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Principles of Internet Technologies

Lecture 3:

Network Types

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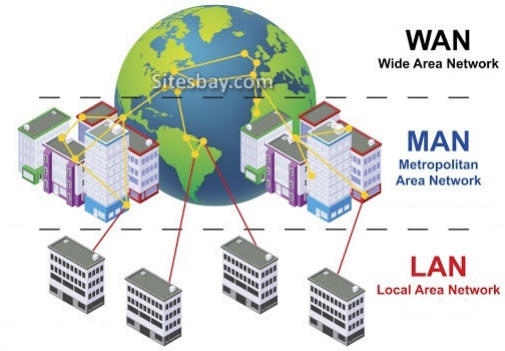

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Computer Network

- *The computer network (**CN**) size may vary from **small** to **large** depending on the number of computers it connects. A CN can include different types of **hosts** (also called nodes) like **server**, **desktop**, **laptop**, **cellular phones**.*
- *Apart from **CN**, **CN** also included networking devices like **switch**, **router**, **modem**, etc.*
- *CN devices and hosts can be connected either through **wired media** like **cables** or **wireless media** like **air***
- *For communication, data in a network is divided into **smaller chunks** called **packets**. These **packets** are then carried over a network..*

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Network Components

1. ***The Network Hardware Devices.***
2. ***Network Media: Wired:*** *Twisted Pair cables, Co-axial, fiber Optic,* ***Wireless:*** *Microwave, Satellite*
3. ***Network Types: we can classify networks in different ways:***
    1. ***Based on the network's Geographical Area and network size: (****LAN,WAN, MAN, etc)*
    2. ***Based on Physical Topologies (connectivity):*** *(Bus, Ring, Star, Mesh, Hybrid Topologies)*
    3. ***Based on Architecture method:*** *(Peer-to-Peer, Client/Server)*
4. ***Network Protocols:*** *(TCP/IP).*
5. ***Applications of Networks.***

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Network Types: Geographical Area

- *There are various types of computer networks and based on the* ***geographical area*** *and* ***network size****, computer networks are broadly categorized as:*
    1. ***PAN*** *(Personal Area Network)*
    2. ***LAN*** *(Local Area Network)*
    3. ***CAN*** *(Campus Area Network)*
    4. ***MAN*** *(Metropolitan Area Network)*
    5. ***WAN*** *(Wide Area Network).*

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PAN (Personal Area Network)

- *PAN Also Known as **HAN** (Home Area Network) **is the interconnection between devices within the range of a person's private space, typically within a range of 10 m.***
- *If you have transferred images or songs from your laptop to mobile using Bluetooth or Wi-Fi , you have set up and used a personal area network.*
- *This network could be fully **Bluetooth**, **Wi-Fi** or a combination of **wired and wireless.***

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LAN (Local Area Network)

- *LAN or Local Area Network is a network that connects computers, mobile phones, tablet, mouse, printer, etc., **placed at a limited distance.***
- *The geographical area covered by a **LAN** can range from a **single room**, a **floor** or an **office.***
- *A LAN may be set up using **wired**, **Ethernet cables**, **fibre optics** or **wireless (Wi-Fi)**. A LAN that is completely wireless is called **Wireless LAN** or **WLAN**.*
- ***Ethernet** is a set of rules that decides how computers and other devices connect with each other through cables in a **local area network (LAN)**.*

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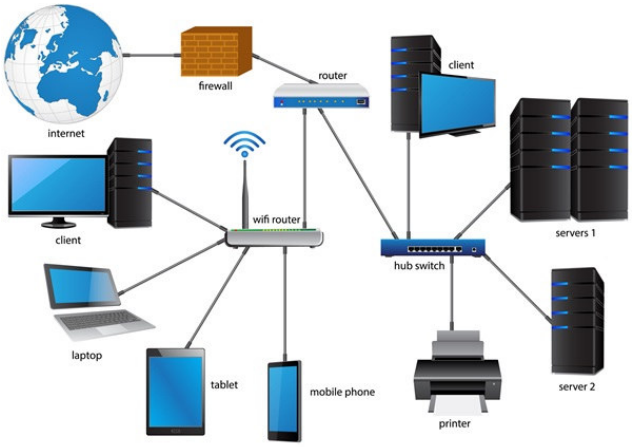
LAN (Local Area Network)

