Computer Networks

BCST -502 BCSP- 502

B.Tech (CSE) 5th Semester

Course Instructor: Dr Bishwajeet Pandey

New 2020 Syllabus

Unit –I

Computer Network: Definitions, goals, components, Architecture, Classifications & Types.Layered Architecture: Protocol hierarchy, Design Issues, Interfaces and Services, ConnectionOriented & Connectionless Services, Service primitives, Design issues & its functionality. ISOOSI Reference Model: Principle, Model, Descriptions of various layers and its comparison with TCP/IP. Principals of physical layer: Media, Bandwidth, Data rate and Modulations

Unit-II

Data Link Layer: Need, Services Provided, Framing, Flow Control, Error control. Data Link Layer Protocol: Elementary &Sliding Window protocol: 1-bit, Go-Back-N, Selective Repeat, Hybrid ARQ. Protocol verification: Finite State Machine Models & Petri net models. ARP/RARP/GARP

Unit-III

MAC Sub layer: MAC Addressing, Binary Exponential Back-off (BEB) Algorithm, Distributed Random Access Schemes/Contention Schemes: for Data Services (ALOHA and Slotted- ALOHA), for Local-Area Networks (CSMA, CSMA/CD, CSMA/CA), CollisionFree Protocols: Basic Bit Map, BRAP, Binary Count Down, MLMA Limited Contention Protocols: Adaptive Tree Walk, Performance Measuring Metrics. IEEE Standards 802 series & their variant.

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Unit-IV

Network Layer: Need, Services Provided, Design issues, Routing algorithms: Least CostRouting algorithm, Dijkstra's algorithm, Bellman-ford algorithm, Hierarchical Routing,Broadcast Routing, Multicast Routing. IP Addresses, Header format, Packet forwarding,Fragmentation and reassembly, ICMP, Comparative study of IPv4 & IPv6

Unit-V

Transport Layer: Design Issues, UDP: Header Format, Per-Segment Checksum, CarryingUnicast/Multicast Real-Time Traffic, TCP: Connection Management, Reliability of DataTransfers, TCP Flow Control, TCP Congestion Control, TCP Header Format, TCP TimerManagement. Application Layer: WWW and HTTP, FTP, SSH, Email (SMTP, MIME, IMAP), DNS, Network Management (SNMP).

About Course Instructor

- PhD from Gran Sasso Science Institute, Italy
- PhD Supervisor Prof Paolo Prinetto from Politecnico Di Torino, World Rank 13 in Electrical Engineering
- MTech from Indian Institute of Information Technology, Gwalior
- Scopus Profile: https://www.scopus.com/authid/detail.uri?authorId=57203239026
- Google Scholar: https://scholar.google.com/citations?user=UZ_8yAMAAAAJ&hl=hi
- Contact: gyancity@gyancity.com, +91-7428640820 (For help in this Subject @ BIAS and Guidance for future MS from Europe and USA after BIAS)

About Course Outline

- UNIT 1: Lecture No 1-4
- UNIT 2: Lecture No 5-11 (Including Lab on Vivado)
- UNIT 3: Lecture No 14-18
- UNIT 4: Lecture No 19-21, Lecture 12-13
- UNIT 5: Lecture No 22-28 (Including Lab on Packet Tracer)
- Lecture No 29-35: Discuss Previous Year Question of UKTU
- Out of 35 Lectures: Some will delivered by Professor From Foreign University

