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COMPUTER NETWORKS - II

HANDWRITTEN NOTES

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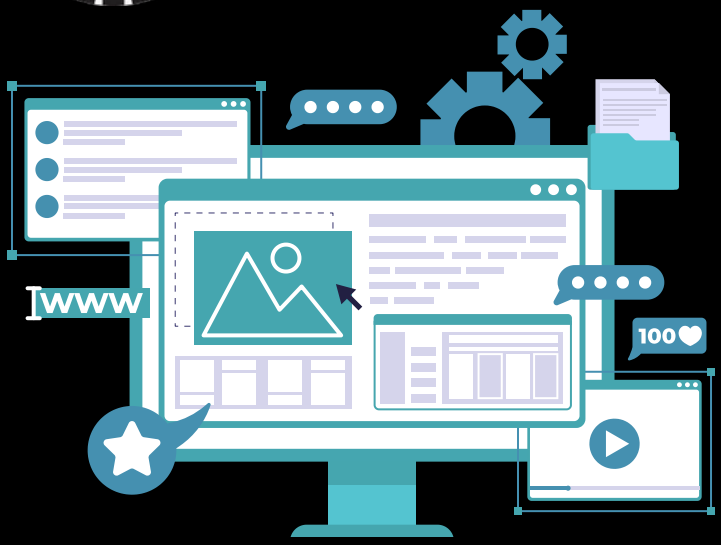

These Storage Networks notes are curated as per the upcoming semester exam syllabus and cover all key topics for quick revision. Specially prepared by seniors for Graphic Era students, they are ideal for last-minute preparation. Go through them carefully.
All the best for your exam!

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Unit-1

* Routing Algorithms

Routing algorithms are the methods used in CN to determine the best path for data packets to travel from source to destination.

Main goal -
- To find optimal path (fastest, cheapest)
- Ensure efficient delivery of packets.

Routing algorithms are used in routers to create and update the routing table.

Types of Routing

1) Static - manually configured by network administrator best for small and stable networks
   Eg - Fixed Roads
2) Dynamic - Automatically learned and updated by routers, best for medium & large networks
   Eg - self-updating GPS

Types of Routing ~~Algorithms~~

Global Routing

- Each Router has complete knowledge of network Topology.
- Routing decision is taken independently
- Highly scalable
- High accuracy, fast path calculation suitable for complex networks
- High overhead due to global state sharing
- Eg - Link State Routing

Centralized Routing

- A single central router or controller makes routing decision for whole network.
- Made by central Controller
- Limited scalability
- Simple management, ~~easier~~ easier control.
- Higher delay if central Node is overloaded.
- Eg - SDN (Software defined networking) with controller

Simple Examples –

- Global Routing – A network has 5 Routers. Each Router exchanges information with every other router. Like R2 knows link cost of all other routers

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- Centralized Routing – A network has 5 Routers but one central controller making all decisions. Like it calculate best routes for all routers

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The Link state (LS) Routing Algorithm

The Link state Routing algorithm builds a complete of Network topology at each Router. Routing decisions are based on global information.

→ working

1) Network Discovery - Each router finds its directly connected network and cost to reach them.

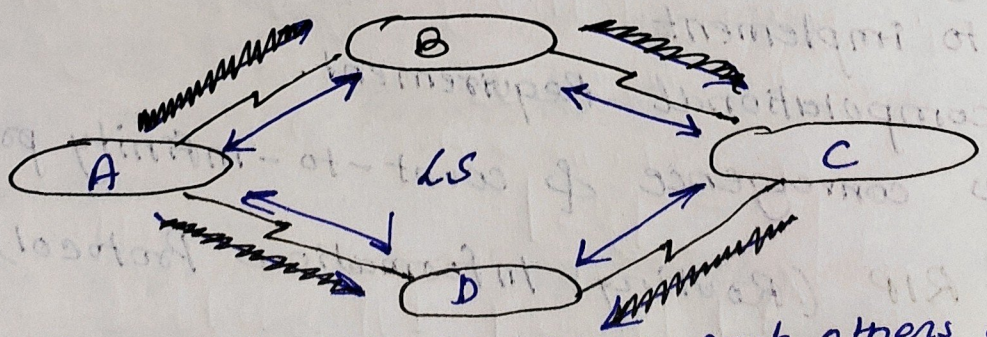
2) Link state Advertisement - Each Router generates link state packeting to describe its link.

3) Database formation - All routers collects LSA's and build an ideal topology database.

4) Shortest path calculation - Each router runs Dijkstra's Shortest path Algorithm to compute optimal route.

5) Routing table updates - Based on shortest path Routing table is updated and Created.

Example - OSPF (open Shortest Path First)
IS-IS (Intermediate System to Intermediate System



All routers can access each others data.

Advantages of Link State

- Fast convergence
- Accurate routing due to complete topology knowledge

But it is more complex to implement.

