Introduction of Wireless Communication

Unit: 2

Wireless Communication
KEC 076

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ECE

Course Details
(B. Tech 7th Sem)

WIRELESS COMMUNICATION

Course Contents / Syllabus

UNIT-I	**Introduction of Wireless Communication**	8 Hours
History and evolution of mobile radio systems, General Model of Wireless Communication Link, Types of mobile wireless services/systems- Cellular, WLL, Paging, Satellite Systems, Future trends in personal wireless systems.		
UNIT-II	**Cellular Concepts and System Design Fundamentals**	8 Hours
Cellular Infrastructure, Cellular System Components, Antennas for Cellular Systems, Operation of Cellular Systems, frequency reuse, channel assignment, handoff strategies, Interference and system capacity.		
UNIT-III	**Mobile Radio Propagation Models**	8 Hours
Radio wave propagation issues in personal wireless systems, Propagation models, Channel Noise and Losses, Fading in Land Mobile Systems, Multipath Fading, Fading Effects on Signal and Frequency, Shadowing; Wireless Channel Modeling: AWGN Channel, Rayleigh Channel,		
UNIT- IV	**Equalization, Diversity Techniques & Multiple Access Techniques**	8 Hours
Equalization, Rake receiver concepts, Diversity Techniques, Linear predictive coders and channel coding. Multiplexing and Multiple Access: FDMA, TDMA, CDMA, OFDMA, Multiple Access for Radio Packet Systems: Pure ALOHA, Slotted ALOHA, CSMA and their versions; Packet and Pooling Reservation Based Multiple Access Schemes.		
UNIT-V	**Wireless Systems & Standards**	8 Hours
GSM system for mobile Telecommunication, General Packet Radio Service, Edge Technology; CDMA 2000, IMT 2000 and UMTS, Long Term Evolution (LTE), Introduction to Mobile Adhoc Networks, Li-Fi Communication, Ultra-Wideband Communication, Mobile data networks, Introduction to 4G, 5G and concept of NGN.		

WIRELESS COMMUNICATION

Course Outcomes: After completion of this course students will be able to		
CO 1	Explain with various generations of mobile communications.	K1, K2
CO 2	Explain concept of cellular communication.	K2
CO 3	Describe the basics of wireless communication.	K2
CO 4	Explain and differentiate contention free and contention based multiple access techniques.	K2,K4
CO 5	Explain Various modern wireless technologies.	K2

WIRELESS COMMUNICATION

Text Books:	
1. T.S. Rappaport, "Wireless Communication-Principles and practice", Pearson Publications, Second Edition.	
2. Upena Dalal, "Wireless Communication and Networks", Oxford Press Publications.	
3. T L Singal ,"Wireless Communications ", McGraw Hill Publications.	
Reference Books:	
1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press.	
2. S. Haykin & M. Moher, "Modern wireless communication", Pearson, 2005.	
NPTEL/ YouTube/ Faculty Video Link:	
Unit 1	https://youtu.be/JCGMP37-2EA
Unit 2	https://youtu.be/f2wlHL1Sok8 https://youtu.be/0PWILK-hqbQ
Unit 3	https://youtu.be/SFcRtZ30rqs https://youtu.be/BKf2mN9W6Nk https://youtu.be/tePZhxRLsjE
Unit 4	https://youtu.be/GLmF3YB0pQU https://youtu.be/QHqZwBoTJRY
Unit 5	https://youtu.be/t3FVP5wuG4g https://youtu.be/ixY0Cau4mBM

Content

- Cellular Infrastructure
- Cellular System Components
- Antennas for Cellular Systems
- Operation of Cellular Systems
- Frequency reuse
- Channel assignment
- Handoff strategies
- Interference and system capacity.
- Faculty Video Links, YouTube and NPTEL Video Links, and Online course details
- Daily Quiz
- Weekly Assignment
- MCQs
- Expected Questions for University Exam

Course Objective

1. To make students familiar with fundamentals of mobile communication systems.
2. To choose system (TDMA/FDMA/CDMA) according to the complexity, installation cost, speed of transmission, channel properties etc.
3. To identify the requirements of mobile communication as compared to static communication.
4. To identify the limitations of 2G and 2.5G wireless mobile communication and use design of 3G and beyond mobile communication systems.
5. To identify various modern wireless technologies.

Unit Objective

In this unit students will be able :

- To familiar with fundamentals of mobile communication systems.
- To study various fading models.
- To study Cellular system and its architecture.

Course Outcome

- After completion of the course student will be able to

CO1. Explain various generations of mobile communications.
CO2. Explain the concept of cellular communication.
CO3. Describe the basics of wireless communication.
CO4. Explain and differentiate contention-free and contention-based multiple access techniques.
CO5. Explain Various modern wireless technologies.

CO-PO and PSO Mapping

- Mapping of Course Outcomes and Program Outcomes:

S.No	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	KEC-076.1	2	2	1	1	2	2	2	2	2	2	1	3
2	**KEC-076.2**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**3**	**1**	**2**
3	**KEC-076.3**	**3**	**1**	**2**	**1**	**2**	**2**	**1**	**1**	**2**	**3**	**2**	**2**
4	KEC-076.4	3	1	1	1	3	3	2	1	1	3	1	2
5	KEC-076.5	2	1	2	2	3	3	2	1	2	3	2	2
6	KEC-076.6	3	2	2	2	2	3	2	1	2	3	1	2

CO-PO and PSO Mapping

- Mapping of Program Specific Outcomes and Course Outcomes:

S.No	Course Outcome	PSO1	PSO2	PSO3
1	KEC-076.1	3	2	1
2	**KEC-076.2**	**3**	**3**	**1**
3	**KEC-076.3**	**3**	**3**	**1**
4	KEC-076.4	2	2	1
5	KEC-076.5	3	3	1
6	KEC-076.6	3	3	1
	Average	2.83	2.66	1

Prerequisite and Recap

- Basics of communication
- Model of communication.