- *LAN networks can be extended up to **1 km**. Data transfer in LAN is **quite high**, and usually varies from **10 Mbps (called Ethernet)** to **1000 Mbps (called Gigabit Ethernet)**.*



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CAN (Campus Area Network)

- *A **CAN** is a **group** of interconnected local area networks (LANs) within a limited geographical area such as **university Campuses**. These LANs are connected via switches and routers, then creating a single network called **CAN**.*
- ***CAN is larger than LAN but smaller than MAN and WAN.***
- *This network is sometimes called a **Residential Network** or **ResNet**, because it is only used by **residents of a particular campus**.*
- *The Campus Area Network covers areas within a range of about **1 to 5 km** and it can be **wired** or **wireless**.*

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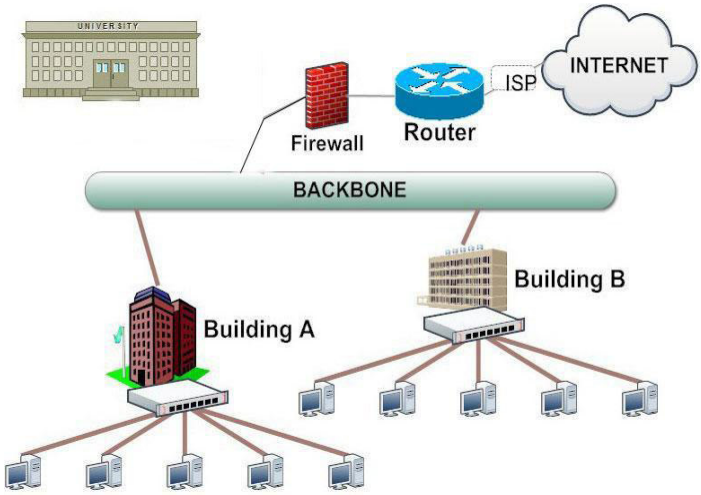
CAN (Campus Area Network)

- *Each building in the campus would usually have **one** or more **LANs**, with each LAN having a set of computers connected together by a **switch**.*
- ***The objective of CAN** is to share **hardware** and **software** resources, thereby **decreasing infrastructure costs for the organization**.*



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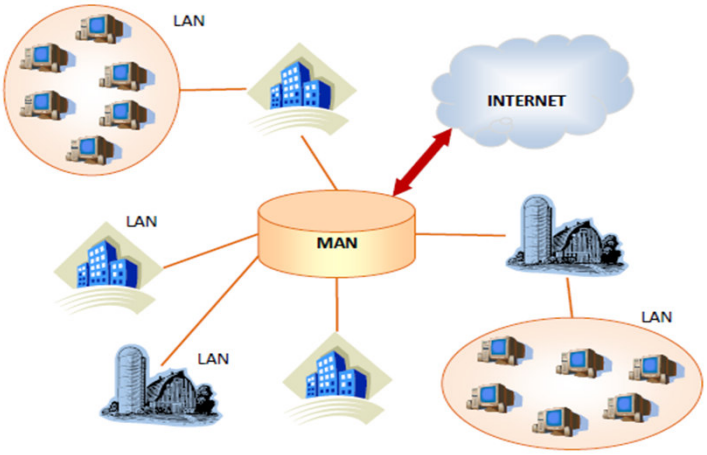
MAN (Metropolitan Area Network)

- *MAN is an **extended form of LAN** which covers a larger geographical area like a city or a town. Data transfer rate in MAN also ranges in **Mbps**, but it is considerably **less** as compared to LAN.*
- *This kind of network can be extended up to **30–40 km**. A MAN is a combination of **multiple LANs**, MANs are **larger than LANs**, but **smaller than WAN**. The most common example of MAN is **cable TV network.***
- ***MANs are typically owned and managed by a single entity. This could be an ISP or telecommunications company that sells its services to end-users in that metropolitan area.***

