Network Hardware

- There are technical issues involved in network design
- There is no generally accepted taxonomy into which all computer networks fit, but 2 dimensions stand out as important: transmission technology and scale
  - classification of networks
- 2 types of transmission technology
  1. Point-To-point links
  2. Broadcast Links.

Point-to-point links

- Connect individual pairs of machines
- To go from source to destination on a n/w, short messages called packets have to first visit one & more intermediate machine.
- In multiple routes, finding good one is important
- P-to-P & P2P transmission with exactly one sender and receiver is called unicasting.

Broadcast links

- The communication channel is shared by all the machines on the network
- packets sent by any machine are received by all the others.

N/w Hardware
- Transmission Technology
  - Point-to-point
  - Broadcast
- Scale
  - PAN
  - LAN
  - WAN
  - MAN
  - Internetwork

- An address field in packet specifies the intended recipient. When a machine receives the packet, it checks the packet, if it is intended for that machine, it takes otherwise ignores.
- Ex: wireless network.

~~Communication channel is shared by all the machines on the network,~~

Communication shared over a coverage region depends on the wireless channel and the transmitting machine.

- Broadcast systems allow the possibility of addressing a packet to all destinations by using a special code in the address field.
- when a packet with this code is transmitted, it is received and processed by every machines on the network.
- This mode of operation is called broadcasting
- Some broadcast systems also support transmission to a subset of the machines, which known as multicasting.

- Another Criteria for classifying network is by Scale Distance is important classification metric because different technologies are used at different scales.
- we classify multiple processor systems by their rough physical size.

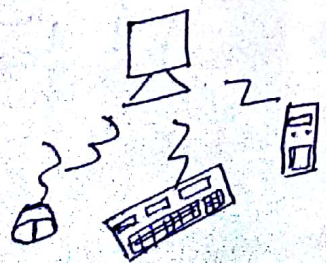
inter processor distance	processors located in same	Example
1m	Square meter	PAN
10m	Room	LAN
100m	Building	
1Km	Campus	
10Km	City	MAN
100Km	Country	WAN
1000Km	Continent	
10,000Km	planet	The internet

- Personal Area Networks (PAN)
  - Devices communicate over the range of a person
  - Ex: wireless n/w that connects computer with peripherals
  - Short range wireless n/w : Bluetooth

Bluetooth n/w use master-slave paradigm

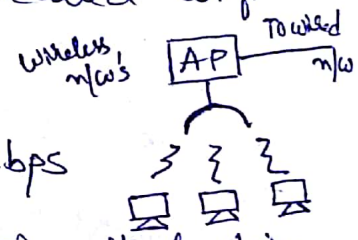
PC is master, mouse keyboard are slaves

master tells slaves - what addresses to use
- when to broadcast
- how long they can transmit
- what frequencies they can use

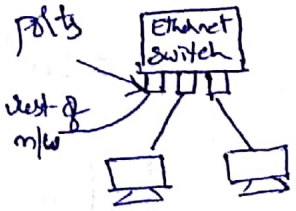


- Local Area Networks

- LAN is privately owned network that operates within and nearby single building like a home, office & factory
- LANs are used to connect computers & electronics to share resources & exchange of information.
- when LAN's are used by companies, they are called enterprise networks.
- Wireless LAN's are very popular
  Every computer has radio modem & an antenna that it uses to communicate with other computers
- A device called Access Point & wireless router or base station, relays packets between the wireless computers & also between them & internet.
- Standard for wireless LAN is IEEE802-11 called wifi.



- LANS (wireless)
  - Runs at speed from 11 - 100's of Mbps
  - use a range of different transmission technologies (copper wires, optical fibers)
  - Restricted in size



- Wired LAN
  - built from point-to-point links
  - IEEE 802.3 called Ethernet

Each Computer speaks the Ethernet protocol and connects to a box called a switch with a point-to-point link.

- A switch has multiple ports, each of which can connect to one computer
- The job of switch is to relay packets between computers that are attached to it, using the address in each packet to determine which computer to send it to.
- To build larger LANs, switches can be plugged into each other using their ports.
- There are other wired LAN topologies too.

  Switched Ethernet is a modern version of the original Ethernet design that broadcast all the packets over a single linear cable.

  one m/c could transmit at a time

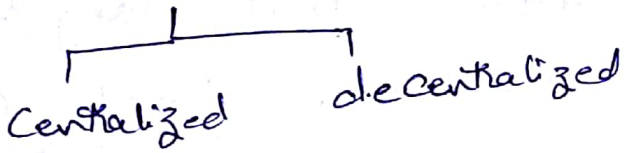
  If 2 or more packets collided, each computer just waited a random time & tried later.

  This is classic Ethernet.

- Both wired & wireless broadcast n/w's can be divided into static & dynamic design depending on how channel is allocated.