Topic Objective

Name of Topic	Objective of Topic	Mapping with CO
Introduction	Students will learn about basics of Cellular Infrastructure	CO2

Cellular Infrastructure

- Early wireless systems had a high-power transmitter, covering the entire service area. This required a very huge amount of power and was not suitable for many practical reasons.

- The cellular system replaced a large zone with a number of smaller hexagonal cells with a single BS (base station) covering a fraction of the area. Evolution of such a cellular system is shown in the given figures, with all wireless receivers located in a cell being served by a BS.

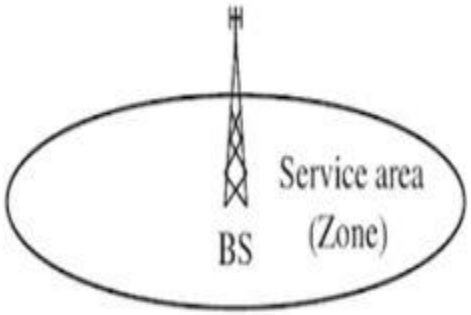


Fig: Early wireless system: large zone

Cellular Infrastructure

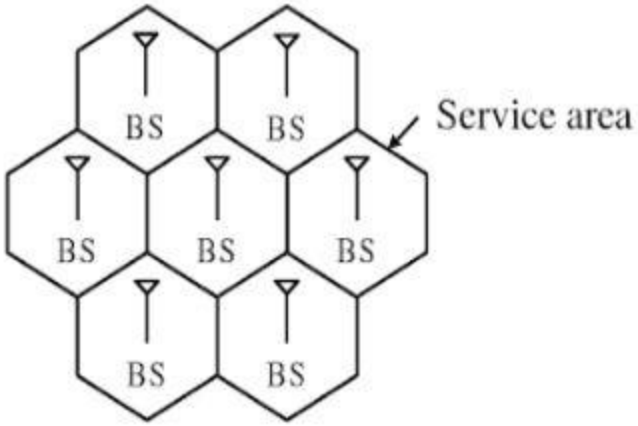


Fig: Cellular system: small zone

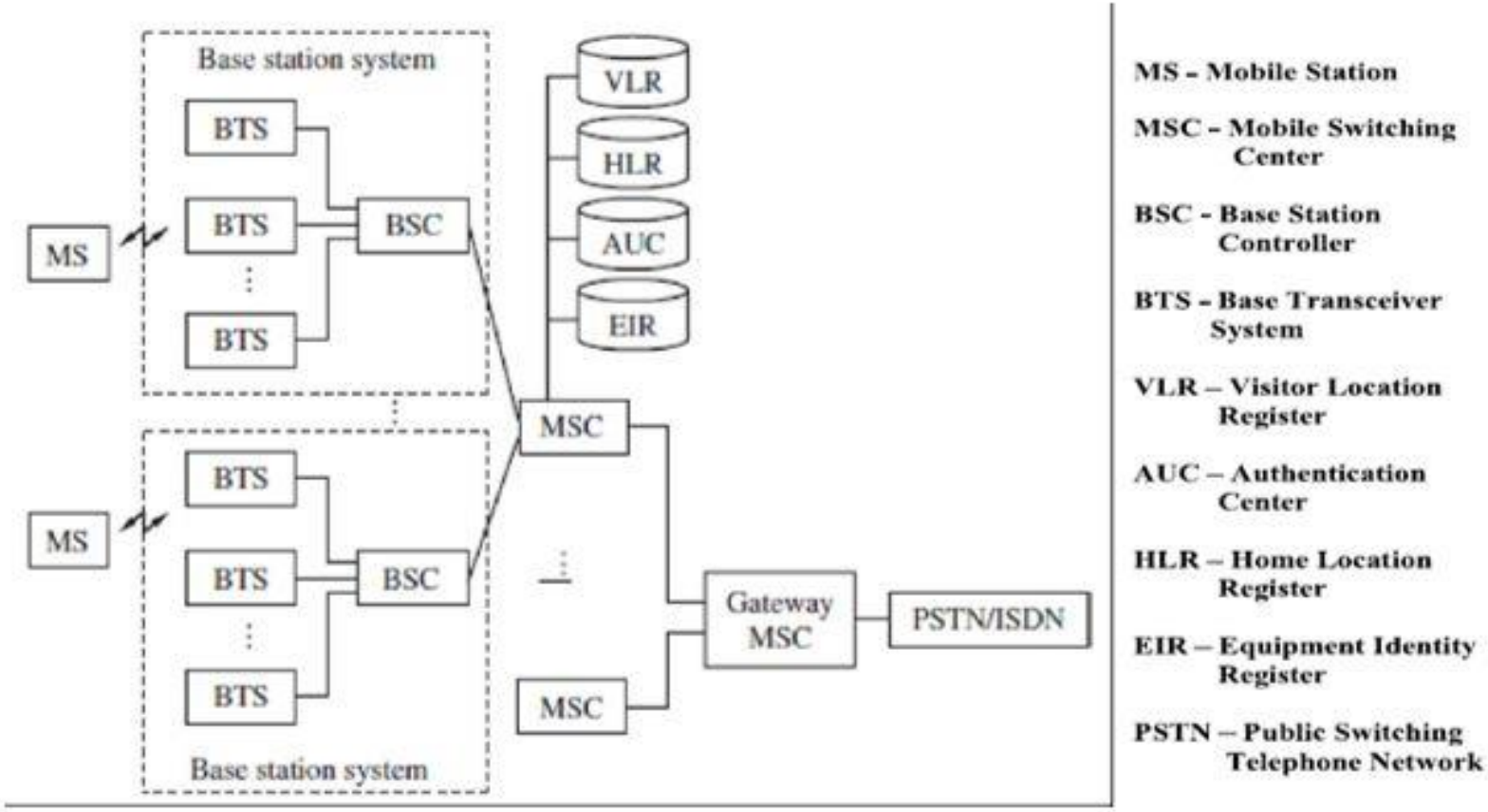
Cellular Infrastructure

Wireless devices need to be supported for different types of services, the wireless device could be a wireless telephone laptop with a wireless card, personal digital assistant (PDA), or web-enabled phone. For simplicity, it could be called an MS.

