



Class: 4th

MOBILE COMMUNICATIONS

Tetorial 1

Wireless Communication System

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Q1: - List the Classifications of mobile radio transmission systems and explain them.

Solution:

Mobile radio transmission systems can be classified into three types

- 1- Simplex systems: communication is possible in only one direction.
- 2- Half-duplex: radio systems allow two-way communication using the same radio channel for both transmission and reception.
- 3- Full duplex: systems allow simultaneous radio transmission and reception between a subscriber and a base station, by providing two simultaneous but separate channels (frequency division duplex, or FDD) or (time division duplex, or TDD).

Q2: - Define the following terms

- 1- Frequency division duplexing (FDD)**
- 2- Reverse channel**
- 3- Forward channel**
- 4- Paging Systems**
- 5- LTE**

Solution:

- 1- Frequency division duplexing (FDD): A pair of simplex channels with a fixed and known frequency separation is used to define a specific radio channel in the system.
- 2- Reverse channel: The channel used to carry traffic from the mobile user to a base station.
- 3- Forward channel: The channel used to convey traffic to the mobile user from a base station.



4- Paging systems: Paging systems are communication systems that send brief messages to a subscriber. Depending on the type of service, the message may be either text or voice messages.

5- LTE : LTE (Long Term Evolution) is a standard for wireless communication of high-speed data for mobile phones and data terminals increasing the capacity and speed using a different radio interface

Q3: - List the types of wireless communication systems.

Solution:

The types of wireless communication systems are

- 1- Paging Systems
- 2- Cordless Telephone Systems
- 3- Satellite communication systems
- 4- Wireless LAN systems
- 5- Cellular Telephone Systems

Q4: - Answer the following

A: -What are the main features of Satellite Communication Systems.

B: - What are the main characteristics of Wireless LAN (WLAN)

C:- List the main features of the LTE

Solution:

A: - The main feature of the **satellite communication systems**

- Very wide range and coverage
- Very useful in sparsely populated areas: rural areas, sea, mountains, etc.
- Target: Vehicles and/or other stationary/mobile uses
- Expensive base station (satellites) systems



B: -The main characteristics of Wireless LAN (WLAN) are

- Low mobility (not for vehicular use)
- High speed data transmission
- Confined regions – buildings and campuses
- Coverage: 100m – 300m per base station
- Uses the following bands (902-928 MHz, 2400-2483.5 MHz, 5725-5850 MHz)

C. The main features of the LTE

- downlink peak rates of 300 Mbit/s,
 - uplink peak rates of 75 Mbit/s
 - Quality of Service (QoS) provisions permitting a transfer latency of less than 5 ms in the radio access network (RAN).
 - Has the ability to manage fast-moving mobiles
 - Supports scalable carrier bandwidths, from 1.4 MHz to 20 MHz.
 - Orthogonal frequency-division multiple access (OFDMA) for the downlink, Single-carrier FDMA for the uplink to conserve power.
 - Supports both FDD and TDD.
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Q5/Assume a system of 32 cells with a cell radius of 1.6 km, a total of 32 cells, a total frequency bandwidth that supports 336 traffic channels, and a reuse factor of $N = 7$.

(a) If there are 32 total cells, what geographic area is covered, how many channels are there per cell, and what is the total number of concurrent calls that can be handled?

(b) Repeat for a cell radius of 0.8 km and 128 cells.

Solution:

The area of a hexagon of radius R is

$$Area_a = \frac{3\sqrt{3}}{2} R^2 = \frac{3\sqrt{3}}{2} (1.6)^2 = 6.65 \text{ km}^2$$

The total area covered is $6.65 \times 32 = 213 \text{ km}^2$.

For $N = 7$, the number of channels per cell is $K/N = 336/7 = 48$,

Total number of concurrent calls that can be handled is

$$Capacity = 48 \times 32 = 1536 \text{ channels}$$

(b)

The area of a hexagon of radius R is

$$Area_b = \frac{3\sqrt{3}}{2} R^2 = \frac{3\sqrt{3}}{2} (0.8)^2 = 1.66 \text{ km}^2$$

The area covered is $1.66 \times 128 = 213 \text{ km}^2$.

The number of channels per cell is $K/N = 336/7 = 48$,

Total number of concurrent calls is

$$Capacity = 48 \times 128 = 6144 \text{ calls}$$



Q6: - List **Five** features of 1st ,2nd, 3rd , 4G system.

Parameters	1G	2G	3G	4G
Introduced in year	1983	1990	2000	2010
Location of first commercialization	USA	Finland	Japan	South Korea
Technology	AMPS (Advanced Mobile Phone System), NMT, TACS	IS-95, GSM	UMTS, HSPA	LTE-A, WiMAX 2
Multiple Address/Access system	FDMA	TDMA, CDMA	WCDMA	OFDMA
Switching type	Circuit switching	Circuit switching for Voice and Packet switching for Data	Packet switching + Circuit switching	Packet switching
Speed (data rates)	2.4 Kbps to 14.4 kbps	14.4 Kbps	3.1 Mbps	> 300 Mbps
Special Characteristic	First wireless communication	Digital version of 1G technology	Digital broadband, speed increments	Very high speeds, All IP
Features	Voice only	Multiple users on single channel	Multimedia features, Video Call	High Speed, real time streaming
Supports	Voice only	Voice and Data	Voice and Data	Voice and Data
Internet service	No Internet	Narrowband	Broadband	Ultra Broadband
Bandwidth	25, 30 KHz	200 KHz	5- 25 MHz	100 MHz
Operating frequencies	800 MHz	GSM: 900MHz, 1800MHz CDMA: 800MHz	1.6 – 2.1 GHz	2 – 8 GHz
Band (Frequency) type	Narrow band	Narrow band	Wide band	Ultra Wide Band
Advantage	Simpler (less complex) network elements	Multimedia features (SMS, MMS), Internet access and SIM introduced	High security, international roaming	Speed, High speed handoffs, MIMO technology, Global mobility
Disadvantages	Limited capacity, not secure, poor battery life, large phone size, background interference	Low network range, slow data rates	High power consumption, Low network coverage, High cost of spectrum licence	Hard to implement, complicated hardware required
Applications	Voice Calls	Voice calls, Short messages, browsing (partial)	Video conferencing, mobile TV, GPS	High speed applications, mobile TV, Wearable devices