UNIT 01 : INTRODUCTION

- The first public mobile telephone system, known as Mobile Telephone system (MTS), was introduced in 1946
- It suffered many limitations such as
(a) the fact that transceivers were very big and could be carried only by vehicles,
(b) inefficient way of spectrum usage and
(c) manual call switching.

- The era of cellular telephony as we understand it today began with the introduction of the first Generation of Cellular systems (1G Sys)
- 1G Systems are considered primitive is due to the fact that they utilize analog signaling for user traffic.
- This leads to no. of problems :
1) No use of encryption
2) Inferior call qualities
3) spectrum inefficiency.

- 2G Systems overcome many of the deficiencies of 1G.
1) Encryption
2) Use of error correction

In digital systems, it is possible to apply error detection and error correction techniques to the user traffic.
- Using these techniques the receiver can detect and correct bit errors, thus enhancing transmission reliability

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This obviously leads to signals with little or no corruption, which of course translates into
(a) better voice call qualities,
(b) higher speeds for data applications, and
(c) efficient spectrum use.

- In analog systems, each RF carrier is dedicated to a single user, regardless of whether the user is active or not.
- In digital systems each RF carrier is shared by more than one user, either by using different time slots or different codes per user.

- 2G systems allow the use of Time Division Multiple Access (TDMA) and Code Division Multiple Access (CDMA) as well.

- The use of TDMA or CDMA in cellular systems offers a number of advantages:
  - Natural integration
  - Flexibility for mixed voice/data communication
  - Potential for further capacity increases
  - Reduced RF transmit power
  - Reduced system complexity.

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- 2G systems are limited in terms of maximum data, it makes 2G systems practically useless for the increased requirements of future mobile applications.

- Third generation (3G) mobile and wireless networks aim to fulfill the demands of future services.
- 3G systems will offer global mobile multimedia communication capabilities in a seamless and efficient
  - users will be able to use a single device in order to enjoy a wide variety of applications manner.

* Some key characteristics of 3G systems are
  - Support for both symmetric & asymmetric traffic
  - packet-switched and circuit-switched services support.
  - Support for running several services over the same terminal simultaneously.
  - Backward compatibility and system interoperability
  - Support for roaming.
  - Ability to create a personalized set of service per user.

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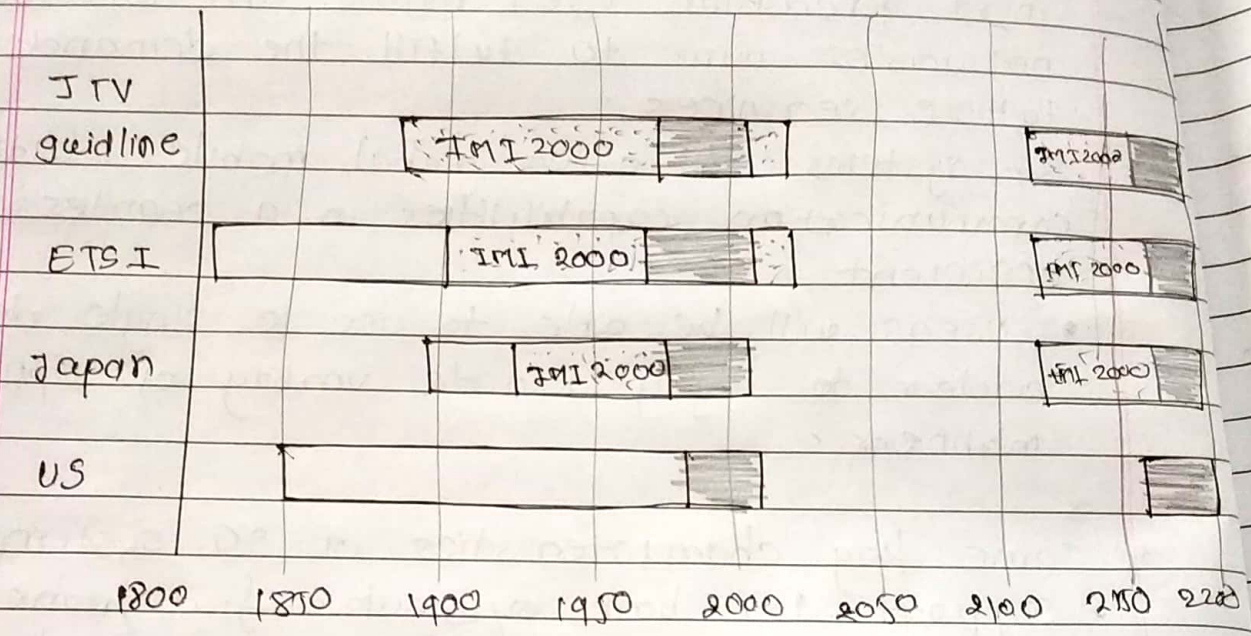
* 3G Spectrum Allocation.

All 3G systems would operate in the same frequency band, a fact that would greatly ease global roaming, especially among operators following the same IMT-2000 standard.