In a cellular structure, an MS (mobile station) needs to communicate with the BS of the cell where the MS is currently located and the BS acts as a gateway to the rest of the world. Therefore, to provide a link, the MS needs to be in the area of one of the cells (and hence a BS) so that the mobility of the MS can be supported. Several base stations are connected through hard wires and are controlled by a BS controller (BSC), which in turn is connected to a mobile switching center (MSC).

Cellular Infrastructure

A cellular system requires a fairly complex infrastructure. A generic block diagram in shown i figure:



Cellular Infrastructure

A BS consists of a base transceiver system (BTS) and a BSC. Both tower and antenna are a part of the BTS, while all associated electronics are contained in the BSC.

The HLR (home location register) and VLR (visitor location register) are two sets of pointers that support mobility and enable the use of the same telephone numbers worldwide.

The AUC (authentication center) unit provides authentication and encryption parameters that verify the user's identity and ensure the confidentiality of each cell.

The EIR (equipment identity register) is a database that information about identity of mobile equipment. Both AUC and EIR can be implemented as individual stand-alone units or as a combined AUC/EIR unit.

Cellular Infrastructure

The HLR is located at the MSC where MS is initially registered and is the initial home location for billing and access information.

In simple words, any incoming call, based on the calling number, is directed to the HLR of the home MS where the MS is registered. The HLR then points to the VLR of the MSC where the MS is currently located.

Cellular Infrastructure

Several mobile switching centers are interconnected to a PSTN (public switched telephone network) and the ATM (asynchronous transfer mode) backbone. To provide a better perspective of wireless communication technology, simplified system infrastructure for the cellular system is shown in the figure:

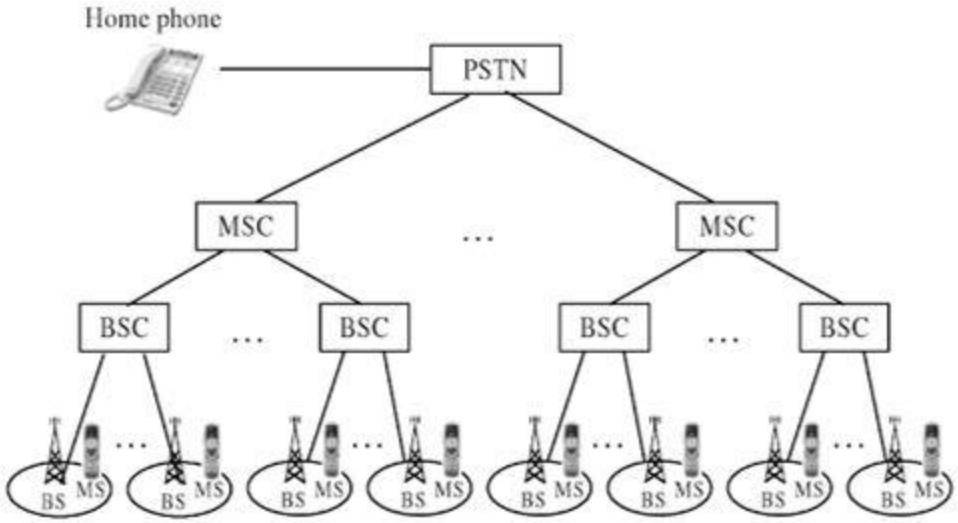


Fig: cellular system infrastructure

Basic Components of Cellular Systems

Introduction

There are various cellular systems in the world, as the GSM and CDMA. The design of these cellular systems is complicated, but most cellular systems' architecture can be broken down into six basic components.

In this article, I will illustrate the six basic components that can be found in most cellular systems.

Basic Components of Cellular Systems

Six Basic Components of Cellular Systems

The architecture of most cellular systems can be broken down into the following six components:

a) Mobile Station (MS)

A mobile station is a mobile/wireless device containing a control unit, a transceiver, and an antenna system for data and voice transmission. For example, in GSM networks, the mobile station will consist of the mobile equipment (ME) and the SIM card.

b) Air Interface Standard

There are three main air interface protocols or standards: frequency division multiple access (FDMA), time division multiple access (TDMA), and code division multiple access (CDMA). These standards are the medium access control (MAC) protocols defining the rules for entities to access the communication medium.

These air interface standards allow many mobile users to share simultaneously a finite amount of radio channels.

Basic Components of Cellular Systems

c) Base Station (BS)

A base station is a fixed station in a mobile cellular system used for radio communications with mobile units. They consist of radio channels and transmitter and receiver antenna mounted on a tower.

d) Databases

Another integral component of a cellular system is the databases. Databases are used to keep track of information like billing, caller location, subscriber data, etc. There are two main databases called the Home Location Register (HLR) and the Visitor Location Register (VLR). The HLR contains the information of each subscriber who resides in the same city as the mobile switching center (MSC). The VLR temporarily stores the information for each visiting subscriber in the coverage area of an MSC. Thus, the VLR is the database that supports roaming capability.

Basic Components of Cellular Systems

e) Security Mechanism

The security mechanism is to confirm that a particular subscriber is allowed to access the network and also to authenticate the billing.
There are two databases used for security mechanisms: Equipment Identify Register (EIR) and Authentication Center (AuC). The EIR identifies stolen or fraudulently altered phones that transmit identity data that does not match the information contained in either the HLR or VLR. The AuC, on the other hand, manages the actual encryption and verification of each subscriber.