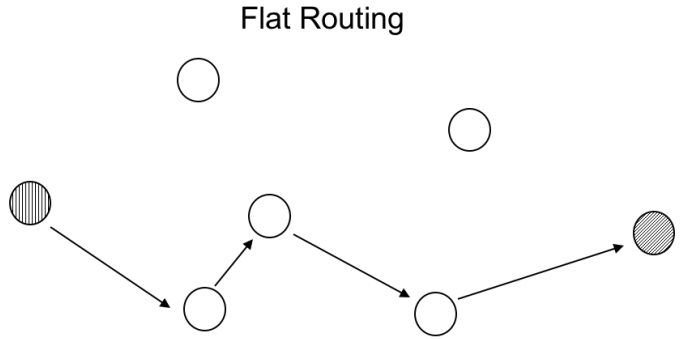
OUTLINE OF LECTURE 21

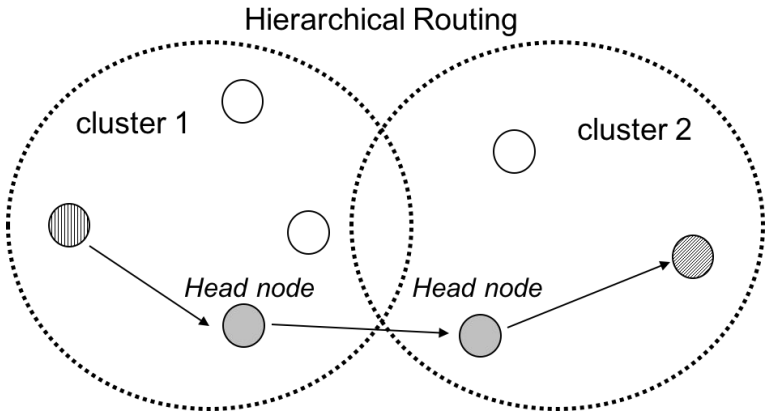
- **Routing Protocols**
  - Hierarchical Routing
  - Broadcast Routing
  - Multicast Routing
- **ICMP**
- **Network Topology**

Hierarchical Routing

- **Hierarchical routing** is a method of routing in networks that is based on hierarchical addressing.

- Hierarchical routing is the procedure of arranging routers in a hierarchical manner. A good example would be to consider a corporate intranet.





Hierarchical Routing

- Most Transmission Control Protocol/Internet Protocol (TCP/IP) routing is based on a two-level hierarchical routing in which an IP address is divided into a network portion and a host portion.

- Gateways use only the network portion until an IP datagram reaches a gateway that can deliver it directly.

- Additional levels of hierarchical routing are introduced by the addition of subnetworks.

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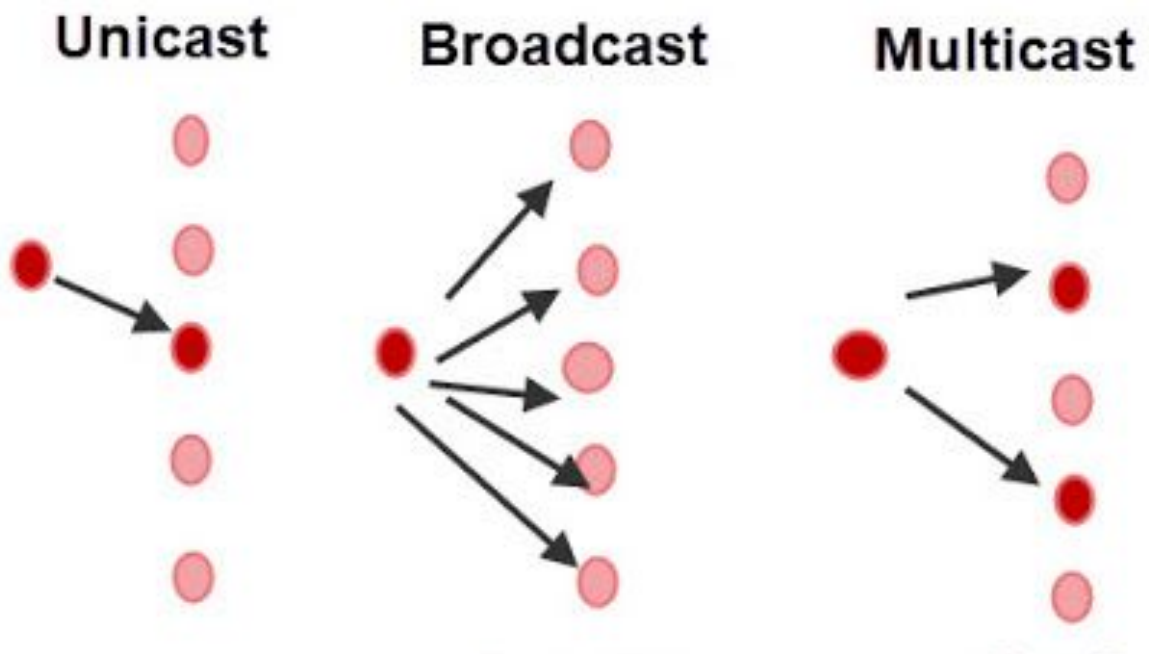
Hierarchical Routing

