# Networking Layer

Discussion on switching is continued with an increased scope.

## * Layer 3 Switching

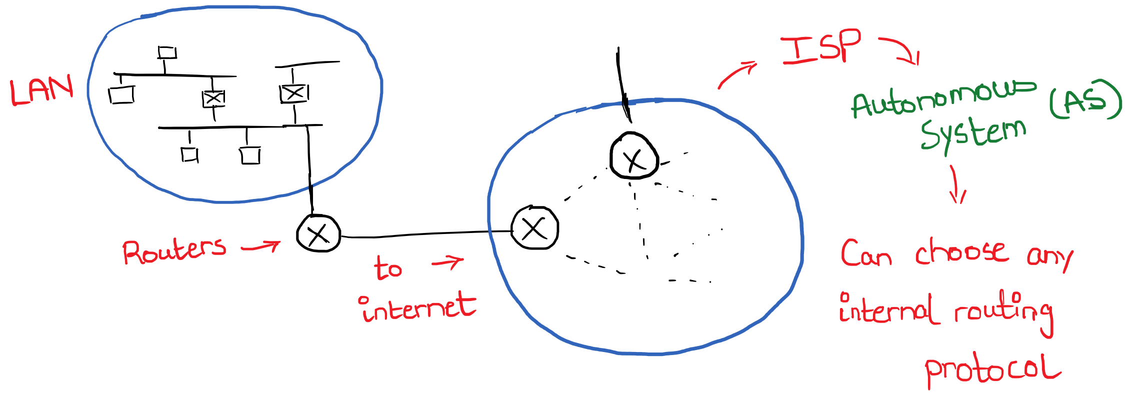
Is used to have millions of users connected to a network. This is not possible via extensive Layer 2 switching because of a number of short comings.

- The spanning tree protocol would cause the packet to take a longer path than the optimal one, as few nodes are disabled. For a large number of nodes, it would be very inefficient.
- This size of the forwarding table is proportional to number of nodes, which is very large. This is because each node has to be stored in the table. The MAC addresses have no restriction, which causes storing and lookup tough. This non-restricted storage is called as Flat addressing.

IP addresses are stored using Hierarchical Addressing in Layer 3 to combat this.

Layer2 is not stable, as the failure of the root node would require the spanning tree to be reconstructed. The root node sends out Hello messages to let the network know that it is up an running. Failure of any node would cause the hello messages to not reach all nodes, needing tree reconstrunction.

Historically, different institutions used to have their own addressing conventions which made connecting them globally tough. IP addresses take care of this issue.




We will be looking at a few protocols used by AS. These are divided into two categories -

Intra domain Routing — Protocols within AS

Inter domain Routing — protocols between ASes (lol)

↳ Border Gateway Protocol (BGP)

" The " protocol used in internet.

Intra domain protocols are of two types -

1) Distance Vector RIP - Routing Information Protocol

2) Link-State routing OSPF — Open shortest path

ISIS — Intermediate system to IS

- These three protocols try to find shortest paths while avoiding loops in the system. Famous algorithms are used for this requirement.

## * Distance Vector protocol

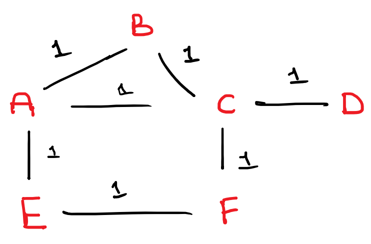
Distance Vector uses a "distributed" Bellman-Ford Algorithm.

That is, only the next hop is needed, and not the entire path itself. We utilise this property to modify the algorithm appropriately.

The algorithm's steps are described below –

- Each router in the network maintains a forwarding table, whose columns contain the possible destination, the hop need to reach it, and the cost of path to destination

- The table is initialised with itself having cost 0, and this is broadcasted such that only its neighbours can hear.




A hears (B,0), (C,0)
(E,0)

A sends out (A,0) to B,C,E

| dest. | next hop | cost |
|---|---|---|
| A | – | 0 |
| B | B | 1 |
| C | C | 1 |
| E | E | 1 |

A's table after one update

IP addresses

not broadcasted !

- After the update, A sends out the table to its $\boxed{\text{neighbours}}$. Similarly, it also hears additional information from its neighbours.

In the above example :-

A hears from B — (B,0), (A,1), (C,1)
from C — (C,0), (B,1), (A,1), (F,1), (D,1)
from E — (E,0), (A,1), (F,1)

Updated table — assuming C is heard first

| dest. | Next hop | Cost |
|---|---|---|
| A | - | 0 |
| B | B | 1 |
| C | C | 1 |
| E | E | 1 |
| F | C | 2 $(\underbrace{1}_{A\to C} + \underbrace{1}_{C\to F})$ |
| D | C | 2 (1 + 1) |

An entry is updated if $w(A\to X) + w(X \to Dest) < w(A \to Dest)$

* Reliability - what to do when a link fails?

Assume that the A→C link fails due to a practical error in the network. A's forwarding table is updated to contain $(C,\infty)$ as a row, which is then shared to E and B. Assume that reaching C from E required passing through A previously.

| dest. | Next hop | Cost |
|---|---|---|
| C | A | 2 |

old

$\xrightarrow[\text{from A}]{\text{E receives } (C,\infty)}$

| dest. | Next hop | Cost |
|---|---|---|
| C | A | $\infty$ |

It then receives (C, 1) from F, which updates the routing table to (C, F, 2). This updated path ripples backwards, modifying the entry appropriately.

If a packet addressed to C is received by A when the row is $(C, \infty)$, the packet is dropped. We would thus want the update period to be short. There are two types of updates :-

1) Triggered updates –

Are triggered due to an event, such as disconnection in this case. They usually have a high priority. A sending out $(C, \infty)$ is an example of this.

2) Periodic Updates

Tell neighbours about the shortest path and the cost. These are sent out periodically during the construction of the forwarding table.