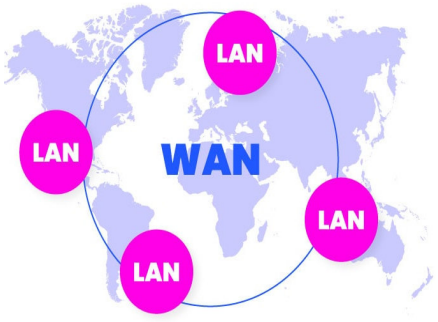
MAN (Metropolitan Area Network)

- ***MANs** are typically extremely efficient and can provide fast communication via **high-speed carriers,** such as **fiber optic cables.***



WAN (Wide Area Network)

- *WAN is spread over a **country** or **many countries**. WAN is typically a network of **many LANs and MANs**. **WAN** Network is set up using **wired** or wireless connections, depending on availability and reliability.*
- *WAN allows the transmission of data across **greater geographic distances**. The most common example of **WAN** is the **Internet**.*



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Network Topologies

- *Geometric representation in which devices are interconnected to form a network is called **network topology**. Network topology defines the structure of the network. There are five types of topology and these are:*
  1. ***Bus topology.***
  2. ***Ring topology.***
  3. ***Star topology.***
  4. ***Mesh topology.***
  5. ***Hybrid topology.***

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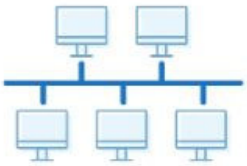
Network Topologies: Bus topology

- ***A Bus topology** consists of a **single cable** called a **backbone (usually coaxial)** connecting all nodes on a network **without intervening connectivity devices (switch or hub)**. When a workstation has to send data, it transmits packets with destination address in its header along the bus. There are **terminators** at each end of the bus that **stops the signal** and **keeps it from traveling backwards**.*
- ***Advantages of Bus Topology:***
  1. *Easy to install and maintain and can be extended easily.*
  2. *Very reliable because of single transmission line.*



- ***Disadvantages of Bus Topology:***
  1. *It is possible that more than one station may attempt transmission in the same time (collision).*
  2. *Additional devices slow the network down.*

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Network Topologies: Ring topology

- *In ring topology each terminal is connected to exactly two nodes, giving the network a circular shape. Data travels in only one pre-determined direction.*
- *One method for passing data on ring networks is **token passing**, When a terminal has to send data, it transmits it to the neighboring node which transmits it to the next one.*

- ***Advantages of Ring Topology:***
  1. *Avoids the **collisions** that are possible in the bus topology.*
  2. *Ideal for optical fibres as data travels in only one direction.*
- ***Disadvantages of Ring Topology:***
  1. *A break in the ring (such as station disabled) can disable the entire network.*
  2. *Difficult to remove one or more nodes while keeping the rest of the network intact.*

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Network Topologies: Star topology

- *In star topology all devices are connected to a central hub. Nodes communicate across the network by passing data through the hub or switch. Star topology is considered very effective, efficient and fast as each device is directly connected with the **central device**.*
- ***Advantages of Star Topology:***
  1. *Robustness, if one link fails; only that link is affected. All other links remain active.*
  2. *Easy to install and reconfigure.*

- ***Disadvantages of Star Topology:***
  1. *Requires more cabling than ring or bus .*
  2. *Failure of central node brings down the whole network.*

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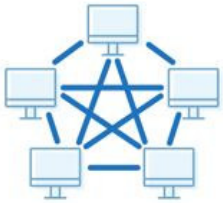
Network Topologies: Mesh topology

- *In Mesh topology each terminal has its connections to all other terminals. Mesh topology is implemented to provide as much protection as possible from interruption of service* ***because each cable between two nodes carries different data.***
- ***Advantages of Mesh Topology:***
  1. *The use of dedicated links guarantees that each connection can carry its data load, thus eliminating the traffic problems that can occur when links must be shared by multiple devices.*
  2. *Provide more Privacy and Security.*
- ***Disadvantages of Mesh Topology:***
  1. *A large amount of cabling and I/O ports required.*
  2. *Installation and reconfiguration are difficult.*