- Hierarchical routing has been presented as a way of arranging wide ad hoc networks in clusters to improve network efficiency.

- Although the clustering mechanism may lead to an increase in control traffic and complexity, routing protocols can benefit from hierarchical structures so that routing flooding, especially in proactive protocols, can be confined within clusters and nodes can be arranged in virtual groups to optimize communications and reduce interferences.



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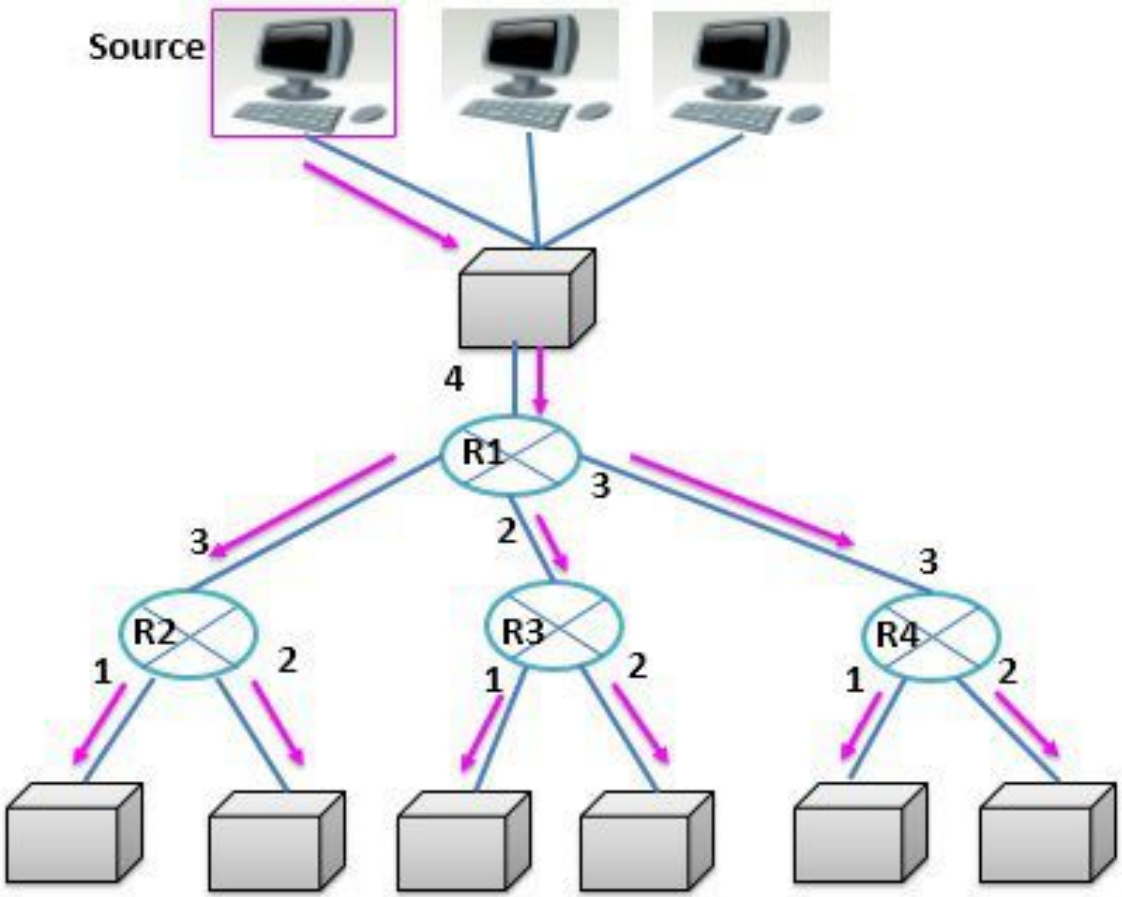

