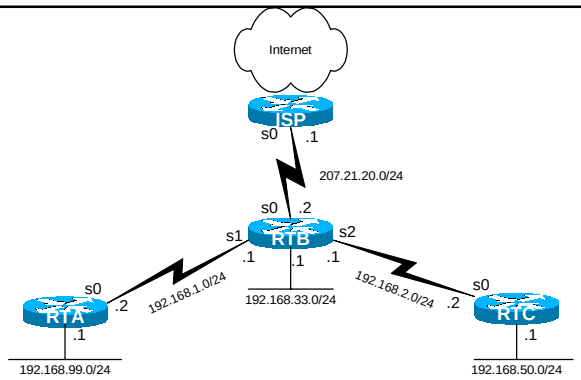


```
RTB(config)#ip route 0.0.0.0 0.0.0.0 207.21.20.1
RTB#show ip route
Gateway of last resort is 207.21.20.1 to network 0.0.0.0
C    207.21.20.0/24 is directly connected, Serial0
R    192.168.99.0/24 [120/1] via 192.168.1.2, 00:00:25, Serial1
R    192.168.50.0/24 [120/1] via 192.168.2.2, 00:00:24, Serial2
C    192.168.1.0/24 is directly connected, Serial1
C    192.168.2.0/24 is directly connected, Serial2
C    192.168.33.0/24 is directly connected, FastEthernet0
S*   0.0.0.0/0 [1/0] via 207.21.20.1
```

Default Routing and RIP

- Cisco IOS 12.0 and earlier: RIP will propagate the quad-zero default route automatically.
- Cisco IOS 12.1 and later: RIP will **not** propagate the quad-zero default route automatically.
  - You must use the default-information originate command or redistribute static command (later)
  - Using default-information originate will not break < 12.0
- Normally, it is best to use only add one quad-zero route or the routers may load-balance to wrong destinations.

RTB:

```
ip route 0.0.0.0 0.0.0.0 207.21.20.1
router rip
     network 192.168.1.0
     network 192.168.2.0
     network 192.168.33.0
     default-information originate
```

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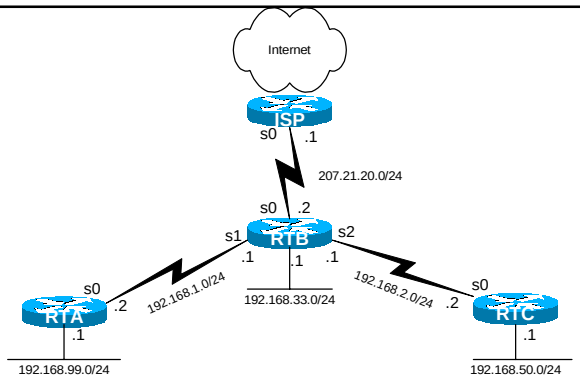

Router RTA

```
RTA#show ip route
Gateway of last resort is 192.168.1.1 to network 0.0.0.0
C    192.168.99.0/24 is directly connected, FastEthernet0
R    192.168.50.0/24 [120/2] via 192.168.1.1, 00:00:03, Serial0
C    192.168.1.0/24 is directly connected, Serial0
R    192.168.2.0/24 [120/1] via 192.168.1.1, 00:00:03, Serial0
R    192.168.33.0/24 [120/1] via 192.168.1.1, 00:00:03, Serial0
R*   0.0.0.0/0 [120/1] via 192.168.1.1, 00:00:03, Serial0
```

ip default-network command

- Global configuration command
- Primarily used with IGRP
- Can be used with RIP but quad-zero is usually preferred
- EIGRP supports both the quad-zero and ip default-network commands. (More later)

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IGRP and ip default-network

- All routers running IGRP including between RTB and ISP.
- IGRP does **not** recognize the 0.0.0.0/0 route and will not include it in its updates.
- We must use the **ip default-network** command (which is propagated)
- RTB must also have a route to destination network or a 0.0.0.0/0 static route to forward traffic to a default route once it reaches RTB.
- **Note**: The static route (ip route 0.0.0.0/0 in this example) must be configured with a next-hop-address, otherwise it will not be considered as a candidate default but only as an exterior route (later). (Always a good idea to use the exit-interface as well, to avoid recursive routing table lookups during packet forwarding.
- Must include network between RTB and ISP in RTB's config:

```
router igrp 24
   <text omitted>
   network 207.21.20.0
ip route 0.0.0.0 0.0.0.0 serial0 207.21.20.1
ip default-network 207.21.20.0
```