The Distance Vector Routing Algorithm

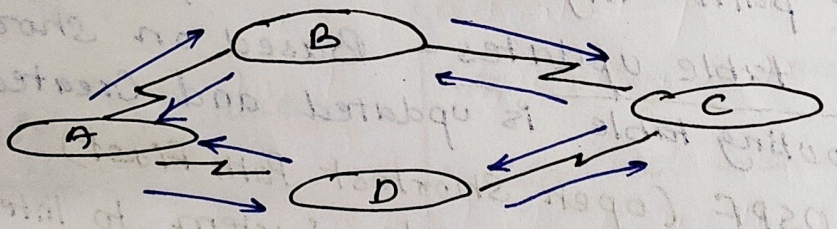
The distance Vector Routing Algorithm is based on exchanging routing tables with neighbours periodically.

→ Working

1) Initialize distance Vector
   Each Router starts with distance 0 to itself and ∞ to others.
2) Periodic Exchange
   Each router exchange routing tables with its direct neighbours only.
3) Update Routing table
   Router checks if going to neighbor offer shortest path through -

$$D(i,j) = \min(D(i,j), D(i,k) + D(k,j))$$

4) Propogation - update propogate gradually until all router converge.



Advantages

- Simple to implement.
- Low computational Requirement.

But slow convergence & count-to-infinity problem.

Eg → RIP (Routing Information Protocol)

Brief difference

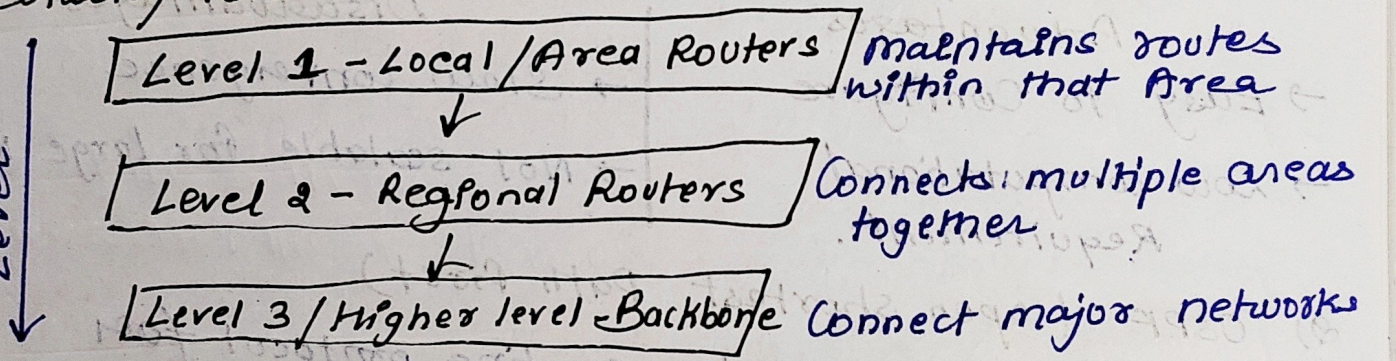
Link state	Distance Vector
• Full Network topology	• Distances to destination only.
• Dijkstra Algorithm used	• Bellman-Ford used.
• Fast	• Slow
• Knowledge type = Global	• Knowledge type = local
• Eg - OSPH, IS-IS.	• Eg = RIP, BGP

Hierarchical Routing

Hierarchical Routing is a routing technique in which the network is divided into multiple layers or region. and Routing is done level by level instead of treating the entire network.

→ Hierachy levels

Real life Ex → Internet, Mobile Networks



→ Example - A Rooter inside college → knows all devices in college but only summary route to university WLAN / Internet.

key idea - Rooter store
- Detailed Routes for their local Region
- Summary Routes for other Regions

Advantages -
- works very well for large networks.
- Reduced memory Requirement - Smaller Routing table
- Faste Route

But it depends upon upper level, more difficult to configure.

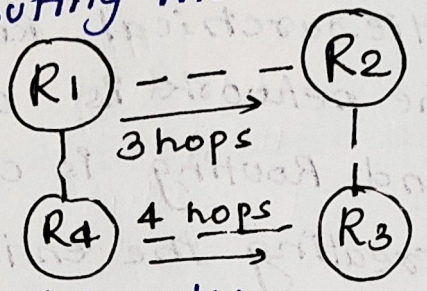
Routing

Routing in the Internet refers to selecting the best path for data packets to travel across a network. And can be done based on network size, complexity and administrative control

The three most widely used protocols are —

1) RIP — Routing Information Protocol

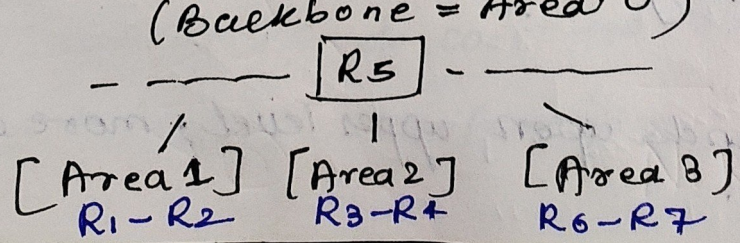
- RIP is one of the oldest distance vector Routing protocol uses hop count as routing metric.
- Maximum Hop count = 15
- Periodic updates = every 30 sec
- Uses Bellman-Ford Algo
- Suitable for small & simpler Networks