Basic Components of Cellular Systems

f) Gateway

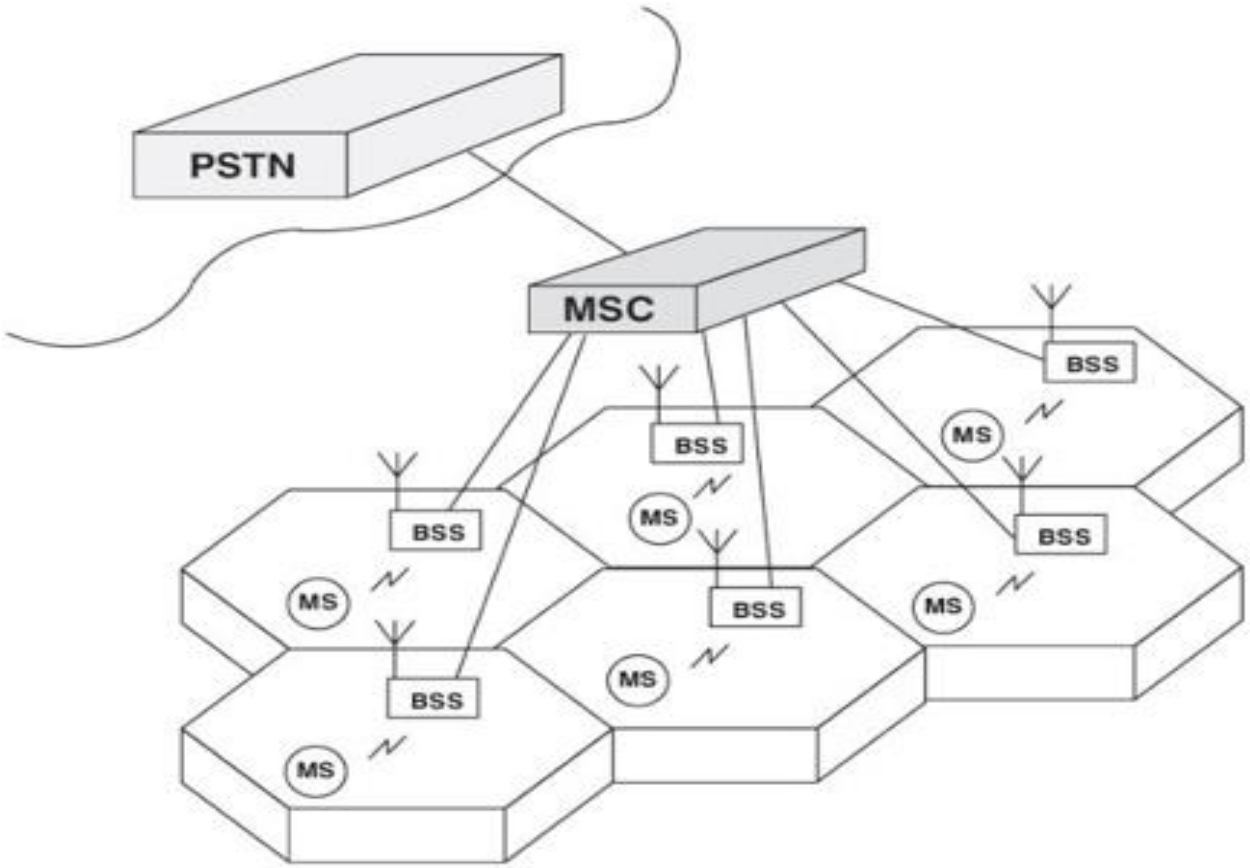
The final basic component of a cellular system is the Gateway. The gateway is the communication link between two wireless systems or between wireless and wired systems. There are two logical components inside the Gateway: mobile switching center (MSC) and interworking function (IWF).
The MSC connects the cellular base stations and the mobile stations to the public switched telephone network (PSTN) or other MSC. It contains the EIR database.
The IWF connects the cellular base stations and the mobile stations to the Internet and performs protocol translation if needed.

Basic Components of Cellular Systems

Conclusion

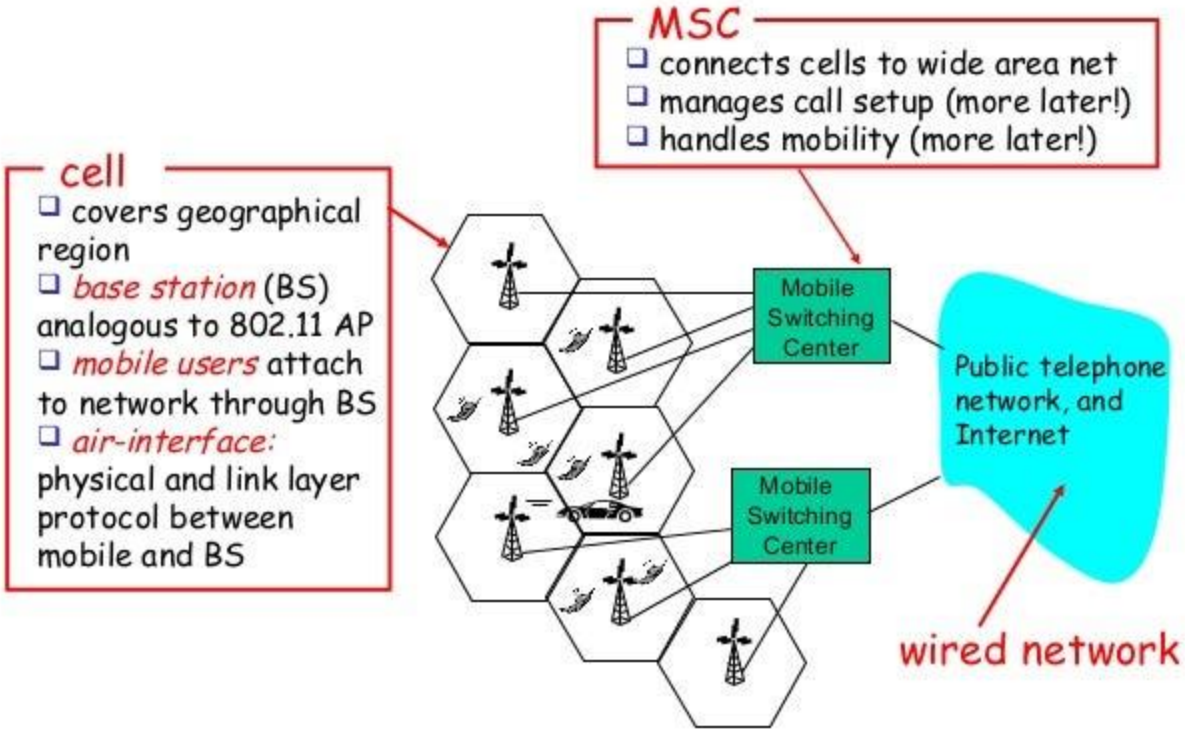
This article aims to provide an introductory guide to the architecture of a typical cellular system and identify the six basic components found in most cellular systems. This article offers an insight towards how a cellular system is designed although different cellular systems may have variations in their own implementations.