* Third Generation Applications

1) Multimedia Applications
2) Mobile commerce applications
3) Multimedia messaging applications.
4) Broadcasting applications
5) Geo-location-based applications

* Third Generation standards

- Standardization Activities : IMT-2000

- The Radio Access Network (RAN) comprises a set of interconnected base station controllers each one coordinating a set of base station

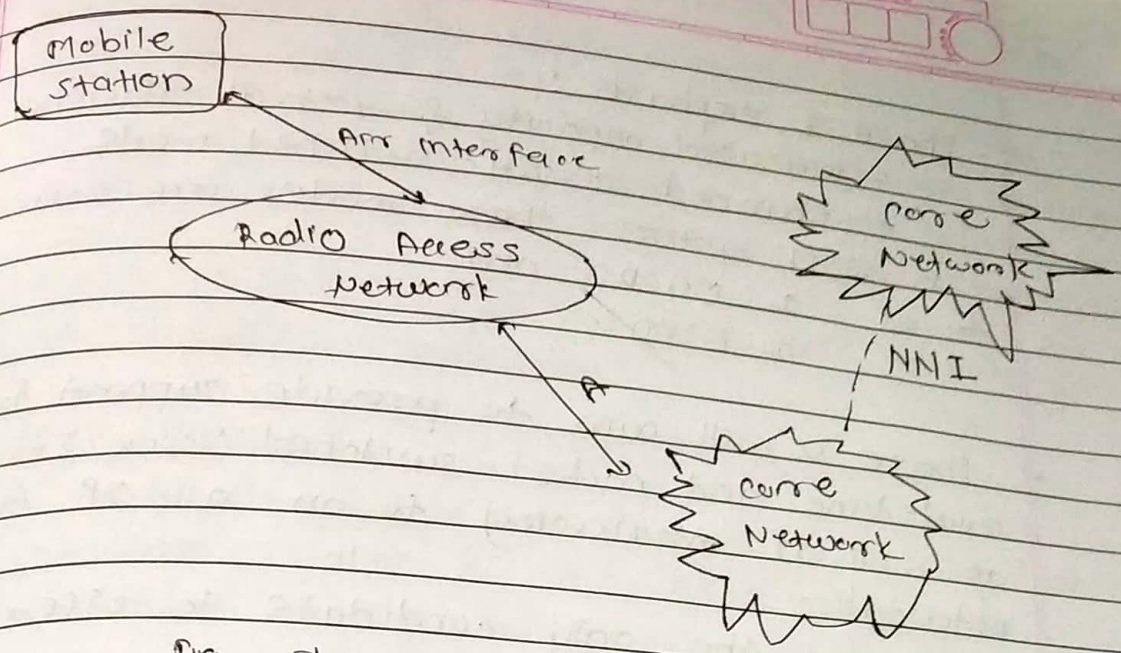


fig. The IMT-2000 specification.

* Radio Access standards :
- The ETSI proposal, also known as the
⇒ Universal Mobile Telecommunication Systems (UMTS), ⇒ calls for use of Wideband CDMA, (WCDMA) at the radio access method.
⇒ The proposal consisted of two WCDMA modes.
1) Frequency Division Duplex (FDD) WCDMA
2) Time Division Duplex (TDD) WCDMA

* EDGE (Enhanced Data Rates for GSM Evolution) :

- It is the only IMT-2000 ~~air~~ interface standard based on TDMA technology.
- Using the same bandwidth and channel structure as GSM, its original purpose was to be the next upgrade for networks supporting GPRS and HSCSD.

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- Phase 1 emphasis :
  - Increased capacity & spectral efficiency
  - enhanced circuit - switched mode
- In GSM systems, these modes are referred to as 1. EGPRS and
  2. ECSD.

- Phase 2 will aim to provide support for QoS, real-time and packet-switched voice services as well as interfacing to an all-IP core network.
- EDGE is the only candidate to offer support for 3G services.
- The Gaussian Minimum Shift Keying (GMSK) modulation of GSM, EDGE also uses the modulation scheme eight-phase shift keying

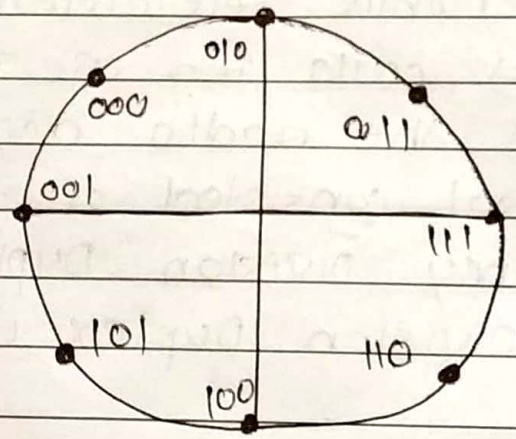

Fig. 8-PSK Modulation.

- In 8-PSK, every transmitted signal can have 8 possible values.

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* EDGE classic and EDGE compact :

EDGE compact :

- uses a new 200 kHz control channel structure
- By ~~use~~ means of base station synchronization and use of a 1/3 frequency reuse pattern,
- EDGE compact can be deployed even in only 600 kHz of available bandwidth.

EDGE classic :

- maintains the traditional GSM control channel structure used by the ETSI standard with a 4/12 reuse pattern.

* Multiplexing :

To make efficient use of the transmission system, it is desirable to carry multiple signals on a single medium. This is referred to as multiplexing.