Broadcast

Broadcast Routing

- Broadcasting: send a packet to all destinations.
  - Distributing weather reports, stock, radio programs, etc.
- Broadcast routing algorithm
  - Send a distinct packet to each destination (waste bandwidth)
  - Flooding (generate too many packets)
  - **Multi-destination routing**
    - The packet includes a list of destinations
    - The router sends the packet on an outgoing line if it is the best route for at least one of destinations (according to routing table).

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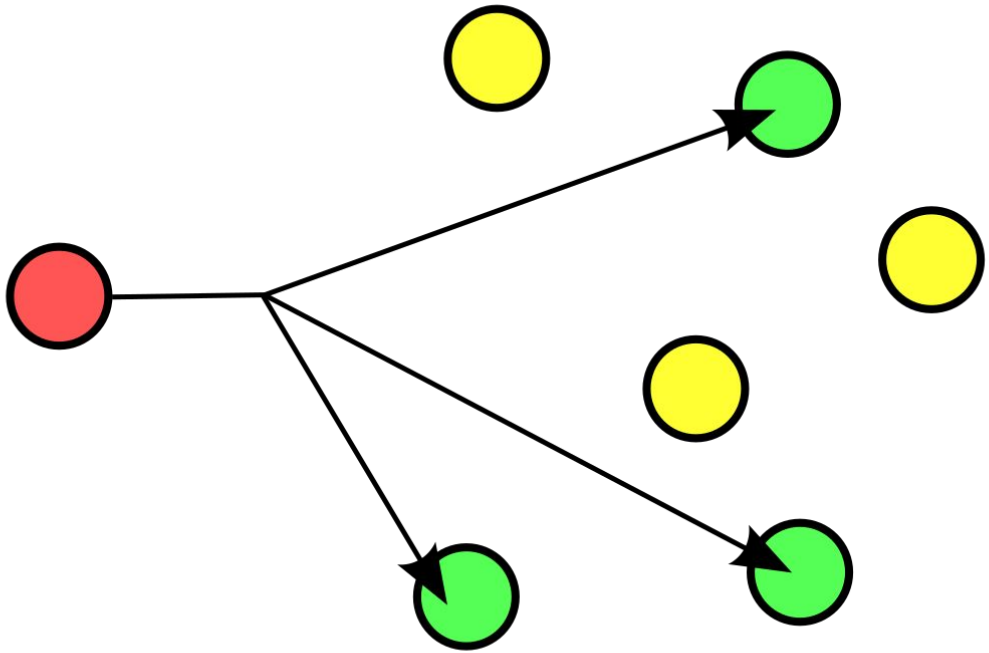
Multicast



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Multicast Addresses

- IPv4 Multicast addresses use the reserved **class D** address range:
- `224.0.0.0 through 239.255.255.255`
- The addresses range between **224.0.0.0 and 224.0.0.255** is reserved for use by routing and maintenance protocols inside a network.