Basic Components of Cellular Systems



Basic Components of Cellular Systems

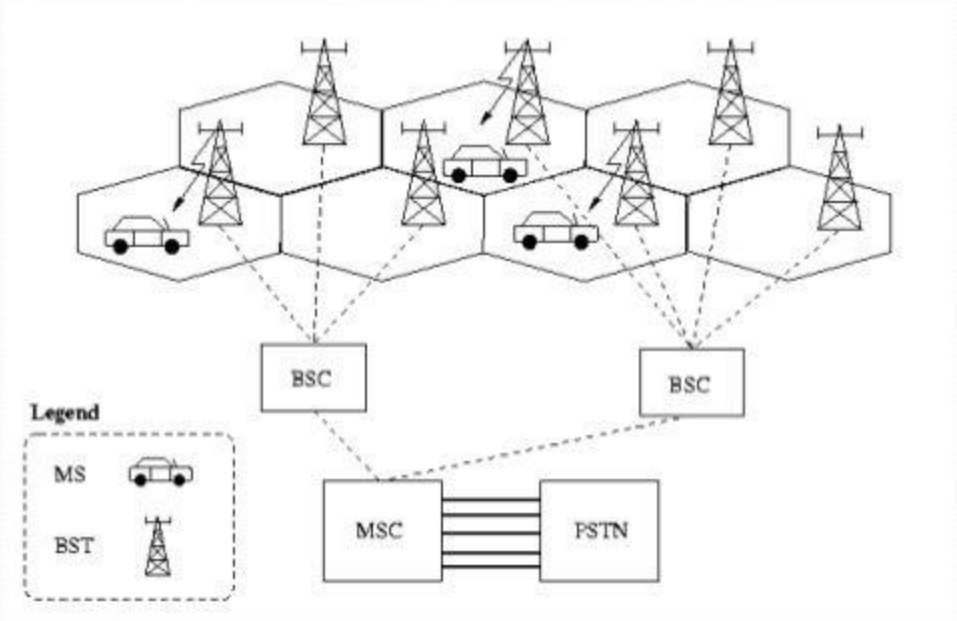
Components of cellular network architecture