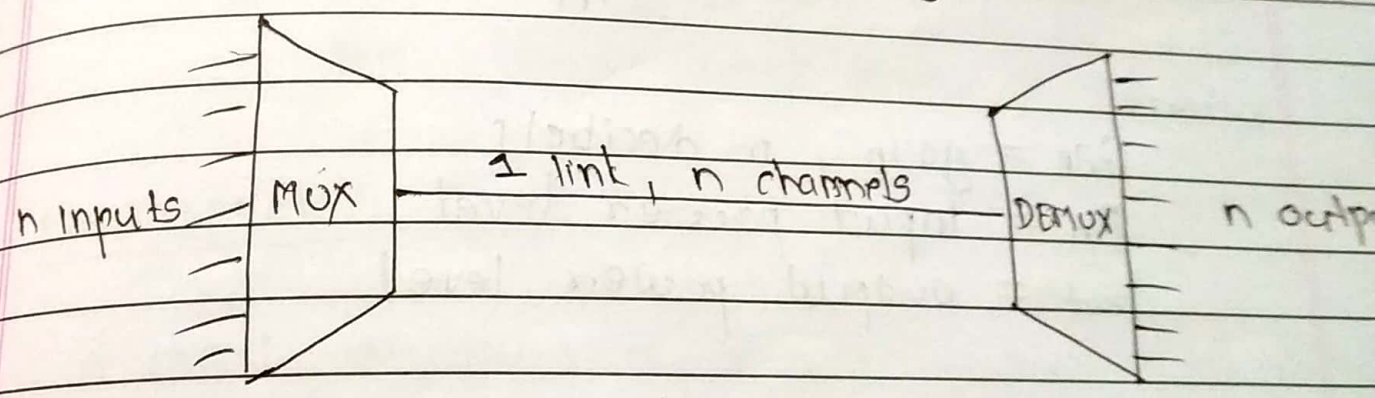

fig. Multiplexing.

Features :

- Higher data rate
- cost effective transmission
- relatively modest data rate support.

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- Two techniques for multiplexing.
1) Frequency division multiplexing (FDM) and
2) Time division multiplexing (TDM)

* Time Division Multiplexing (TDM) :

- TDM takes advantage of the fact that the achievable bit rate of the medium exceeds the required data rate of a digital signal.
- Multiple digital signals can be carried on a single transmission path by interleaving portions of each signal in time.
- The sequence of time slots dedicated to a particular source is called a channel.
- one cycle of time slots is called a frame
- The decibel gain is given by

$$G_{dB} = 10\log_{10} \frac{P_{out}}{P_{in}}$$

where

G_{dB} = gain, in decibels
P_{in} = input power level.
P_{out} = output power level

- If the value of G_{dB} is positive, this represent an actual gain in power.
- If the value of G_{dB} is negative, this represent an actual loss in power.
- a decibel loss as

$$L_{dB} = -10\log_{10} \frac{P_{out}}{P_{in}} = 10\log_{10} \frac{P_{in}}{P_{out}}$$

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* Wide area networks (WANs):

- It consists of a number of interconnected switching nodes
- A transmission from anyone device is routed through these internal nodes to the specified destination device.

* Local area networks (LANs)

- The scope of the LAN is small, typically a single building or a cluster of buildings.
- The internal data rates of LANs are typically much greater than those of WANs

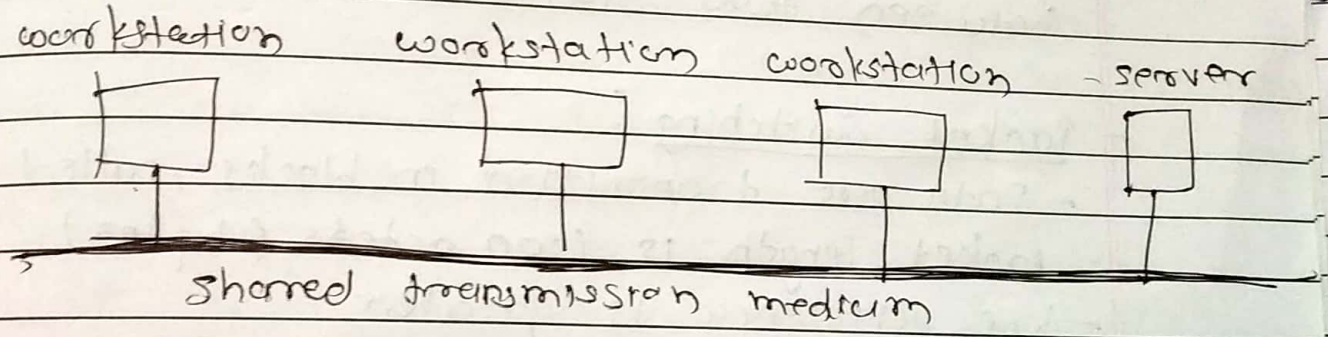

Fig. Simple Local Area Network

* Metropolitan Area Network:

- A MAN occupies a middle ground between LANs and WANs
- MANs cover greater distances at higher data rates than LANs
- A MAN is intended to provide the required capacity at lower cost & greater efficiency ~~than~~

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* Switching Techniques :

- For transmission of data beyond a local area, transmitting data from source to destination through a network of intermediate switching nodes, ~~this switched~~ ;
- Each station attaches to a node, and the collection of nodes is referred to as a communication network.