Multicast routing

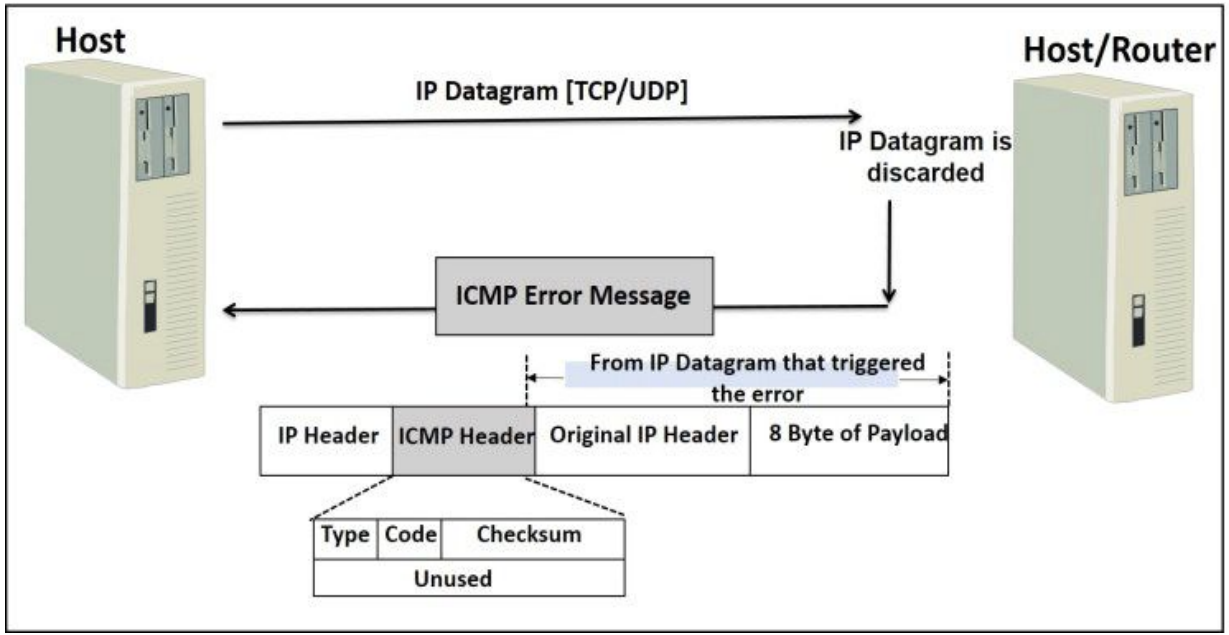
- **Multicast Routing** is one of the routing protocols in TCP/IP communication.
- In computer networking, there are several multicast group communication protocols where data transmission is addressed to a **group of destination computers** simultaneously.
- To implement the multicast routing, IGMP protocol and multicast routing protocol(Reverse-path forwarding, PIM-SM) for registration subscriber grouping and control traffic are required for multicast transmission.

Broadcast Versus Multicast

- Multicasting is different from IP broadcasting as:
  a. Broadcasting uses a single IP address. Host bits set to all 1's. There are a range of multicast addresses
  b. Broadcast messages are not sent through routers but multicast messages are.
  c. All hosts will receive broadcasts by default
  d. A host must be configured to receive multicast messages.

ICMP

- **ICMP** (Internet Control Message Protocol) is an error-reporting protocol network devices like routers use to generate error messages to the source IP address when network problems prevent delivery of IP packets.



What is the purpose of ICMP?

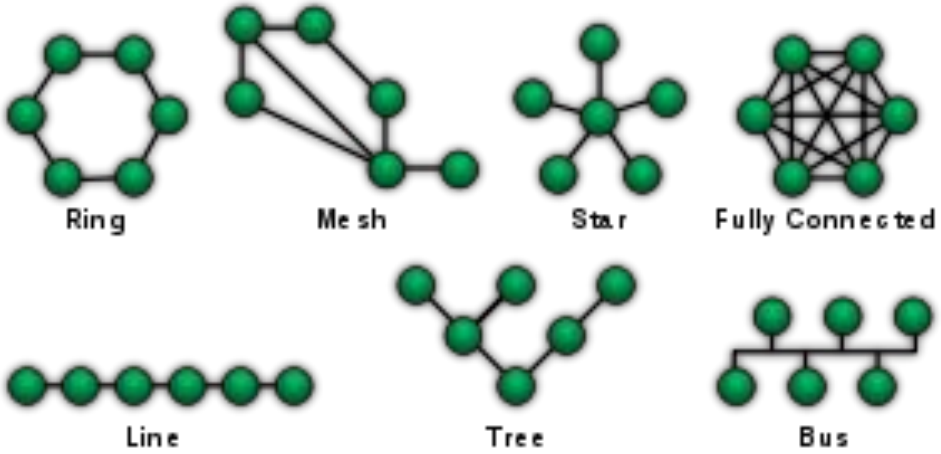
- IP: Internet Protocol does not have a built-in mechanism that sends control messages and error messages. That is why a **protocol like ICMP** is needed.
- Practically, ICMP offers **error control** and often it is employed to report errors, send **management queries** and operations information.
- Network devices like routers need to use the ICMP in order to send the error messages. That is why ICMP is considered as a supporting protocol.