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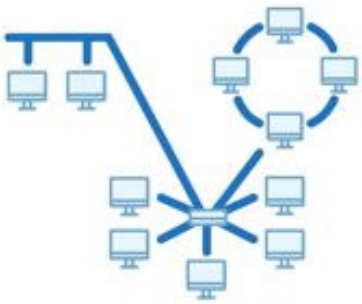
Network Topologies: Hybrid topology

- *Hybrid is a combination of any two or more network topologies like star, ring, and bus. Such topologies are usually realized in* ***WANs network type*** *where multiple* ***LANs*** *are connected. Those LANs may be in the form of ring, bus or star.*
- ***Advantages of Hybrid Topology:***
  1. *Reliable as Error detecting and trouble shooting is easy.*
  2. *Scalable as size can be increased easily.*
- ***Disadvantages of Hybrid Topology:***
  1. *Complex in design.*
  2. *Costly.*



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Network Topologies

- *Some of the factors that affect choice of topology for a network are:*

1. ***Cost:*** *Installation cost is a very important factor in overall cost of setting up an infrastructure.*
2. ***Flexibility and Scalability:*** *The topology of a network should be flexible enough to allow reconfiguration of network setup and scalable enough to allow the addition of new devices without affecting the network performance.*
3. ***Reliability:*** *Network should be designed in such a way that it has minimum down time. Failure of one node or a segment of cabling should not render the whole network useless.*
4. ***Ease of installation:*** *Network should be easy to install in terms of hardware and software.*
5. ***Ease of maintenance:*** *Troubleshooting and maintenance of network should be easy.*

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Network Architecture Method

- ***Network architecture*** *refers to how computers are organized and how tasks are allocated between these computers to get the maximum advantages of a computer network such as* ***better response time***, ***security***, ***scalability*** *etc.*
- *Two of the most widely used types of network* ***architecture*** *are*

1. ***Peer-to-Peer architecture***
2. ***Client/server architecture is also called 'tiered' .***

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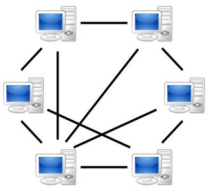
Peer2Peer architecture

- ***Peer2Peer network*** *is a network in which all the computers are linked together with equal capabilities and responsibilities for processing the data. It's mostly used for file sharing.*
- *Peer2Peer network is useful for* ***small environments****, usually up to* ***at least 10 computers*** *and there is no central computer (server) that controls network activity.*
- ***Advantages of Peer2Peer architecture:***
  1. *In case of a one computer failure, all other computers in the network are not affected and they will continue to work.*
  2. *It is less costly as it does not contain any dedicated server.*
- ***Disadvantages of Peer2Peer architecture:***
  1. *Files and folders cannot be centrally backed up.*
  2. *These types of networks do not perform well under heavy data loads.*



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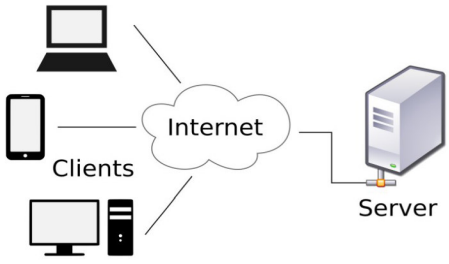
Client/server architecture

- ***Client/server architecture*** *is a type of system where one or more client computers connected to a central server over a network or internet connection to share or use resources.*
- *In* ***Client/server architecture a****ll the communication takes place through the* ***server****, for example if a client wants to share the data with other client then he has to send the data to server first and then the server will send the data to other client.*
- ***Advantages of Client/server architecture :***
  1. *It provides better security than P2P.*
  2. *Data backup is easy.*
- ***Disadvantages of Client/server architecture :***
  1. *In case of server failure entire network is down.*
  2. *It is very expensive as compared to P2P.*



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