- Circuit Switching has been the dominant technology for both voice and data communication
- communication via circuit switching implies that there is a dedicated communication path between two stations.

- Packet Switching :
  - Data are transmitted in blocks, called packets.
  - packet length is 1000 octets (bytes).
  - line efficiency is greater.

* Concept of Spread Spectrum :

- The essential idea is to spread the information signal over a wider bandwidth, to make jamming and interception more difficult.
- The first type of spread spectrum developed is known as frequency hoppi

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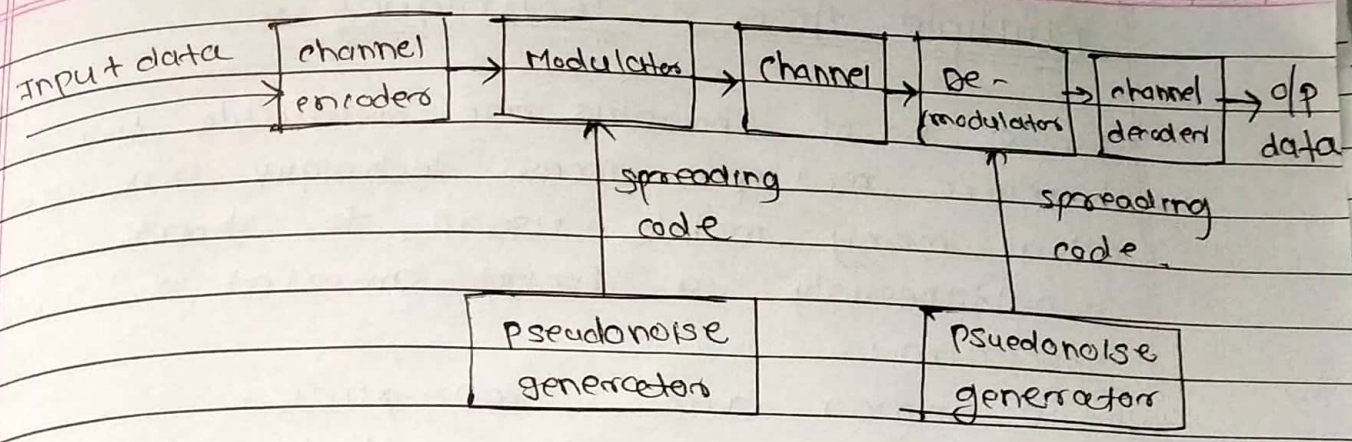

Fig. Spread spectrum system.

- i/p is fed into channel encoder that produces an analog signal. This signal is further modulated using a sequence of digits known as a spreading code or spreading sequence which is generated by a pseudo-noise generator.
- The effect of this modulation is to increase significantly the bandwidth.
- On the receiving end, the same digit sequence is used to demodulate the spread spectrum signal.
- Finally, the signal is fed into a chanel decoder to recover the data.

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UNIT 02

Multiple Access Techniques :-

- Finite no. of channels are available for communi
- Therefore multiple access technique are used to allow many mobile users to share simultaneously a finite amount of radio spectrum.
- Three major access techniques.
  - frequency division multiple access (FDMA)
  - Time division multiple access (TDMA)
  - code division multiple access (CDMA)

- These techniques can be grouped as narrowband and wideband.

- **Narrowband System :**
  Available radio spectrum is divided into a large number of narrowband channels.
- such systems are called TDMA / FDD or TDMA / TDD

- **Wideband System :**
  A large no. of transmitters are allowed to transmit on the same channel.
- These are packet radio (PR) and space division multiple access (SDMA).

