Part 1: The Routing Table Structure

Part 2: The Lookup Process
Directly Connected Networks

```
RouterB# show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, Ia - IS-IS inter area
* - candidate default, U - per-user static route, o - ODR
     P - periodic downloaded static route

Gateway of last resort is not set

RouterB#
```

```
RouterB# debug ip routing
RouterB(config)# interface serial 1
RouterB(config-if)# ip add 192.168.1.1 255.255.255.0
RouterB(config-if)# no shutdown

00:59:48: %LINK-3-UPDOWN: Interface Serial1, changed state to up
00:59:48: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1, changed state to up
00:59:48: RT: add 192.168.1.0/24 via 0.0.0.0, connected metric [0/0]
00:59:48: RT: interface Serial1 added to routing table

RouterB(config-if)# end

RouterB# undebug all
All possible debugging has been turned off
RouterB#
```
Directly Connected Networks

```
RouterB# show ip route
Codes:  C - connected,  S - static,  I - IGRP,  R - RIP,  M - mobile,  B - BGP
<text omitted>
Gateway of last resort is not set

C  192.168.1.0/24 is directly connected, Serial1
RouterB#
```

Creating a Parent/Child Route

```
RouterB(config)# interface fastethernet 0
RouterB(config-if)# ip add 172.16.3.1 255.255.255.0
RouterB(config-if)# no shutdown
01:21:11: RT: add 172.16.3.0/24 via 0.0.0.0, connected metric [0/0]
01:21:11: RT: interface FastEthernet0 added to routing table
RouterB(config-if)# end

RouterB# show ip route
Codes:  C - connected,  S - static,  I - IGRP,  R - RIP,  M - mobile,  B - BGP
<text omitted>
Gateway of last resort is not set

172.16.0.0/24 is subnetted, 1 subnets // class B Net
C  172.16.3.0 is directly connected, FastEthernet0
C  192.168.1.0/24 is directly connected, Serial1
RouterB#
```
Parent, Child, Ultimate Routes

So far on Router B:

Parent Route: 172.16.0.0/24 is subnetted, 1 subnets
Child Route: C 172.16.3.0 is directly connected, FastEthernet0
Ultimate Route: C 192.168.1.0/24 is directly connected, Serial1

// Ultimate – äußerste, letzte

Creating Another Child Route

RouterB(config)#int s 0
RouterB(config-if)#ip add 172.16.2.2 255.255.255.0
RouterB(config-if)#end

RouterB#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
<text omitted>

Gateway of last resort is not set

172.16.0.0/24 is subnetted, 2 subnets
C 172.16.2.0 is directly connected, Serial0
C 172.16.3.0 is directly connected, FastEthernet0
C 192.168.1.0/24 is directly connected, Serial1
RouterB#
Same structure no matter the source of route

```
RouterB# show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
<text omitted>

Gateway of last resort is not set

172.16.0.0/24 is subnetted, 4 subnets
S   172.16.4.0 is directly connected, Serial1
R   172.16.1.0 [120/1] via 172.16.2.1, 00:00:08, Serial0
C   172.16.2.0 is directly connected, Serial0
C   172.16.3.0 is directly connected, FastEthernet0

10.0.0.0/16 is subnetted, 1 subnets
S   10.1.0.0 is directly connected, Serial1
C   192.168.1.0/24 is directly connected, Serial1
S   192.168.100.0/24 is directly connected, Serial1
```

Static Routes and Recursive Lookups

```
RouterA# show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
<text omitted>

Gateway of last resort is not set

172.16.0.0/24 is subnetted, 2 subnets
C   172.16.1.0 is directly connected, FastEthernet0
C   172.16.2.0 is directly connected, Serial0
```

```
RouterB# show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
<text omitted>

Gateway of last resort is not set

172.16.0.0/24 is subnetted, 4 subnets
S   172.16.4.0 is directly connected, Serial1
R   172.16.1.0 [120/1] via 172.16.2.1, 00:00:08, Serial0
C   172.16.2.0 is directly connected, Serial0
C   172.16.3.0 is directly connected, FastEthernet0

10.0.0.0/16 is subnetted, 1 subnets
S   10.1.0.0 is directly connected, Serial1
C   192.168.1.0/24 is directly connected, Serial1
S   192.168.100.0/24 is directly connected, Serial1
```

```
RouterA# show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
<text omitted>

Gateway of last resort is not set

172.16.0.0/24 is subnetted, 2 subnets
C   172.16.1.0 is directly connected, FastEthernet0
C   172.16.2.0 is directly connected, Serial0
```
Static Routes and Recursive Lookups

