routing is the process of moving data (packets) between networks, a router is a device which performs routing.

Since routers also have MAC addresses and IP addresses, what is the difference between them and hosts. Let’s refer to the IPv6 RFC 2460:

Node: a device with an IP address

Router: a node that forwards packets not addressed to itself

Host: a node that isn’t a router

So, we can understand that routers forward packets that are not destined to itself

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For example, if this packet arrived at this network and arrived at host D, host D will just drop it because the DST IP address is not matching to its IP address. However, if the packet arrived at the router, it would realise the DST IP address isn’t to itself, but it will still try to deliver the packet to its appropriate destination.

But for routers to forward packets that are not destined to itself, the router must be connected to another network. When a router is connected to a network, it will have an IP address and MAC address for every network that it is connected to (it needs an IP address and a MAC address per interface).

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A computer screen shot of a computer

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As we can see, the router has a different IP address and MAC address for each network. Routers must maintain a map of all the networks they know about; this is known as the routing table. Routes are stored in routing tables.

R1’s routing table would look like this:

* For destination 10.0.55.x, send packet via left interface
* For destination 10.0.44.x, send packet via right interface

More professionally it would look like this:

A number and a number on a blue background

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DC = directly connected

There are 3 ways for routes to be populated in a routing table:

* Directly connected
* Statically connected
* Dynamically connected

Now let’s add another network:

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Since we added another network, there must be another router, and that means that it would need an IP address and a MAC address and also a routing table.

For example, let’s say that a packet from host C is sending data to host B (SRC 10.0.66.7 DST 10.0.55.8), R2 router would look at its routing table and realise that host B’s IP address (10.0.55.8) is located on the network which is on the right interface (10.0.55.x), then it will forward the packet.

Now what if host C wants to send a packet to host A (SRC 10.0.66.7 DST 10.0.44.9). R2’s routing table does not find the network that the DST IP address is located in, this means that the router does not know how to forward the packet which will result with the packet being dropped.

When routers receive packets with an unknown IP address, the packet is dropped.

R2 does not know that the 10.0.44.x network exists because it is not directly connected, however there are 2 other ways for this route to be populated.

The second method is static routing; this is when routes are manually provided by an administrator about the location of a particular network. For example, an administrator can log into router R2 and configure it with a static route, telling router R2 that anytime it wants to reach the 10.0.44.x network, it should send the packet to the 10.0.55.1 IP address (which is R1s IP address on the left interface (the interface which is connected to the 10.0.55.x network)), here:

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As we can see in R2’s routing table there is now a static connection to the 10.0.44.x network, if R2 wants to forward a packet to the 10.0.44.x network, it should forward it to the 10.0.55.x router (R1 left interface IP address).

So, if host C wants to forward a packet to host A (SRC 10.0.66.7 DST 10.0.44.9), R2 will check the routing table and see that to forward the packet to the 10.0.44.x network, it must forward the packet to the 10.0.55.1 router IP address. Then R1 will check its routing table and determine that the packet should be sent to the interface on the right which it will arrive to host A.

But what happens if host A responds? The packet: SRC 10.0.44.9 DST 10.0.66.7. when R1 receives this packet, it will check its routing table and R1 will not know how to deliver the packet so R1 will just drop the packet.

However, we can do a static connection to inform R1 of the 10.0.66.x network. The routing tables new entry would look like this: Static 10.0.66.x 10.0.55.2. this will tell R2 that if it wants to send a packet to the 10.0.66.x network, the packet should be forwarded to the 10.0.55.2 IP address which is R2’s IP address for the right-side interface. From there the R2 router will look at its own routing table and see that it can forward the packet to the left interface (10.0.66.x), then the packet can be delivered to host C.

Network structure update:

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Now the last way for routing tables to be populated is by dynamic routes. This is where routes are learned automatically from other routers. The routers talk to each other and share information that they know to tell each other how to get to the networks that they can get to.

Let’s go back to the old image:

A screenshot of a computer

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R1 would tell R2: I know about the 10.0.55.x and 10.0.44.x networks, then R2 will say I already know about the 10.0.55.x network, but I don’t know about the 10.0.44.x network. Then R2 will dynamically learn about the 10.0.44.x network, and it will be in the routing table. The same will happen for R1, it will learn about the 10.0.66.x network because R2 will inform R1 that it knows about it.

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The method that the routers will use to do dynamic routing is by protocols (dynamic routing protocols). There are many different dynamic routing protocols such as RIP, OSPF, BGP, EIGRP, IS-IS.