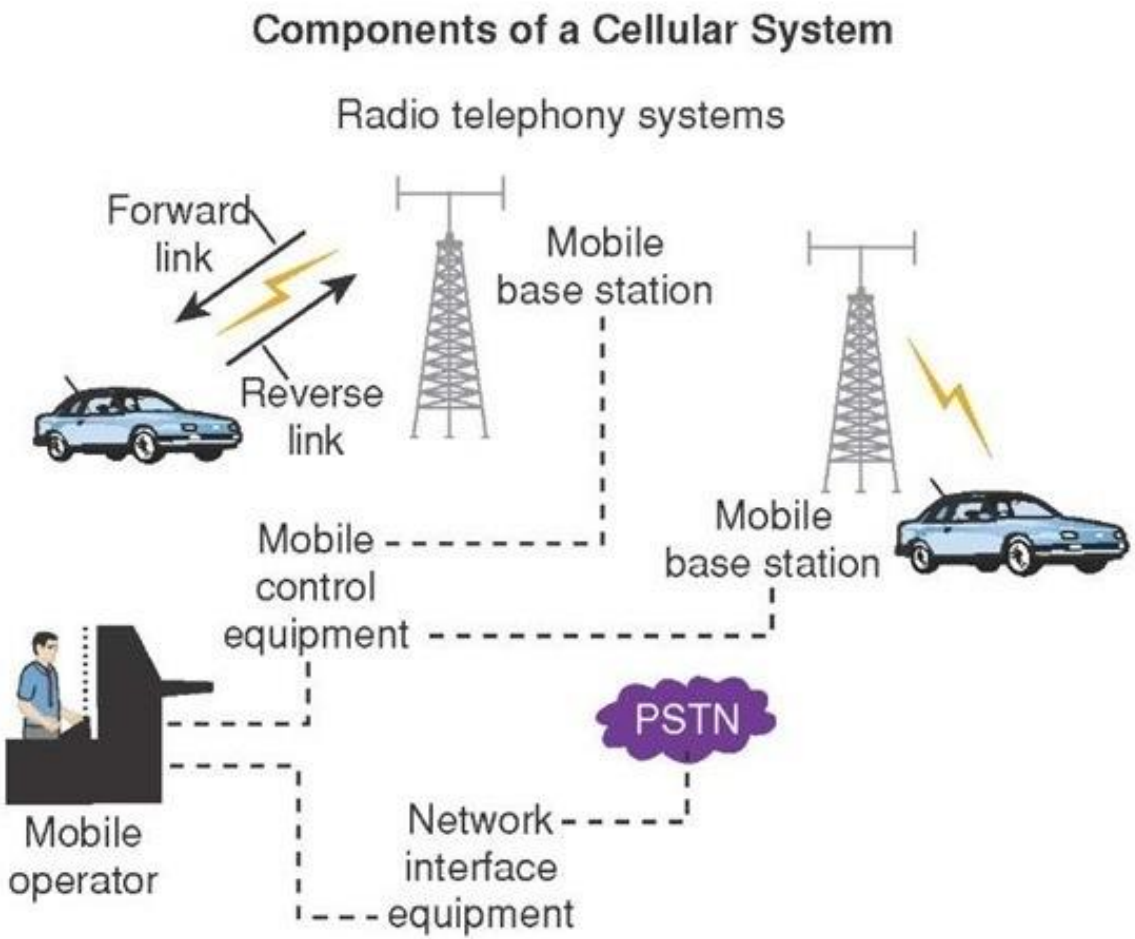
6: Wireless and Mobile 6-

Basic Components of Cellular Systems

OVERVIEW OF CELLULAR NETWORK



Basic Components of Cellular Systems



Antennas for Cellular Systems

Antennas play a crucial role in cellular communication systems, as they are responsible for transmitting and receiving radio signals between mobile devices (such as smartphones) and the cellular network infrastructure. Cellular systems, like 2G, 3G, 4G, and 5G, rely on various types of antennas to ensure efficient and reliable wireless communication. Here's an overview of antennas for cellular systems:

- **Base Station Antennas**

Omni-Directional Antennas: These antennas radiate signals in all directions, providing 360-degree coverage. They are commonly used in urban and suburban areas to serve multiple users within their coverage area.

Antennas for Cellular Systems

•**Directional Antennas**: Directional antennas focus their signal in a specific direction, offering higher gain and longer reach. They are often used in rural or remote areas to cover long distances or to serve specific sectors in urban environments.

•**Sector Antennas**: These antennas are a subset of directional antennas and are commonly used in base stations to provide sectorized coverage. A base station may have multiple sector antennas, each covering a specific angular segment of the cell.

Antennas for Cellular Systems

User Equipment (UE) Antennas:

1. **Internal Antennas**: These are integrated within mobile devices (e.g., smartphones and tablets) and are designed to be compact and inconspicuous. They may use various designs, such as planar inverted-F antennas (PIFA) or meander-line antennas.
2. **External Antennas**: Some devices, like mobile hotspots or data cards, have external antennas that can be extended or adjusted for better signal reception.

MIMO (Multiple-Input, Multiple-Output) Antennas:

1. MIMO technology is essential for enhancing the capacity and performance of cellular networks, especially in 4G and 5G systems. MIMO antennas utilize multiple antennas at both the transmitter (base station) and receiver (user device) to improve data throughput and reliability by exploiting spatial diversity.

Antennas for Cellular Systems

Smart Antennas:

1. Smart antennas use signal processing techniques to adapt their radiation patterns dynamically, optimizing signal quality and capacity. They can be used in both base stations and user devices to improve performance in challenging environments.

Small Cell Antennas:

1. Small cell technology involves deploying compact base stations in densely populated areas to offload network traffic and improve coverage and capacity. These antennas are typically designed to be low-profile and can be placed on streetlights, utility poles, or building exteriors.

Antenna Beamforming:

1. Beamforming technology, especially in 5G, allows antennas to focus their signal directionally toward specific user devices, improving signal quality, capacity, and energy efficiency.

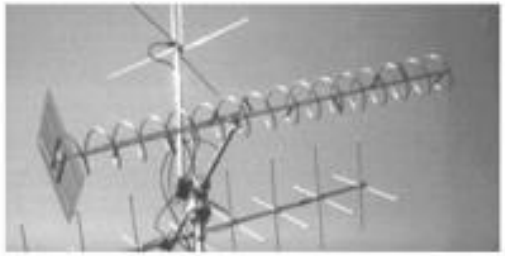
Antennas for Cellular Systems

Diversity Antennas:
Diversity antennas are used to combat signal fading and interference by providing multiple spatial paths for signal transmission and reception. They can be used in both base stations and user devices.

Antenna design and deployment are critical considerations for cellular system engineers and operators. They must balance factors such as coverage area, capacity, signal quality, interference mitigation, and cost to provide reliable and high-performance cellular services to users. As cellular technology continues to evolve, antennas will play an increasingly essential role in meeting the growing demands for wireless connectivity.

Antennas for Cellular Systems

- Dipole
- Horn
- Helical
- Yagi
- Parabolic
- Antenna array



Antennas for Cellular Systems

ANTENNAS USED IN MOBILES

- MOBILE ANTENNA

Operation of Cellular Systems

Cellular systems operate by dividing a geographic area into smaller units called cells. Each cell is served by a base station equipped with antennas and transceivers. Here's a brief explanation of how cellular systems work:

1.Cell Division: The service area of a cellular network is divided into multiple cells. This division allows for efficient use of radio frequencies and minimizes interference between neighboring cells.

2.Base Stations: Each cell has a base station that communicates with mobile devices within its coverage area. The base station contains antennas that transmit and receive radio signals.

3.Frequency Allocation: Frequencies are allocated to each cell to avoid interference. Cells that are geographically distant can use the same frequencies without causing interference. This concept is known as frequency reuse.