- Static allocation
  - Divide time into discrete intervals & use round robin, allowing m/c to broadcast in its time slot
  - wastes channel capacity

- Dynamic allocation

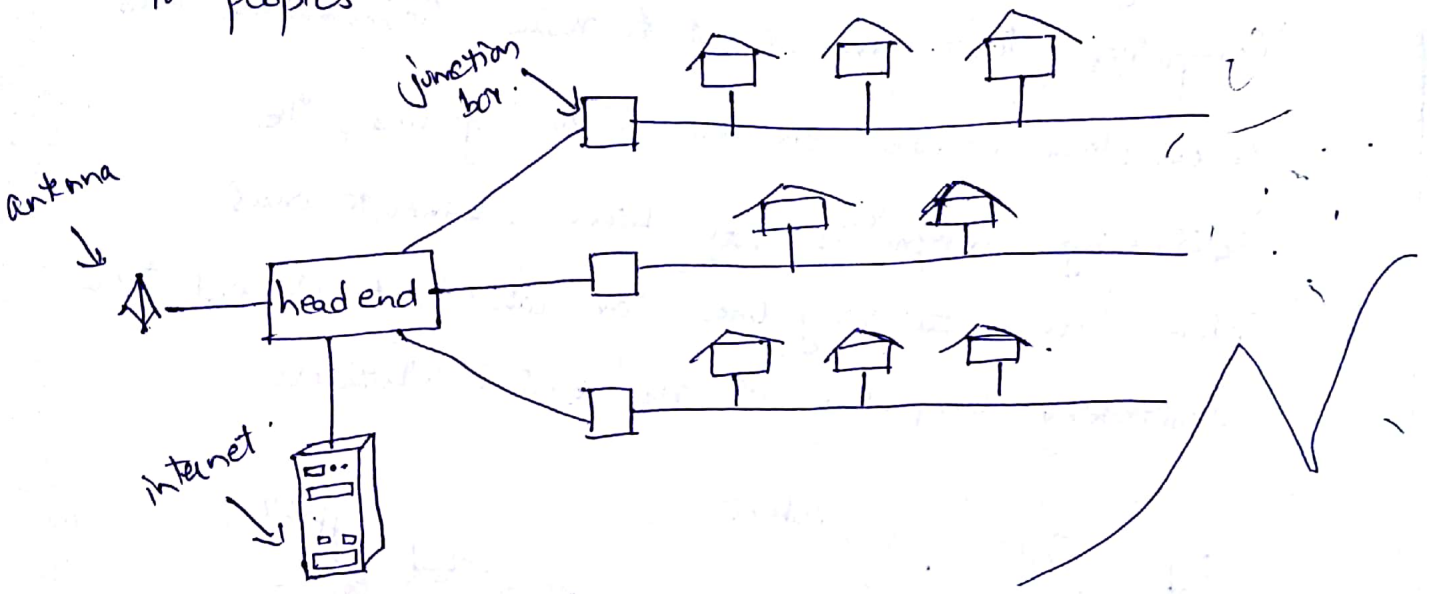


- Centralized
  - Single entity (Ex: Base station) determines who goes next.
  - priority is followed.

- Decentralized
  - No central entity
  - Each m/c decide for itself whether to transmit.

- Metropolitan Area Network

- Covers a city
- Ex: Cable television n/w's
- Both television signals and internet being fed into the centralized cable headend for subsequent distribution to people's homes.



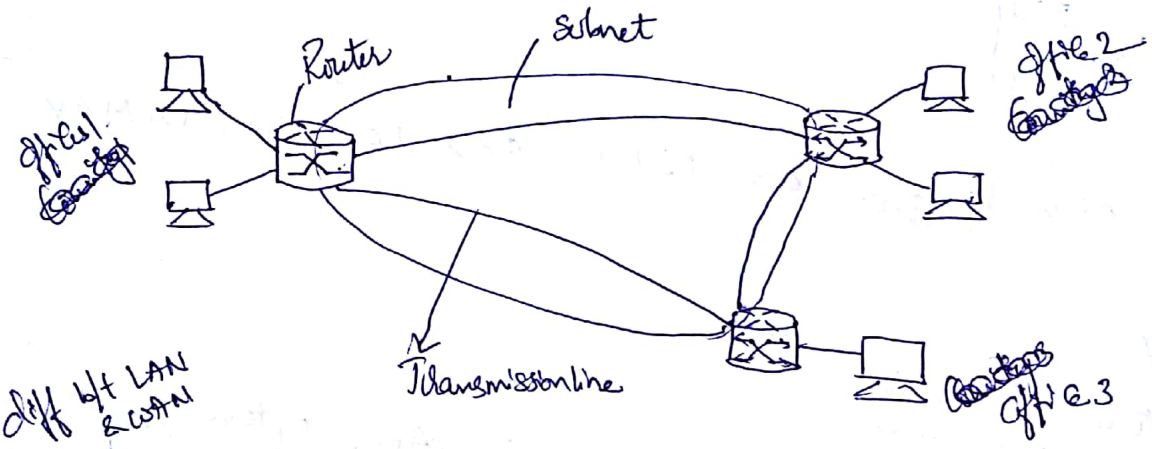
- MAN Standardized as IEEE 802.16 called WiMAX

~~Wireless~~ /

Wide Area Networks

- A WAN spans a large geographical area, often a country & continent.
- Computers are intended for running user programs these machines are hosts.
  Network that connects these hosts is called Communication Subnet & Subnet.
- Job of subnet is to carry messages from host to host