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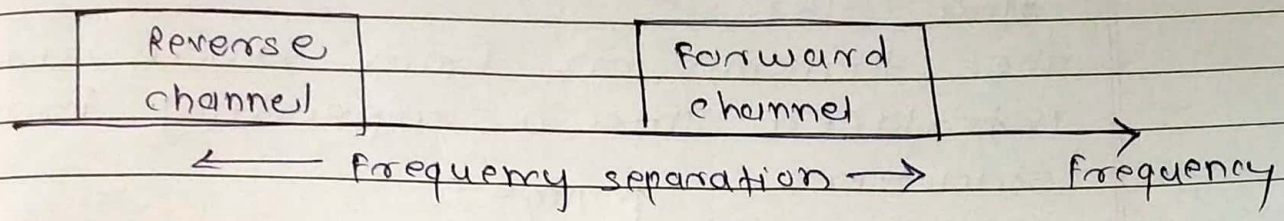
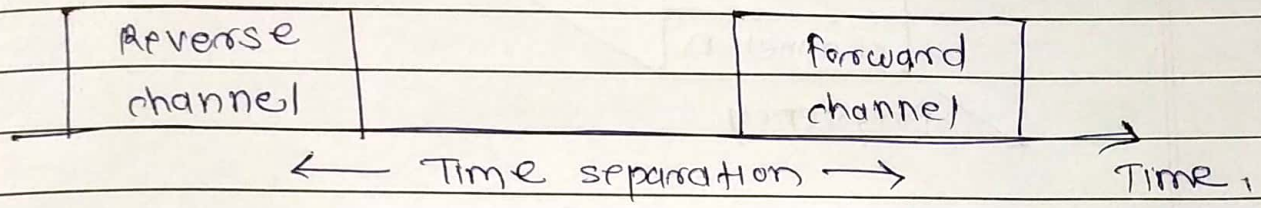
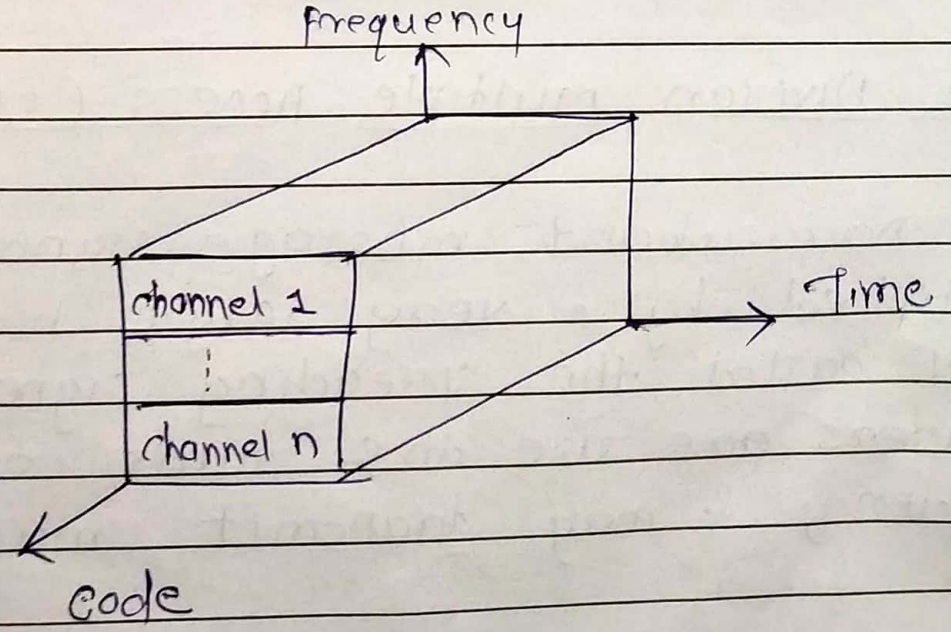
- Frequency division duplexing (FDD) :
  The frequency split between the forward and reverse channel is constant.



- Time division duplexing (TDD) :
  - uses time to provide both a forward and reverse link.



* Frequency Division Multiple Access (FDMA)
  - Radio spectrum is divided into many slices of the frequency bands
  - Each band or channel is allocated to user.



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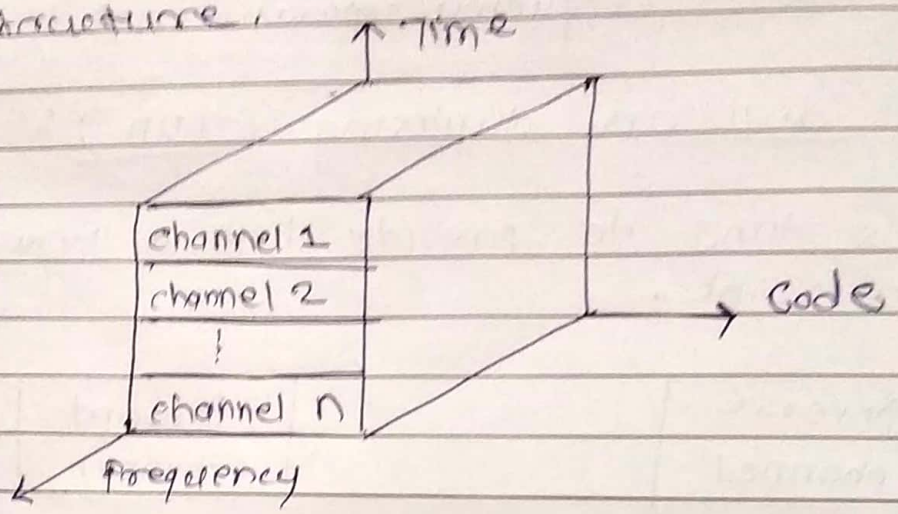
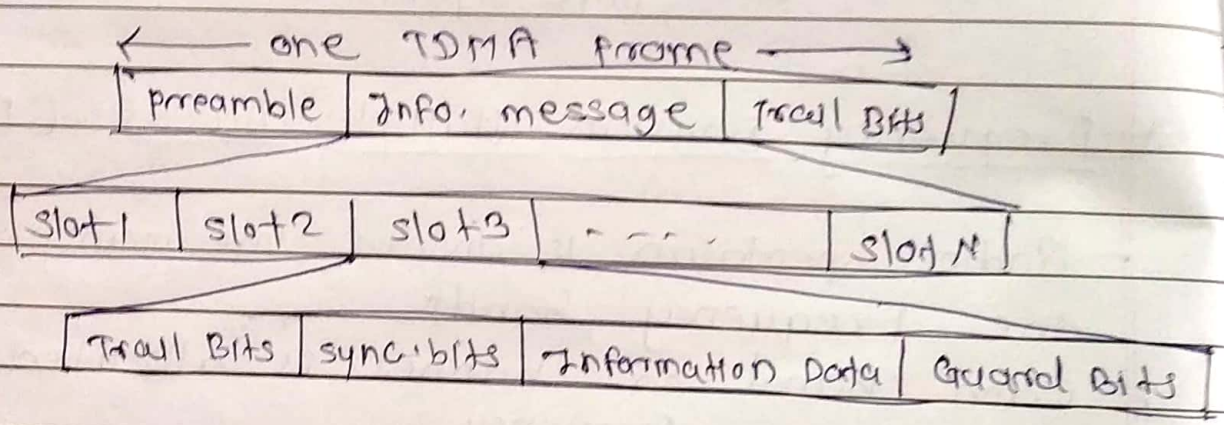
* Time Division Multiple Access (TDMA):