Operation of Cellular Systems

4. Mobile Devices: Mobile phones and other wireless devices communicate with the nearest base station. When a user makes a call or uses data, their device sends signals to the base station.

5. Handover: As a mobile device moves, it may enter the coverage area of a different cell. To ensure uninterrupted service, a handover process occurs, where the call or data session is transferred from the current cell to the new cell seamlessly.

6. Network Infrastructure: The cellular network includes various components like Mobile Switching Centers (MSCs) and Home Location Registers (HLRs). MSCs manage call routing and switching, while HLRs store subscriber information.

7. Authentication and Security: Mobile devices are authenticated before they are allowed to access the network. Data transmitted between the device and the base station is often encrypted to ensure privacy and security.

Operation of Cellular Systems

8. Roaming: When a user travels outside their home network's coverage area, they can still use their mobile device by connecting to other networks through a process known as roaming.

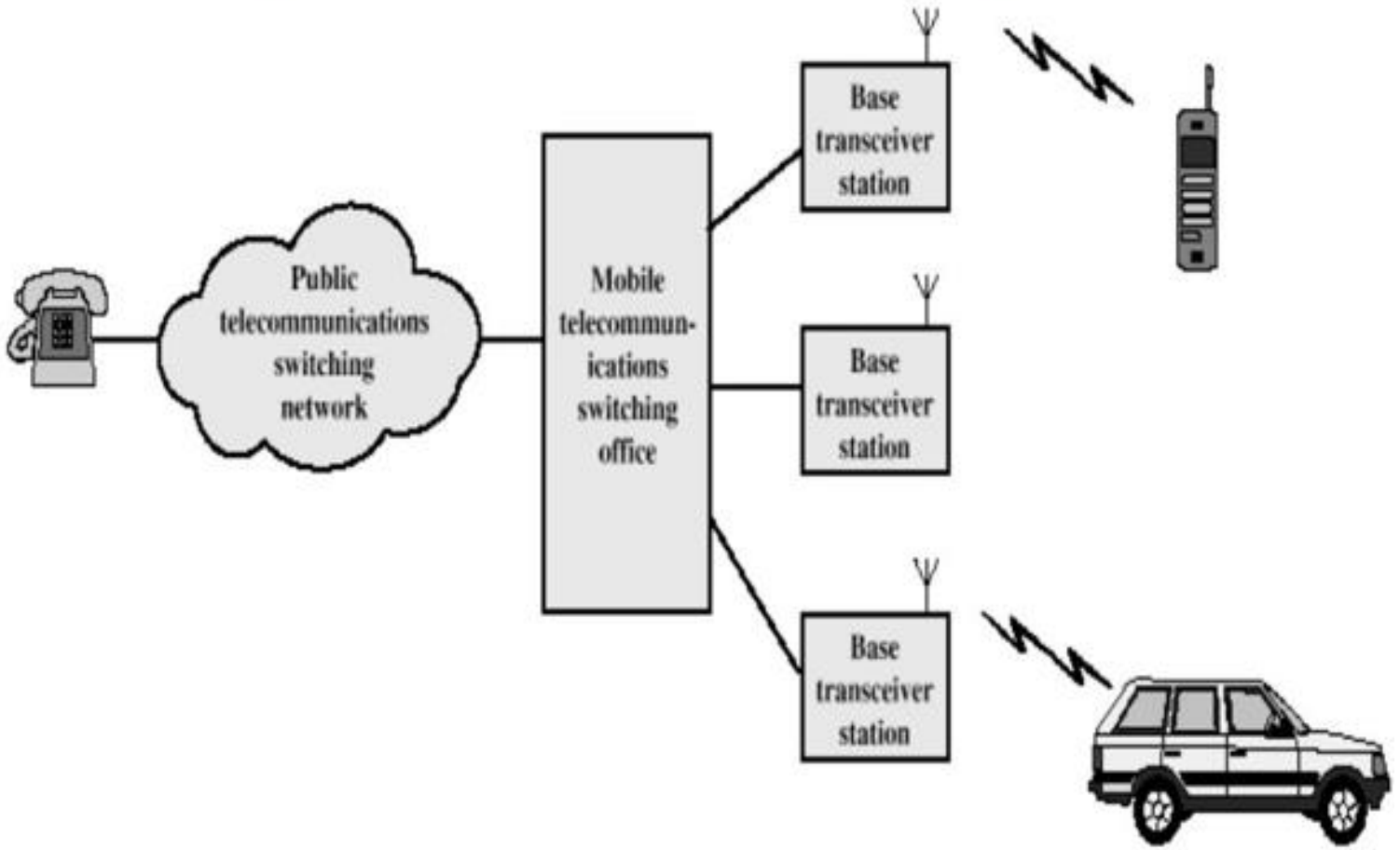
9. Control and Signaling: Control and signaling channels are used for network management tasks, such as call setup, handover, and system maintenance.

10. Evolution: Cellular technology has evolved through generations, including 2G, 3G, 4G (LTE), and 5G, to provide faster data speeds, reduced latency, and support for new applications and devices.

In summary, cellular systems use a network of base stations, frequency allocation, and intelligent handover mechanisms to enable mobile communication. Mobile devices connect to the nearest base station, and the network infrastructure handles call routing, security, and management. This division into cells and frequency reuse optimizes the use of the radio spectrum and ensures reliable wireless communication.

Operation of Cellular Systems

Operation of Cellular System



Frequency reuse

Frequency reuse is a technique used in wireless communication systems to increase the capacity of the network by allowing multiple users to share the same frequency spectrum.

In this scheme, the frequency spectrum is divided into multiple cells, and each cell is assigned a set of frequency channels.
To avoid interference in the cellular system, each cell uses a different set of frequencies compared to its immediate neighbors.