Advantages	Disadvantages
→ Easy to Configure	→ Slow convergence
→ Low computational Requirement.	→ Not scalable for large Network

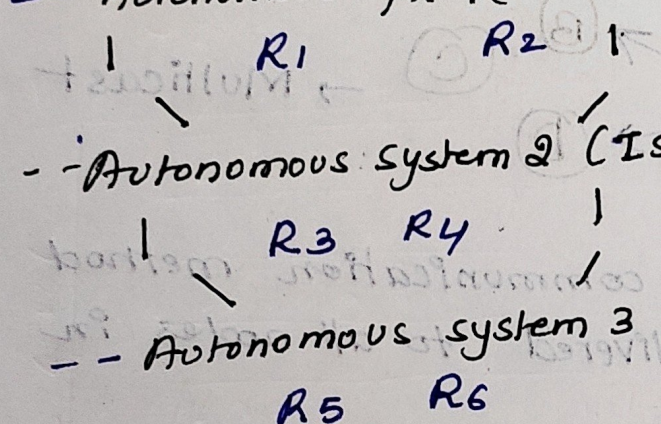
2) OSPF (Open Shortest Path First)

- OSPF is a Link state routing protocol for large Enterprise Network.
- Uses cost (based on bandwidth) as a metric
- Uses Dijkstra's Algo for shortest path
- Supports Hierarchical design using Areas
- backbone = Area 0
- Triggered updates instead of periodic updates
- Fast convergence & Highly scalable.
- But use higher memory and CPU usage



③ BGP (Border Gateway protocol)

- BGP is the main Routing protcol of the Internet and operates between Autonomous systems.
- It is a path vector Protocol.
- Exchange Routing path and policies, not just cost metrics.
- Works on TCP (port 179)
- Support scalability for global Internet Routing.
- Highly scalable and support routing policies & traffic Engineering.
- Complex to Configure and maintain

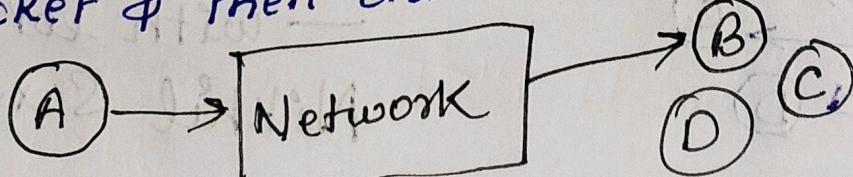


Introduction to Broadcast, Unicast, multicast

- Unicast Routing
- Unicast Routing is a method in which data is sent from one single source to one specific destination across the network.
- It is one to one communication.
- One sender → One Receiver.

Ex → whatsapp message to one person, it goes to only one person — this is unicast

- In unicast router looks to match IP address of packet & then choose shortest path to reach it.

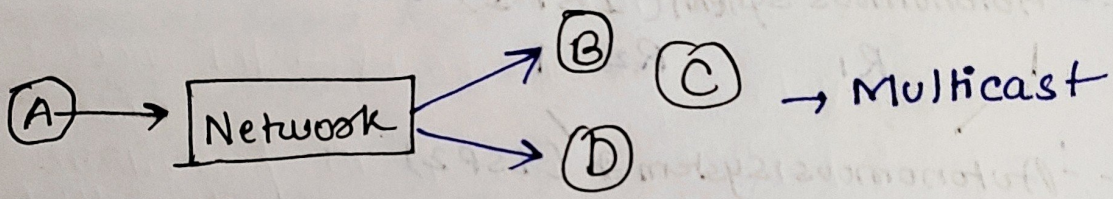


- Multicast Routing

Multitask Routing is a communication method where packed is delivered only to a selected group of receivers.

- One sender → Mutiple specific nodes to receive the packet (not everyone)
- Routes maintains multicast group (group IDs) then forward packet only on links where group member exist.
- Common Multitask Routing Protocols → PIM-SM, PIM-DM

Eg - Video Confrencing, Multiplayer online games



- Broadcast Routing

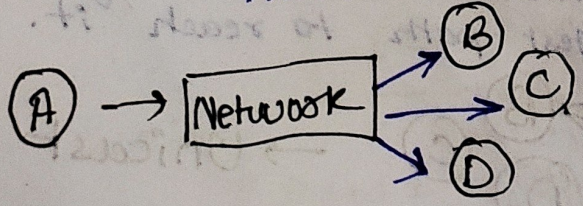
Broadcast Routing is a communication method where a packet is delivered to all nodes in the network.

- One sender — All nodes receeive the same packet.
- Avoid sending seperate packets to each node — saves time and resources.

How it works —

- Flooding - forward packet on every outgoing link
- Spanning Tree - build loop-free tree remove duplicates
- Reverse path forwarding - forward only if shortest route.

Ex → DHCP server searching for Clients.
Announcement in Local Network



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Nikhil Saxena