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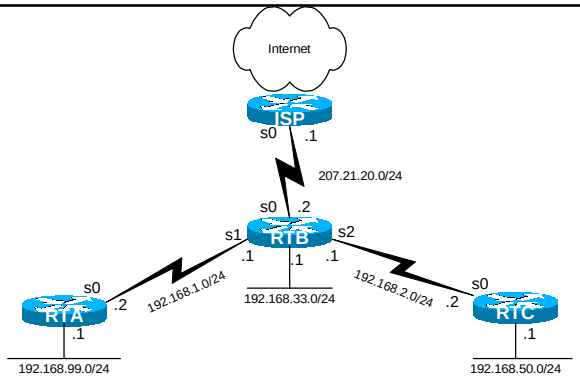
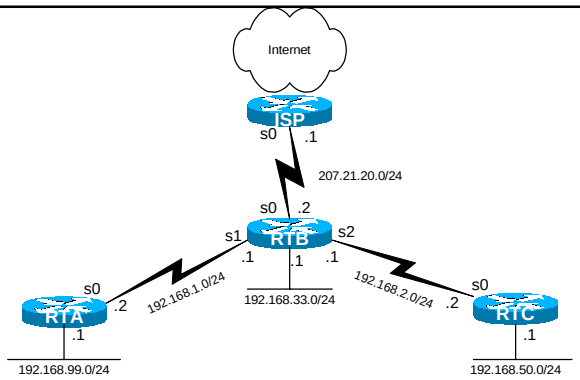
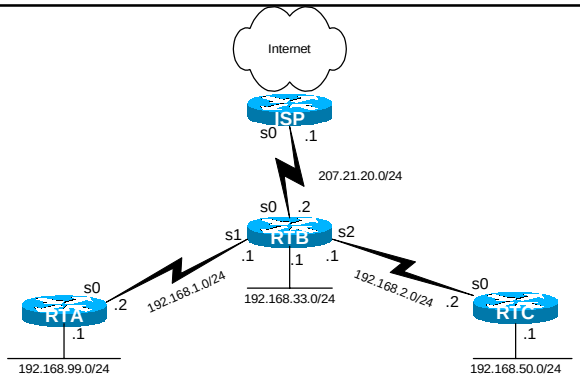



```
RTB(config)# router igrp 24
RTB(config-router)# network 192.168.1.0
RTB(config-router)# network 192.168.2.0
RTB(config-router)# network 207.21.20.0

RTB(config)# ip route 0.0.0.0 0.0.0.0 serial0 207.21.20.1
RTB(config)# ip default-network 207.21.20.0
```




```
RTB(config)# ip default-network 207.21.20.0
RTB#show ip route
Gateway of last resort is not set
C*   207.21.20.0/24 is directly connected, Serial0
I    192.168.99.0/24 [100/80135] via 192.168.1.2, 00:00:59, Serial1
I    192.168.50.0/24 [100/80135] via 192.168.2.2, 00:00:22, Serial2
C    192.168.1.0/24 is directly connected, Serial1
C    192.168.2.0/24 is directly connected, Serial2
C    192.168.33.0/24 is directly connected, FastEthernet0
S*   0.0.0.0/0 [1/0] via 207.21.20.0
```



RTA now has a default route...

```
RTA#show ip route
Gateway of last resort is 192.168.1.1 to network 207.21.20.0
I*   207.21.20.0/24 [100/82125] via 192.168.1.1, 00:00:53, Serial0
C    192.168.99.0/24 is directly connected, FastEthernet0
I    192.168.50.0/24 [100/82135] via 192.168.1.1, 00:00:53, Serial0
C    192.168.1.0/24 is directly connected, Serial0
I    192.168.2.0/24 [100/82125] via 192.168.1.1, 00:00:53, Serial0
I    192.168.33.0/24 [100/80135] via 192.168.1.1, 00:00:53, Serial0
```

Alternate – Using a loopback address

```
interface loopback 0
   ip add 1.0.0.1 255.0.0.0
router igrp 24
   network 192.168.1.0
   network 192.168.2.0
   network 192.168.33.0
   network 1.0.0.0     (replaced with loopback)
ip default-network 1.0.0.0      (used loopback)
ip route 0.0.0.0 0.0.0.0 207.21.20.1
```

- Using a loopback address on RTB is actually better, so that IGRP updates do not need to be sent out the 207.21.20.0 net.
- RTB will need to include loopback address as a network statement and as the default-network.
- Quad-zero route is not propagated but used when the packet arrives at RTB.
- "A router that is generating the default for a network also can need a default of its own. One way of doing this is to specify a static route to the network 0.0.0.0 through the appropriate device." CCO ip default-network