RouterA(config)#ip route 172.16.3.0 255.255.255.0 172.16.2.2
03:12:45: RT: add 172.16.3.0/24 via 172.16.2.2, static metric [1/0]
RouterA(config)#
RouterA#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
<text omitted>
Gateway of last resort is not set

172.16.0.0/24 is subnetted, 3 subnets
C  172.16.1.0 is directly connected, FastEthernet0
C  172.16.2.0 is directly connected, Serial0
S  172.16.3.0 [1/0] via 172.16.2.2

First lookup of 172.16.3.0:
S  172.16.3.0 [1/0] via 172.16.2.2

Second lookup of 172.16.2.0:
C  172.16.2.0 is directly connected, Serial0

Static Routes without Recursive Lookup

RouterB(config)#ip route 172.16.1.0 255.255.255.0 serial 0
05:05:30: RT: add 172.16.1.0/24 via 0.0.0.0, static metric [1/0]
RouterB(config)#
RouterB#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
<text omitted>
Gateway of last resort is not set

172.16.0.0/24 is subnetted, 3 subnets

S  172.16.1.0 is directly connected, Serial10
C  172.16.2.0 is directly connected, Serial10
C  172.16.3.0 is directly connected, FastEthernet0
C  192.168.1.0/24 is directly connected, Serial11
RouterB#
Static Routes and Administrative Distance

You might have also noticed that the routing table states that this static route is “directly connected.”

S 172.16.1.0 is directly connected, Serial0

- In the case of a static route, directly connected means that the static route was configured with an exit interface.
- This does **not** mean that it is a directly connected network like an interface on the router.
- Like all static routes, the default administrative distance of this static route is still “1”.
- Only directly connected interfaces, (which have a code of “C” in the routing table) can have an administrative distance of “0”.

Static Routes via Ethernet Interfaces

RouterB(config)# ip route 172.16.1.0 255.255.255.0 172.16.2.1
RouterB(config)# end

RouterB# show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
Gateway of last resort is not set

172.16.0.0/24 is subnetted, 3 subnets
S 172.16.1.0/24 [1/0] via 172.16.2.1
C 172.16.2.0 is directly connected, FastEthernet1
C 172.16.3.0 is directly connected, FastEthernet0
C 192.168.1.0/24 is directly connected, Serial1
RouterB#
Static Routes via Ethernet Interfaces

RouterB(config)#ip route 172.16.1.0 255.255.255.0 fastethernet 1 172.16.2.1
RouterB(config)#end

RouterB#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
<text omitted>

Gateway of last resort is not set

172.16.0.0/24 is subnetted, 3 subnets
S 172.16.1.0/24 [1/0] via 172.16.2.1 FastEthernet1
C 172.16.2.0 is directly connected, FastEthernet1
C 172.16.3.0 is directly connected, FastEthernet0
C 192.168.1.0/24 is directly connected, Serial1

RouterB#

VLSM

Router X

RouterX#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
<text omitted>

Gateway of last resort is not set

172.16.0.0/16 is variably subnetted, 3 subnets, 2 masks
C 172.16.1.4/30 is directly connected, Serial0
C 172.16.1.8/30 is directly connected, Serial1
C 172.16.3.0/24 is directly connected, FastEthernet0

RouterX#
Part 2: The Lookup Process

Subnet Mask = # of bits that must match

Figure 2

IP Packet from Host
192.168.1.10
1000000 10101000 00000001 00001010

Parent Route
172.16.0.0
10101100 00010000 00000000 00000000

16 bits must match, but only one bit matches

RouterA#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
<text omitted>

Gateway of last resort is not set

172.16.0.0/24 is subnetted, 3 subnets
C  172.16.1.0 is directly connected, FastEthernet0
C  172.16.2.0 is directly connected, Serial0
R  172.16.3.0 [120/1] via 172.16.2.2, 00:00:00, Serial0
R  192.168.1.0/24 [120/1] via 172.16.2.2, 00:00:00, Serial0
RouterA#
Subnet Mask = # of bits that must match

Figure 3

| IP Packet       | 192.168.1.10 | 11000000 10101000 00000001 00001010 |
| Ultimate Route  | 192.168.1.0  | 11000000 10101000 00000001 00000000 |

These 24 bits match!