- In WAN, Subnet Consists of 2 distinct Components
  - Transmission lines
  - Switching elements
- Transmission lines move bits between machines They are made of Copper, optical fiber, radio links
- Switching elements or switches are specialized Computers that Connect 2 or more transmission lines when data arrive on an incoming line, the switching ~~computers have been~~ element must choose an outgoing line on which to forward them Switching Computers are also called routers



diff b/t LAN & WAN

- Hosts & Subnet are owned & operated by different people.
- Routers will connect different kinds of networking technology.
- Subnet is connected with LAN's

— 2 varieties of WAN's

1) Rather than lease dedicated transmission lines, Connect office to the internet.

- Connection between offices are made as virtual links that uses underlying capacity of the internet.
- This arrangement is called VPN – Virtual private Network

adv: virtualization – flexible reuse of resource

disadv: lack of control over underlying resource with dedicated line – capacity is clear VPN – may vary with internet service.

2) Subnet may be run by a different Company

Subnet operator is known as network service provider

Subnet operator will Connect to other Customers as long as they pay & it can provide service.

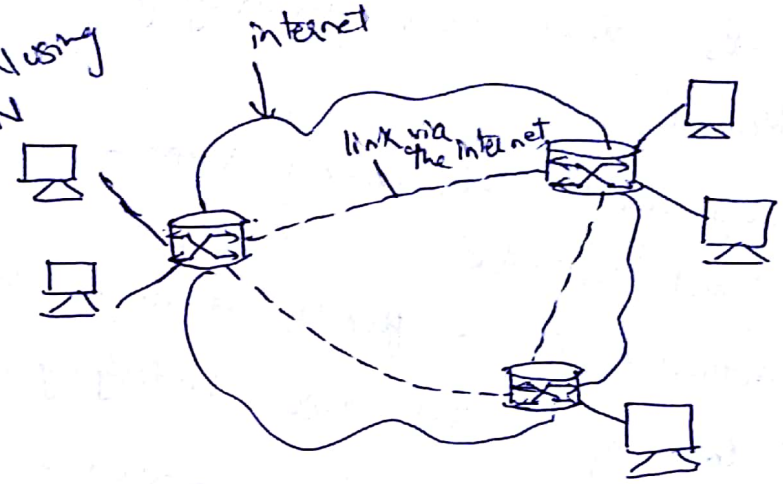
Such Subnet operator is called Internet service provider

– N/w Contain many transmission lines, each Connecting pair of routers.

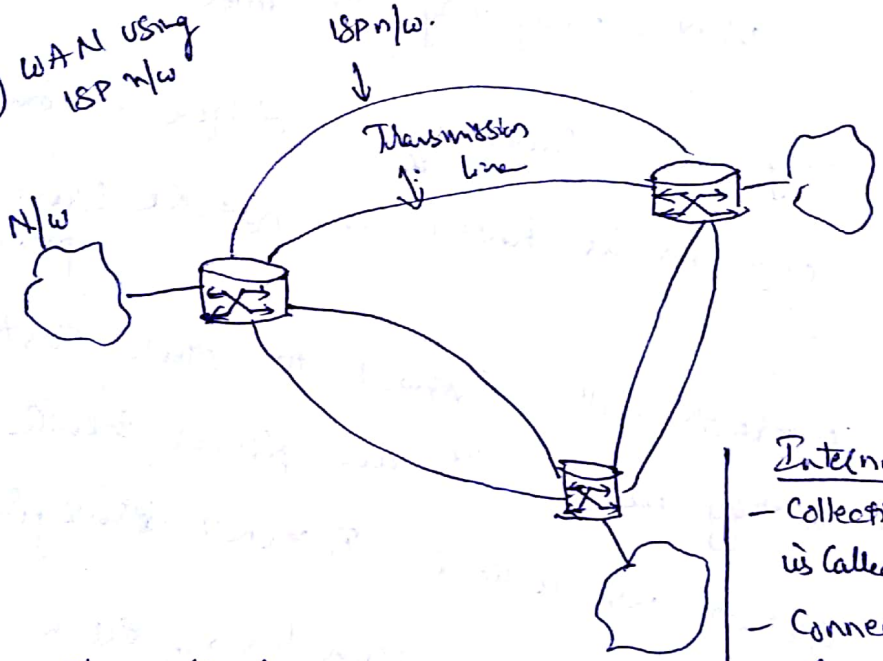
There may be many paths that Connect these 2 routers

- How n/w makes the decision as to which path to use is called routing algorithm.
- How each router makes the decision as to where to send a packet next is called forwarding algorithm

1) WAN using VPN



2) WAN using ISP n/w



- Other kinds of WAN
  - Stetellite systems
  - Cellular Telephone n/w

Internetworks

- Collection of interconnected networks is called internetwork & internet
- Connecting LAN & WAN & 2 LAN's forms an internetwork with agreement
- Machine that makes a connection between 2 or more networks & provides necessary translation in terms of h/w & s/w is a gateway.