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RIP and ip default-network

- FYI – If you wanted to use RIP with ip default-network – I don't recommend this, as the 0.0.0.0/0 route is more straight-forward.
- This slide contains information from: http://www.cisco.com/warp/public/105/default.html
- Gateways of last resort selected using the ip default-network command are propagated differently depending on which routing protocol is propagating the default route.
- For IGRP and EIGRP to propagate the route, the network specified by the ip default-network command must be known to IGRP or EIGRP.
- This means the network must be an IGRP- or EIGRP-derived network in the routing table, or the static route used to generate the route to the network must be redistributed into IGRP or EIGRP.
  RIP advertises a route to 0.0.0.0.
- Note**:** In IOS release 12.0T and higher, RIP doesn't advertise the default router if the route is not learned via RIP.
- Therefore, it may be necessary to redistribute the route into RIP (later), or use the default-information originate command.

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Floating static routes

- Floating static routes are static rotes configured with an administrative distance value that is greater than that of the primary route (or routes), whether it is another static route or a dynamic route.
- Floating static routes are basically fallback or backup routes, that do not appear in the routing table unless the primary route fails.

```
RTR(config)# ip route prefix mask {address | interface}
  [distance] [tag tag] [permanent]
```

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Administrative Distance Values

Connected interface	0
Static route	1
EIGRP summary route	5
External BGP	20
Internal EIGRP	90
IGRP	100
OSPF	110
IS-IS	115
RIP	120
EGP	140
External EIGRP	170
Internal BGP	200
Unknown	255

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Examples of primary static and floating static routes:

```
ip route 0.0.0.0 0.0.0.0 s0
ip route 0.0.0.0 0.0.0.0 s1 5

ip route 10.0.0.0 255.0.0.0 192.168.2.1
ip route 10.0.0.0 255.0.0.0 192.168.3.1 10

ip route 15.0.0.0 255.0.0.0 s0
ip route 15.0.0.0 255.0.0.0 s1 5
ip route 15.0.0.0 255.0.0.0 s2 10
ip route 15.0.0.0 255.0.0.0 s3 15
```

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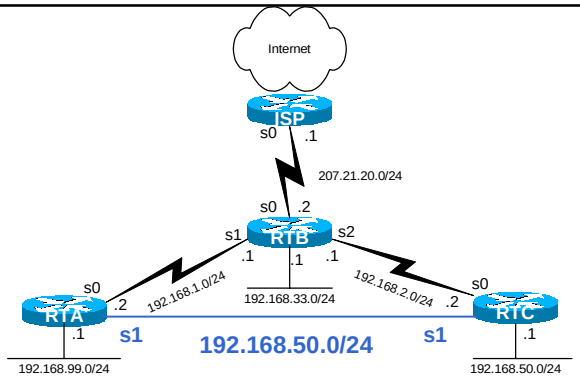

- Let's say the 192.168.50.0/24 link is a slow 56k link and the other serial links are T-1s.
- Normally we want traffic between RTA and RTC to go via RTB, but will use 192.168.50.0/24 as a backup should 192.168.1.0 or 192.168.2.0 fail.

```
RTA(config)# router rip
RTA(config-router)# network 192.168.1.0
RTA(config-router)# network 192.168.99.0

RTB(config)# ip route 192.168.50.0 255.255.255.0 serial1 125
```

ip default-gateway

- "The **ip default-gateway** command differs from the other two commands in that it should only be used when **ip routing** is disabled on the Cisco router."
- "For instance, if the router is a host in the IP world, you can use this command to define a default gateway for it. "
- "You might also use this command when your low end Cisco router is in boot mode in order to TFTP a Cisco IOS®Software image to the router. In boot mode, the router doesn't have **ip routing** enabled."
- CCO

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Dynamic Routing

- We will examine dynamic routing protocols OSPF and EIGRP in detail the next few weeks.
- Next, we will discuss the following presentations:
  - The Routing Table – Structure, Lookups, and the ip classless command
  - Discard Routes – Avoiding Routing Loops
- Instructors – These presentations are on the CCNP Instructor Portal or accessed via my web site: http://www.cabrillo.cc.ca.us/~rgraziani/courses/ccnp_sem5.html

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Cabrillo College

CCNP – Advanced Routing

Ch. 3 Routing Overview

Rick Graziani, Instructor

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