RouterA#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
<text omitted>

Gateway of last resort is not set

172.16.0.0/24 is subnetted, 3 subnets
C 172.16.1.0 is directly connected, FastEthernet0
C 172.16.2.0 is directly connected, Serial0
R 172.16.3.0 [120/1] via 172.16.2.2, 00:00:00, Serial0
R 192.168.1.0/24 [120/1] via 172.16.2.2, 00:00:00, Serial0
RouterA#

Parent then Children

| IP Packet       | 172.16.3.10 | 10101100 00010000 00000011 00001010 |
| Parent Route    | 172.16.0.0  | 10101100 00010000 00000000 00000000 |

These 16 bits match!

RouterA#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
<text omitted>

Gateway of last resort is not set

172.16.0.0/24 is subnetted, 3 subnets
C 172.16.1.0 is directly connected, FastEthernet0
C 172.16.2.0 is directly connected, Serial0
R 172.16.3.0 [120/1] via 172.16.2.2, 00:00:00, Serial0
R 192.168.1.0/24 [120/1] via 172.16.2.2, 00:00:00, Serial0
RouterA#
Figure 6 (child routes shown in different order than with ‘show ip route’)

<table>
<thead>
<tr>
<th>IP Packet</th>
<th>172.16.3.10</th>
<th>10101100 00010000 00000011 00001010</th>
</tr>
</thead>
<tbody>
<tr>
<td>These 24 bits match!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Child Route</th>
<th>172.16.3.0</th>
<th>10101100 00010000 00000011 00000000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child Route</td>
<td>172.16.1.0</td>
<td>10101100 00010000 00000001 00000000</td>
</tr>
<tr>
<td>Child Route</td>
<td>172.16.2.0</td>
<td>10101100 00010000 00000010 00000000</td>
</tr>
</tbody>
</table>

RouterA#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
Gateway of last resort is not set

172.16.0.0/24 is subnetted, 3 subnets
C  172.16.1.0 is directly connected, FastEthernet0
C  172.16.2.0 is directly connected, Serial0
R  172.16.3.0 [120/1] via 172.16.2.2, 00:00:00, Serial0
R  192.168.1.0/24 [120/1] via 172.16.2.2, 00:00:00, Serial0
RouterA#

The Default Route

RouterB(config)#ip route 0.0.0.0 0.0.0.0 serial1
RouterB(config)#end

RouterB#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
Gateway of last resort is 0.0.0.0 to network 0.0.0.0

172.16.0.0/24 is subnetted, 3 subnets
R  172.16.1.0 [120/1] via 172.16.2.1, 00:00:13, Serial0
C  172.16.2.0 is directly connected, Serial0
C  172.16.3.0 is directly connected, FastEthernet0
C  192.168.1.0/24 [120/1] via 172.16.2.2, 00:00:00, Serial0
S* 0.0.0.0/0 is directly connected, Serial1
RouterB#
Changing the default routing behavior, whether classful or classless, is simple. The command to enable classless routing behavior is:

RouterB(config)#ip classless
RouterB(config)#

The command to disable classless routing behavior, in other words, enable classful routing behavior is:

RouterB(config)#no ip classless
RouterB(config)#

Use show running-config to verify which command is in affect.

Classless Routing Behavior

RouterB#show running-config
Building configuration...

Current configuration:
!
version 11.3
!
<text omitted>
!

ip classless
!
<text omitted>
Classless Routing Behavior

RouterB#show ip route
Gateway of last resort is 0.0.0.0 to network 0.0.0.0

172.16.0.0/24 is subnetted, 3 subnets
R  172.16.1.0 [120/1] via 172.16.2.1, 00:00:13, Serial0
C   172.16.2.0 is directly connected, Serial0
C   172.16.3.0 is directly connected, FastEthernet0
C   192.168.1.0/24 is directly connected, Serial1
S*   0.0.0.0/0 is directly connected, Serial1

RouterB#  

Classless Routing Behavior

Routing Behavior: classless (ip classless)
Packet’s Destination IP Address: 172.16.4.10

RouterB#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, <text omitted>

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

1. Match 172.16.0.0/24 is subnetted, 3 subnets
2. No Match R  172.16.1.0 [120/1] via 172.16.2.1, 00:00:13, Serial0
3. No Match C  172.16.2.0 is directly connected, Serial0
4. No Match C  172.16.3.0 is directly connected, FastEthernet0
   C  192.168.1.0/24 is directly connected, Serial1
5. Match! S*   0.0.0.0/0 is directly connected, Serial1

RouterB#