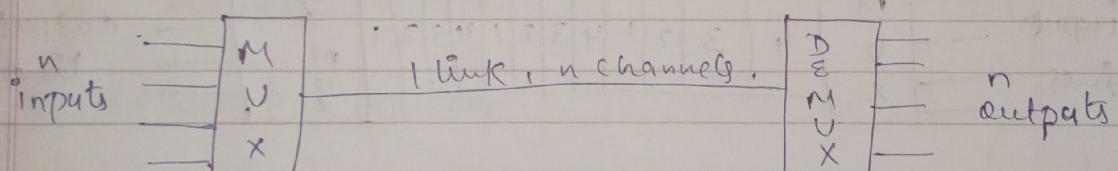


Multiplexing

- * Multiplexing is a technique that allows multiple signals to be transmitted over a single communication channel simultaneously.
- * This helps to increase the efficiency of communication channels & reduce costs.
- * A multiplexer (mux) combines multiple data streams into a single stream (many to 1).
This is commonly used in telephone systems.
- * A D-multiplexer (demux) splits the combined stream into different signals/streams (1 to many).
This is commonly used in broadcasting systems [distribution of audio/video content to a wide audience through radio, TV / ethernet]. It enables a msg to be transmitted to a large no. of people simultaneously.



* Types -

- a) FDM (freq Division (M))
- b) WDM (wave " (M))
- c) TDM (Time " (M)).

(a) FDM

(b) WDM

(c) TDM.

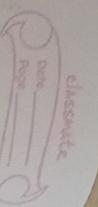
* Divides the freq band into multiple channels & transmit each channel separately.

Divides the wavelength band into multiple channels & transmit each channel separately.

Divides the time slots of a single communication channel into multiple slots & transmit each slot sequentially.

ENCODED PDU → DATA (Decide)

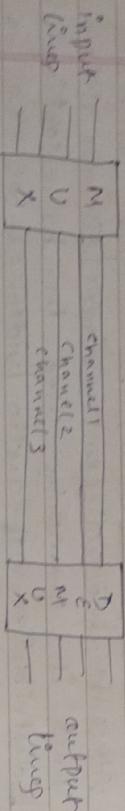
(Start) (End)



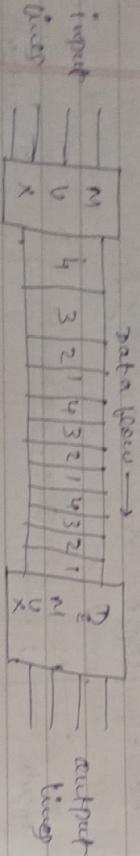
classifications
Data Flow
Protocol

* used in analog telephone system like radio / tv broad casting	used in optical communication system.	used in digital communication system like telephone networks.
* channels are separated based on frequency	-- based on bandwidth	based on time slots.

① FDM :-



② TDM :-



to each other to use a gateway to reach the outside world.

Private network =

type of telephone line connected primarily

to each other to use a gateway to reach

the outside world.

to each other to use a gateway to reach

the outside world.

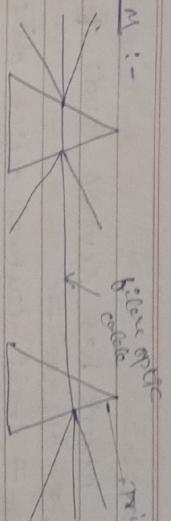
→ Application of multiplexing =

* Telephone network is a telecommunication network used for telephone calls b/w 2 or more parties.

a) Landline network.

b) Wireless network

c) Private network =



classifications
Data Flow
Protocol

- * Synchronous TDM
 - * All channels share a common clock signal
 - * Max no. of channels = limited by the available bandwidth.
 - * Data rate is constant
- Asynchronous TDM.
- * channels do not share a common clock
 - * not max of channels.
 - * limited by the available bandwidth.
 - * Data rate is variable

Local offices.

Telephone network has several levels of switching offices -

- a) end office = local central office directly connected to the end user at a dist of 1-10km

- b) Tandem office = switching center located within the same local area.