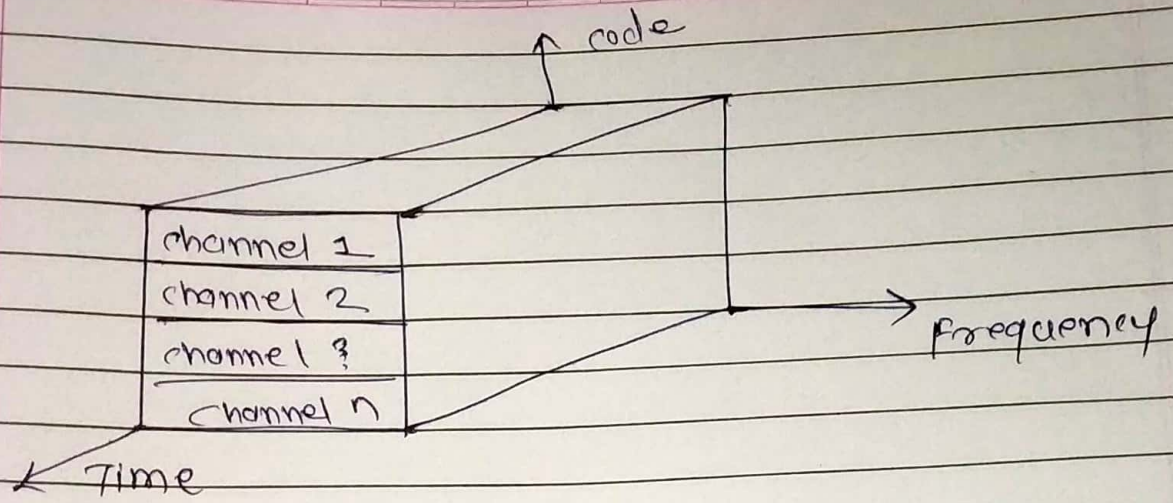
- Each user occupies a cyclically repeat time slot
- the transmission from various users is interlaced into a repeating frame structure.





* Code Division Multiple Access (CDMA):

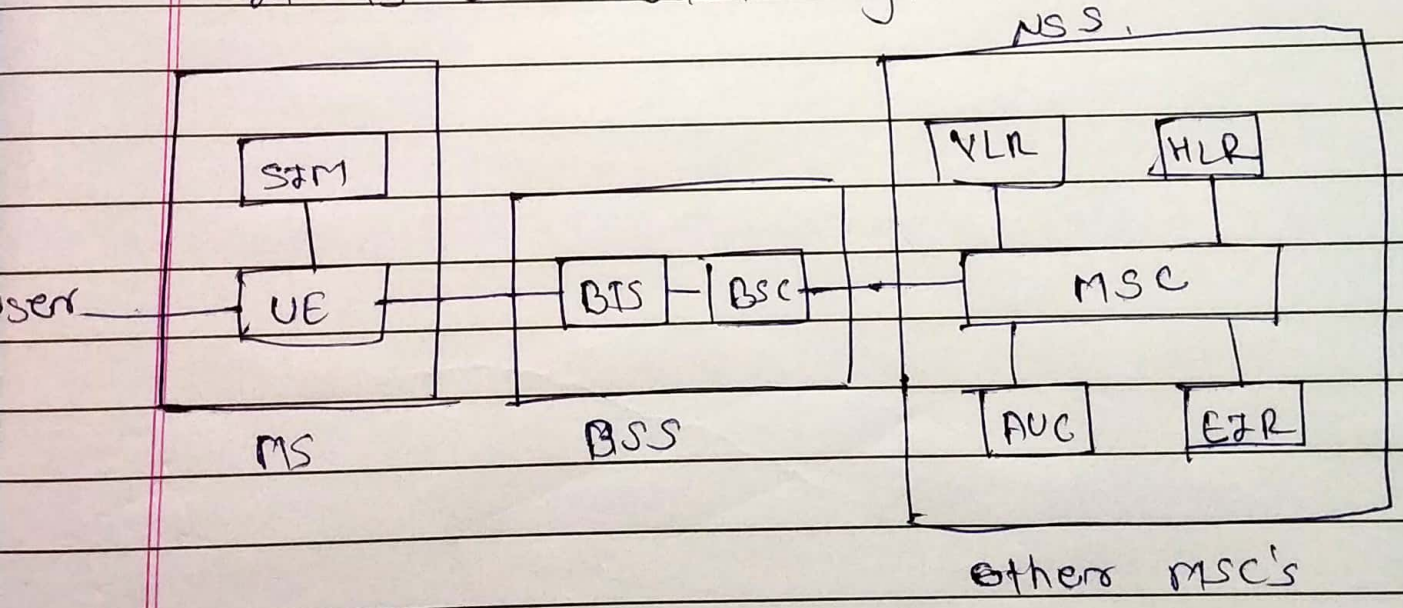
- The narrowband message signal is multiplied by a very large bandwidth signal called the spreading signal.
- All users ~~are~~ use the same carrier frequency & may transmit simultaneously



* Wireless Technologies :
* GSM (Global system for mobile communication

It is a standard to describe the protocols for second generation digital cellular networks.