What are the ICMP message codes?

- 0: **Echo Reply**. It is used for ping.
- 3: Destination is unreachable.
- 4: **Source quench**. It means that the router is overloaded.
- 5: Redirect. It denotes the use of another router.
- 8: **Echo Request**. Similar to 0, it is used for ping.
- 9: Router advertisement reply.
- 10: **Router solicitation**.
- 11: Time Exceeded. It is used for traceroute.

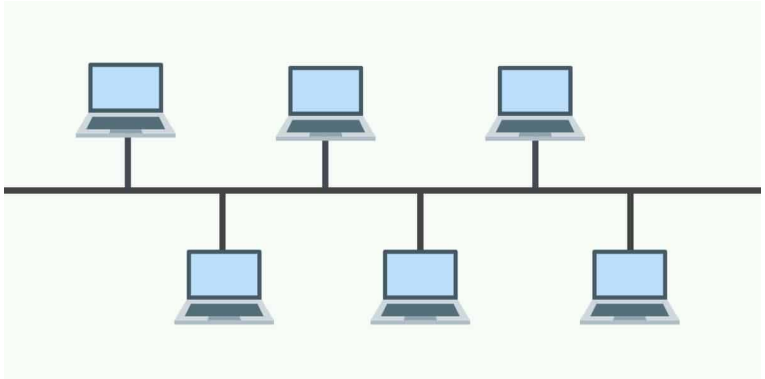
Network Topology

- **Network topology** is the arrangement of the elements (links, nodes, etc.) of a communication network.



BUS Topology

- Bus topology is a network type where every device is connected to a single cable that runs from one end of the network to the other.
- This type of network topology is often referred to as **line topology**. In a bus topology, data is transmitted in one direction only.



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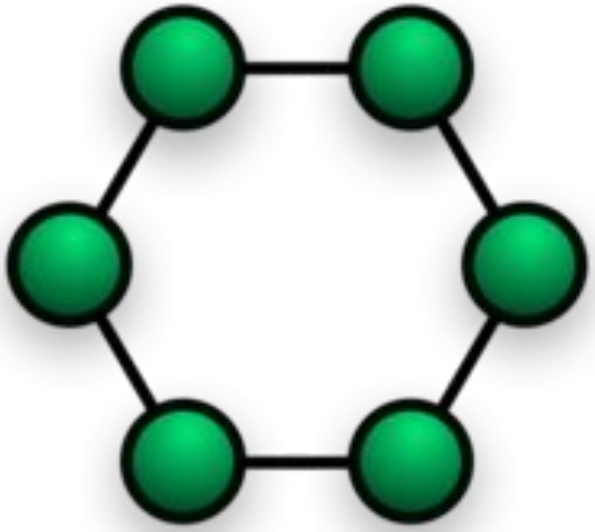
Ring Network

- A **ring network** is a network topology in which each node connects to exactly two other nodes, forming a single continuous pathway for signals through each node - a ring. Data travels from node to node, with each node along the way handling every packet.