- c) Regional offices = interconnected non-hierarchical switching offices for connecting tandem offices.

\Rightarrow cellular network =

- * commun network where the last link is wireless.

- * It is designed to provide commun b/w 2 moving units \rightarrow mobile stations (MS). On b/w 1 mob unit $\&$ 1 stationary unit \rightarrow land unit.

* cells =

- * cellular network is distributed over land areas, each served by 1 fixed location transceiver / base transceiver station.
- * Each cell contains an antenna $\&$ is controlled by a network station \rightarrow Base Station (BS).
- * Each BS intnlly is controlled by a switching office \rightarrow mob switching centre.
- * MSC coordinates commun b/w all the BS, $\&$ telephone central office that is responsible for connecting calls, recording call info & billing.
- * fractions -

* Transmitting = (orig call over microwave connection)

- * call \rightarrow mob sta \rightarrow MSC \rightarrow Telephone \rightarrow To caller.
- * The caller enters a code of 10 digits no $\&$ presses the find button.

- * Mob Sta then scans the band $\&$ find the data (mob no) to the closest BS using that channel.

- * BS relays (transmits) the data to the MSC.

- * MS & finds the data auto tele phone central office If the called party is available a connection is made. So the result is relayed back to the MSC.

* Receiving = (run ring unanswered)

- * MSC \rightarrow call number \rightarrow MSC (transmission) on transmission bridge \rightarrow gives ringing signal.
- * When a mob phone ~~is~~ called telephone control office finds the no to the MSC.

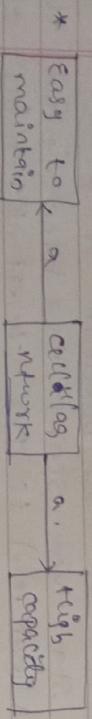
- * MSC searches for the loc of MS by sending ringing signals to each cell in a process \rightarrow paging.
- * Once the mob station is found, MSC transmits a ringing signal, when the mob station answers assigns a voice channel to the call, allowing voice communication to begin.

* Hand off =

- * means to switch between signals lost during

SMS → Short msg services
SIM → Subscriber Identity module.

- * It may happen that during a conversation the mob Sta moves from one cell to another.
- * When it does the signal may break.



=> Mob Commun. Network =

* GSNM [Global System for mob commun.] =

- * It is a standard for digital cellular networks used for voice & data commun.
- * It is now used by over 80% of the global mob market.

* Mob Services

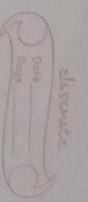
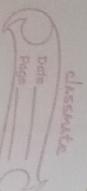
- * GSNM supports a range of mob services including voice calls, SMS, MMS (multi media messaging service) & mob internet.
- * mob Internet services supported by GSNM include GPRS (General packet Radio service) & EDGE (Enhanced Data rates for GSNM evolution).

* GSNM Architecture = (4 types)

a) Mob Station (MS) =

mob phone (device used by the user).

b) Base Station Subsystem (BSS) =



c) Network Switching Subsystem (NSS) =
consist of ① MSC →
Subsystem. ② central component of the network

every MSC is identified by a unique ID.

b) VLR [Visitor Location Register] =

Data base that contains temporary info about subscriber that is needed by the MSC for visiting subscriber.

c) AUC [Authentication center] =

protected database that stores a copy of the secret key stored in each subscriber SIM card.

d) EIR [Equipment Identity Register] =

Data base that contains a list of all valid mob equipment on the network.

d) operation & support subsystem (OSS) =

provides operation & maintenance support for the GSNM network.

* SIM =

Small, removable smart card used in mob devices to authenticate & identify the user on a cellular network.

* Radio Interface in GSM =

- * It is the interface b/w the mob device & the BTS.
- * uses TDMA (Time Division multiple Access) to divide the freq band into time slots.
- * Each time slot can be used for voice data commu.
- * Data commun on Radio interface in GSM is provided by GPRS & EDGE.

* GSM Architecture =