- It is a robust digital cellular standard.



GSM Architecture.

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UNIT NO:-3
Types of WN

2018 March Tuesday 13

11/3/19 — WN

Topic:- AD-HOC N/W.

The term "wireless ad-hoc" stands for a network having no central administration and consisting mobile nodes that uses wireless transmission.
Ad-hoc n/w is self-organizing & adaptive.

It is able to detect the presence of other devices & perform the necessary set up to facilitate comm^n & sharing data & services.

Network are formed on the fly; devices can leave & join the network during its lifetime, devices can be mobile within network, the n/w as a whole may be mobile and the network can be deformed on the fly.

All this need to be done without any system administration & without the requirement for any permanent devices within the n/w.

The n/w is ad-hoc because it does not rely on a pre-existing infrastructure, such as routers in wired n/w or access point in managed wireless n/w.

Characteristic of Ad-hoc n/w.
1) Distributed operation.
2) Dynamic Topology.
3) Multihop communications.
4) Changing link qualities.
5) dependence on battery life.

Notes

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UNIT No :- 3.

A mobile ad hoc network (MANET)

- It is a continuously self-configuring, infrastructure-less network of mobile devices connected wirelessly.
- Each device in a MANET is free to move independently in any direction, and will therefore change its link to other devices frequently.
- Such network may operate by themselves or may be connected to the larger Internet.
- Contain one or multiple and different transceivers between nodes.
- It usually has a routable networking environment.
- It consist of a peer to peer, self-forming, self-healing network.
- It communicate at radio frequencies 30MHz - 5GHz.

Types of MANET.

- Vehicular adhoc networks (VANET)
- Smart phone adhoc networks (SPAN)
- Internet based mobile adhoc network (iMANET).
- Hub-Spoke MANET
- Military or tactical MANET
- Flying adhoc network (FANET).

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*) VANET

- It used for communication between vehicles and roadside equipment.

- Intelligent vehicular adhoc network (InVANET) are kind of artifical intelligence that helps vehicles to behave in intelligent manners during vehile-to-vehile collision, accidnes.

*) SPAN

- It influence the existing hardware in commercially available smart phones to create peer-to-peer networks ~~infrastructure~~ without relying on cellular networks, wireless access points or traditional network infrastructure.

- There is no notion of a group leader so peers can join and leave at will without destroying the network.

→ Advantage of MANET.

- Manet is that n/w is decentralised and nodes/devices are mobile, that is to say there is no fixed infrastructure which provide the possibility for numerous application in different areas such as environmental monitoring, disaster relief & military communications.

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- More stronger than centralized networks due to the multi-hop fashion.

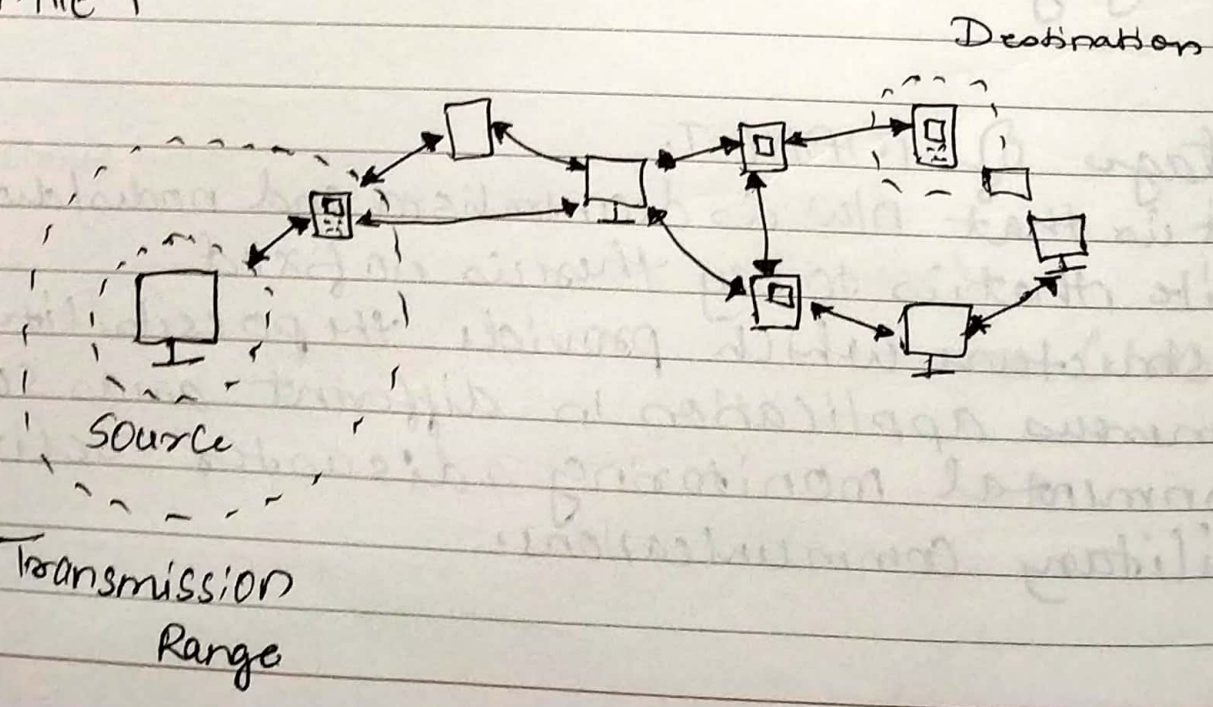
→ Further advantage of manet over network with a fixed topology include

- Flexibility
- Scalability
- lower administration costs.