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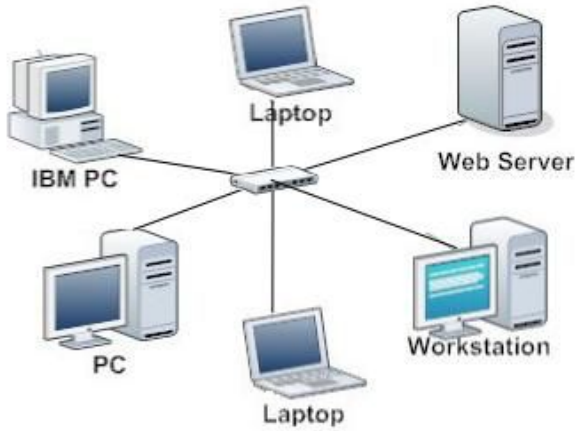
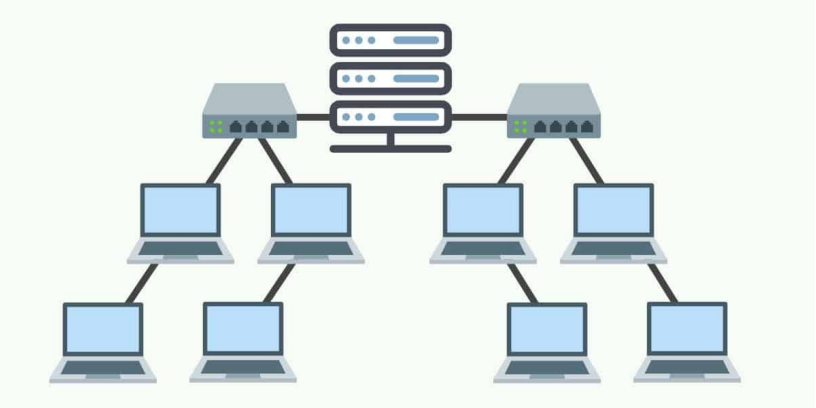
Star Topology

- A **star topology** is a **topology** for a Local Area **Network** (LAN) in which all nodes are individually connected to a central connection point, like a hub or a switch. A **star** takes more cable than e.g. a bus, but the benefit is that if a cable fails, only one node will be brought down.



Tree Topology

- A tree topology network is a structure that is shaped like a tree with its many branches.
- Tree topologies **have a root node** that is connected to another node hierarchy.
- The **hierarchy is parent-child** where there is only one mutual connection between two connected nodes.



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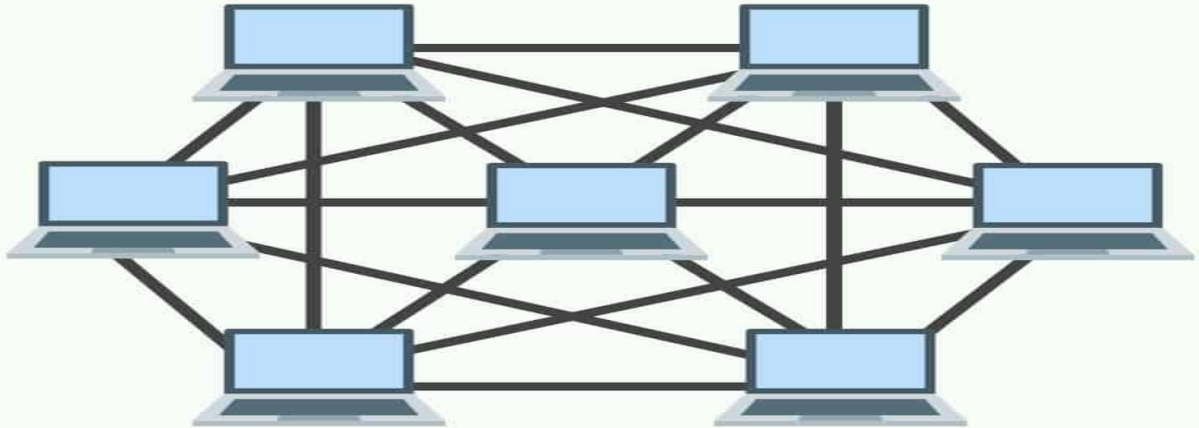
Mesh Topology

- A mesh topology is a point-to-point connection where nodes are interconnected. In this form of topology, **data is transmitted via two methods**: **routing** and **flooding**.



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