- The Routing Table -

Routing Table Basics

Routing is the process of sending a packet of information from one *network* to another *network.* Thus, routes are usually based on the destination network, and not the destination host (host routes *can* exist, but are used only in rare circumstances).

To route, routers build Routing Tables that contain the following:

- The destination network and subnet mask
- The "next hop" router to get to the destination network
- Routing *metrics* and Administrative Distance

The routing table is concerned with two types of protocols:

- A **routed** protocol is a layer 3 protocol that applies logical addresses to devices and routes data between networks. Examples would be IP and IPX.
- A **routing** protocol dynamically builds the network, topology, and next hop information in routing tables. Examples would be RIP, IGRP, OSPF, etc.

To determine the *best* route to a destination, a router considers three elements (in this order):

- **Prefix-Length**
- **Metric** (*within* a routing protocol)
- **Administrative Distance** *(between* separate routing protocols)

Prefix-length is the number of bits used to identify the network, and is used to determine the most *specific* route. A longer prefix-length indicates a more specific route. For example, assume we are trying to reach a host address of 10.1.5.2/24. If we had routes to the following networks in the routing table:

10.1.5.0/24
10.0.0.0/8

The router will do a bit-by-bit comparison to find the most *specific* route (i.e., longest matching prefix). Since the 10.1.5.0/24 network is more specific, that route will be used*, **regardless of metric or Administrative Distance.***

Administrative Distance vs. Metric

A “**metric**” allows a router to choose the best path *within* a routing protocol. Distance vector routing protocols use “**distance**” (usually hop-count) as their metric. Link state protocols utilize some sort of “**cost**” as their metric.

Only routes with the **best metric** are **added to the routing table**. Thus, even if a particular routing protocol (for example, RIP) has four routes to the same network, only the route with the *best* metric (hop-count in this example) would make it to the routing table. If multiple equal-metric routes exist to a particular network, most routing protocols will load-balance.

If your router is running multiple routing protocols, **Administrative Distance** is used to determine which routing protocol to *trust* the most. *Lowest* administrative distance wins.

Again: if a router receives two RIP routes to the same network, it will use the routes’ **metric** to determine which path to use. If the metric is identical for both routes, the router will load balance between both paths.

If a router receives a RIP and an OSPF route to the same network, it will use **Administrative Distance** to determine which routing path to choose.

The Administrative Distance of common routing protocols (remember, lowest wins):

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

A route with an “unknown” Administrative Distance will never be inserted into the routing table.

Viewing the routing table

The following command will allow you to view the routing table:

Router# *show ip route*

```
Gateway of last resort is 192.168.1.1 to network 0.0.0.0

C     192.168.1.0/24 is directly connected, Ethernet0
      150.50.0.0/24 is subnetted, 1 subnets
C     150.50.200.0 is directly connected, Loopback1
C     192.168.123.0 is directly connected, Serial0
C     192.168.111.0 is directly connected, Serial1
R     10.0.0.0 [120/1] via 192.168.123.1, 00:00:00, Serial0
               [120/1] via 192.168.111.2, 00:00:00, Serial1
S*    0.0.0.0/0 [1/0] via 192.168.1.1
```

Routes are labeled based on what protocol placed them in the table:

- C – Directly connected
- S – Static
- S* - Default route
- D - EIGRP
- R – RIP
- I – IGRP
- i – IS-IS
- O - OSPF

Notice the RIP routes contain the following field: **[120/1**]. This indicates both the administrative distance and the metric (the *120* is the AD, and the *1* is the hop-count metric).

To clear all routes from the routing table, and thus forcing any routing protocol to repopulate the table:

Router# *clear ip route **

Choosing the Best Route (Example)

Assume the following routes existed to the following host: 192.168.111.5/24

```
O     192.168.111.0/24 [110/58] via 192.168.131.1, 00:00:00, Serial3
R     192.168.111.0/24 [120/1] via 192.168.123.1, 00:00:00, Serial0
R     192.168.111.0/24 [120/5] via 192.168.5.2, 00:00:00, Serial1
S     192.168.0.0/16 [1/0] via 10.1.1.1
```

We have two RIP routes, an OSPF route, and a Static route to that destination. Which route will be chosen by the router?

Remember the three criteria the router considers:

- **Prefix-Length**
- **Metric**
- **Administrative Distance**

The static route has the lowest administrative distance (**1**) of any of the routes; however, its **prefix-length** is less specific. 192.168.111.0/24 is a more specific route than 192.168.0.0/16. Remember, prefix-length is *always* considered first.

The second RIP route **will not be inserted** into the routing table, because it has a higher metric **(5)** than the first RIP route (**1**). Thus, our routing table will actually look as follows:

```
O     192.168.111.0/24 [110/58] via 192.168.131.1, 00:00:00, Serial3
R     192.168.111.0/24 [120/1] via 192.168.123.1, 00:00:00, Serial0
S     192.168.0.0/16 [1/0] via 10.1.1.1
```

Thus, the true choice is between the OSPF route and the first RIP route. OSPF has the lowest administrative distance, and thus that route will be preferred.

PLEASE NOTE: Calculating the lowest metric route within a routing protocol occurs *before* administrative distance chooses the route it "trusts" the most. This is why the order of the above "criteria" is prefix-length, metric, and *then* administrative distance.

However, the route with the lowest administrative distance is *always* preferred, regardless of metric (assuming the prefix-length is equal). Thus, the metric is *calculated* first, but not *preferred* first over AD.