Static routing

Router routing table rows are rules for handling ranges of IP addresses.

Routing table columns

Column	Meaning
Row Number	Designates the row in the routing table
Destination	Range of IP addresses governed by the row (the destination network !!!)
Mask	Mask for the row
Metric	Quality of the route listed in this row, represents the cost or the speed of the link/path
Interface	The interface (port) to use to send the packet out. Is used to encapsulate (from layer 3 to layer 2, to construct the frame on layer-2) the outgoing IP packet to the Next-Hop Router.
Next-Hop Router	The device (router or destination host) on the interface subnet to receive the packet (the IP address of the router who knows the path to destination network !!!)

Row	Destination Network or Subnet	Mask (/Prefix)	Metric (Cost)	Interface	Next-Hop Router
1	127.171.0.0	255.255.0.0 (/16)	47	2	G
2	172.30.33.0	255.255.255.0 (/24)	0	1	Local
3	60.168.6.0	255.255.255.0 (/24)	12	2	G
4	123.0.0.0	255.0.0.0 (/8)	33	2	G
5	172.29.8.0	255.255.255.0 (/24)	34	1	F
6	172.40.6.0	255.255.255.0 (/24)	47	3	H
7	128.171.17.0	255.255.255.0 (/24)	55	3	H
8	172.29.8.0	255.255.255.0 (/24)	20	3	H
9	172.12.6.0	255.255.255.0 (/24)	23	1	F
10	172.30.12.0	255.255.255.0 (/24)	9	2	G
11	172.30.12.0	255.255.255.0 (/24)	3	3	H
12	60.168.0.0	255.255.0.0 (/16)	16	2	G
13	0.0.0.0	0.0.0.0 (/0)	5	3	H

Routing algoritm

Whenever a packet arrives, the router looks at its IP address, then…

Step 1: Finds All Row Matches (Routing table contains 1.000 rows, all 1000 rows are checked !)

- Each row is a rule for routing packets within a range of IP addresses.
- The router has the IP address of an arriving packet.
- It applies the mask in the row to the arriving IPv4 address.
- If the result is equal to the value in the destination column, then the IP address of the packet is in the row's range. The row is a match.
- This process can end up with multiple rows, hence step 2 !
- If no match is found, we use the default route (row 13 in the previous table). If no default route is present, the packet will not be forwarded and is dropped.

Step 2: Finds the Best-Match Row

- Basic Rule: it selects the row with the longest match (Initial 1s in the row mask).
- Tie Breaker: if there is a tie for longest match, select among the tie rows based on metric.
    - If the metric represents the cost, the row with the lowest metric wins.
    - If the metric represents the speed, the row with the biggest metric wins.

Step 3: Sends the Packet Back out According to Directions in the Best-Match Row

- Send the packet out the router interface (port) designated in the best-match row.
- Send the packet to the router in the next-hop router column.
- If the address says Local, the destination host is out that interface.
- Sends the packet to the destination IP address in a frame. The interface column takes care of the correct encapsulation of the IP packet into a (layer-2) frame.

Dynamic routing protocols

Dynamic Routing Protocol	Interior or Exterior Routing Protocol?	Remarks
RIP (Routing Information Protocol)	Interior	Distance-vector routing protocol (hop count as metric) For small networks that use only TCP/IP 'Chatty protocol', every 30 seconds routing table exchange An application protocol, uses UDP port 520 Slow network convergence (fault detection in this case) https://en.wikipedia.org/wiki/Routing_Information_Protocol
OSPF (Open Shortest Path First)	Interior	Link state routing protocol For large autonomous systems that use only TCP/IP Works on layer 3, with protocol number 89 Fast network convergence (fault detection in this case) https://en.wikipedia.org/wiki/Open_Shortest_Path_First
BGP (Border Gateway Protocol)	Exterior	Organization cannot choose what exterior routing protocol it will use, for ISP backbones To exchange routing and reachability information among autonomous systems (AS) on the Internet An application protocol, uses TCP port 179 https://en.wikipedia.org/wiki/Border_Gateway_Protocol