→ Applications.

- ranging from sensor for environment.
- vehicular adhoc communications.
- In road safety
- In health
- In home
- Peer to peer messaging
- In Weapons
- In robots etc.

MANET



Notes

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Vechicular ad-hoc networks (VANET)

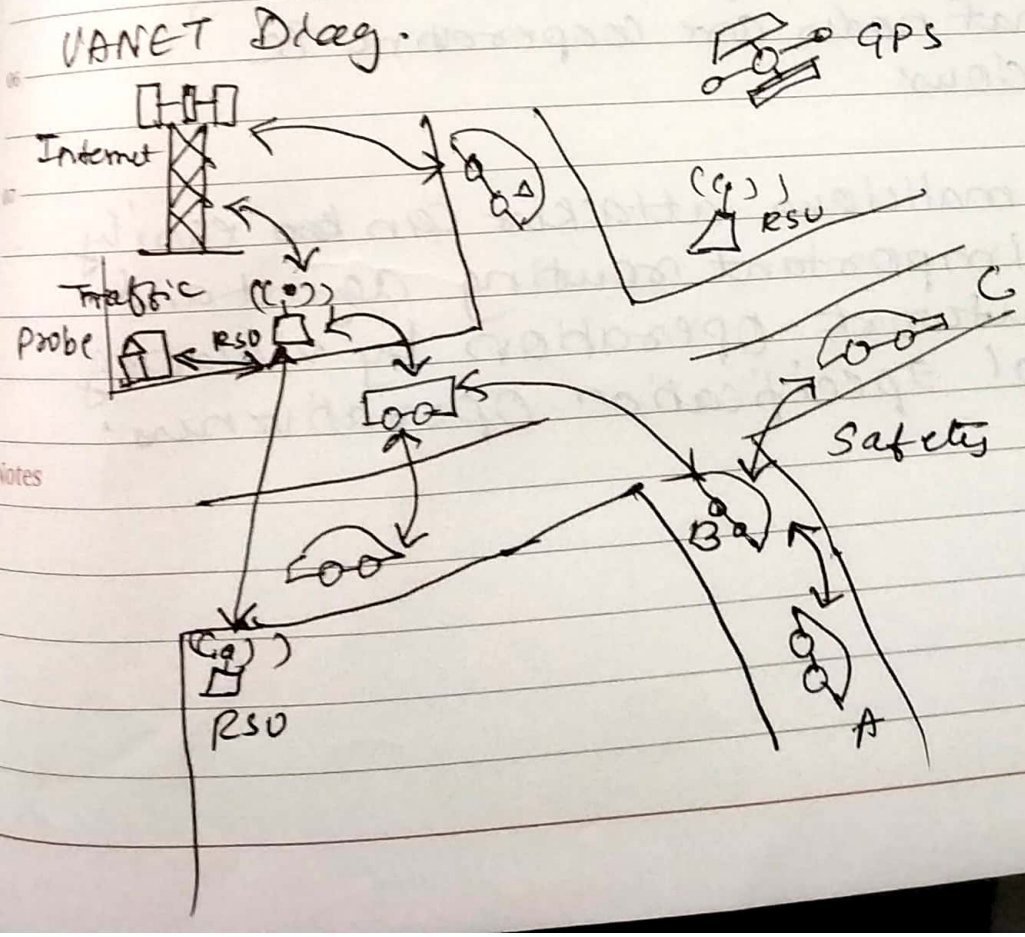
- VANET are created by applying the principles of mobile adhoc network (MANET) - the spontaneous creation of a wireless network for vehicle-to-vehicle (V2V) data exchange - to domain of vehicles.

- VANET are a key part of the Intelligent Transport.
- So Term VANET became mostly synonymous with more generic term inter-vehicle communication (IVC).

Application:-

- Electronic brake light
- Platooning
- Traffic information system.
- Road Transportation Emergency Services.
- On-the-Road Services.

VANET Diag.



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→ Limitation OF Manet.

- Routing in Dynamic Topology.

The existing conventional Bellman Ford routing algorithm or classic Link State algo are not applicable for such dynamic network where the topology changes with the free movement of nodes.

- Topology maintenance.

- Lack of Central Infrastructure.

decreases the routing efficiency

- Scalability.

Routing algorithm for MANET usually assumes that nodes are cooperative & non-malicious.

As a result a malicious attacker can easily become an important routing agent and disrupt network operation by violating the protocol specification operativeness.

Notes

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- Energy Efficiency.
  causes more battery drainage.
- Security and Privacy
- Autonomous
- Poor Transmission Quality.

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