The process of selecting and allocating the frequency sub-bands for all of the cellular base stations within a system is called **frequency reuse** or **frequency planning.**

The total bandwidth is divided into different sub-bands that are used by cells. The number of times a frequency can be reused depends on the tolerance capacity of the radio channel from the nearby transmitter that is using the same frequencies.

Frequency reuse

The salient features of using frequency reuse are:

•Improved spectral efficiency and signal quality (QoS).

• The classical scheme proposed for GSM systems offers protection against interference.

•Frequency reuse scheme allows WiMax system operators to reuse the same frequencies at different cell sites.

The distance between any two co-channels can be calculated by the following formula: D = R * (3 * N) 1/2, where R is the radius of a cell and N is the number of cells in each cluster.

Channel assignment

Channel assignment techniques are used in cellular networks to allocate available channels to cells. The goal is to efficiently use frequencies, time slots, and bandwidth. There are four types of channel allocation strategies: Fixed Channel Allocation (FCA), Dynamic Channel Allocation (DCA), Hybrid Channel Allocation (HCA), and Borrowing Channel Allocation (BCA) 1.

Fixed Channel Allocation (FCA): A fixed number of channels are allocated to each cell. Once the channels are allocated, they cannot be changed. FCA maximizes frequency reuse, but it is susceptible to interference and congestion. If all channels are occupied and a user makes a call, the call is blocked 1.

Channel assignment

Dynamic Channel Allocation (DCA): Channels are not permanently allocated to cells. When a user makes a call request, the base station sends that request to the Mobile Station Center (MSC) for the allocation of channels or voice channels. This way, the likelihood of blocking calls is reduced. As traffic increases, more channels are assigned and vice versa 1.

Hybrid Channel Allocation (HCA): HCA is a combination of both FCA and DCA. The total number of channels or voice channels are divided into fixed and dynamic sets. When a user makes a call, first fixed set of channels are utilized but if all the fixed sets are busy then dynamic sets are used. The main purpose of HCA is to work efficiently under heavy traffic and to maintain a minimum S/I 1.

Channel assignment

Borrowing Channel Allocation (BCA): When a cell experiences high traffic demand and all of its channels are occupied, it can borrow channels from neighboring cells that are not being used at that time

Handoff strategies

Handoff, also known as handover, is a critical operation in wireless communication systems, including cellular networks. It involves transferring an ongoing call or data session from one cell (base station) to another as a mobile device moves through the network. Handoff strategies are essential to maintain call quality, prevent call drops, and ensure seamless communication. There are several handoff strategies used in wireless networks:

1. Hard Handoff (HHO):

Hard handoff is the traditional method of transferring a call or data session from one cell to another. During a hard handoff, the mobile device completely disconnects from the current cell before connecting to the new cell. This brief interruption in the connection can result in call drops and momentary service disruption.

Handoff strategies

2.Soft Handoff (SHO):

Soft handoff is a more advanced strategy used in Code Division Multiple Access (CDMA) and some other cellular technologies. In a soft handoff, the mobile device is simultaneously connected to multiple cells as it transitions from one cell to another. This overlap of connections ensures a seamless transfer without call drops. It provides better call quality and reliability compared to hard handoff.

Handoff strategies

3.Make-Before-Break Handoff:

In this strategy, the mobile device establishes a connection with the target cell before disconnecting from the source cell. This approach ensures that the new connection is stable and strong before releasing the old one, minimizing the likelihood of call drops. Make-before-break handoffs are commonly used in 4G (LTE) and 5G networks.

4. Cell Reselection Handoff:

In situations where a mobile device is moving between cells but the signal from the source cell is still strong, the device may perform a cell reselection handoff. It involves reselecting a neighboring cell without fully disconnecting from the source cell. This strategy is used to optimize network resources.

Handoff strategies

5. Network Controlled Handoff:

Network-controlled handoff relies on information from the cellular network to determine when and to which cell a handoff should occur. The network monitors signal quality, traffic load, and other factors to make handoff decisions. This strategy allows for efficient handoffs based on network conditions.

6. Mobile-Assisted Handoff (MAHO):

In MAHO, the mobile device actively participates in the handoff process by measuring the signal strength and quality of neighboring cells. It assists the network in making handoff decisions. MAHO can help reduce network congestion and improve call quality.

Handoff strategies

7. Load-Based Handoff:

Load-based handoff takes into account the traffic load on cells. When a cell becomes congested, the network may initiate a handoff to a less congested cell to balance the load and ensure quality of service.

8. Velocity-Based Handoff:

Velocity-based handoff considers the speed at which a mobile device is moving. When a device is moving at a high speed, the network may initiate a handoff to cells ahead of the device's path to ensure continuous service.

Effective handoff strategies are essential for providing seamless and high-quality wireless communication services. The choice of strategy depends on the specific cellular technology and network architecture, as well as the need to balance factors like call quality, call drops, and network efficiency.

Daily Quiz

1. What were the earliest forms of mobile radio communication?
2. How did the concept of cellular networks evolve over time?
3. What role did the military play in the development of mobile radio systems?
4. Who were some key figures in the history of mobile radio technology?
5. How did the transition from analog to digital mobile communication systems occur?
6. What were the major milestones in the development of mobile phones?
7. How did the introduction of 2G, 3G, and 4G networks change mobile communication?
8. What impact did the invention of the smartphone have on mobile radio systems?
9. What are the basic components of a wireless communication link?
10. How does modulation and demodulation work in wireless communication?

Daily Quiz

1. How does modulation and demodulation work in wireless communication?
2. What is the significance of frequency bands and channels in wireless communication?
3. Explain the concept of multiplexing in wireless communication.
4. What are the challenges of signal propagation in wireless communication?
5. What is the difference between cellular and ad-hoc wireless networks?
6. How do 4G and 5G networks differ in terms of architecture and capabilities?
7. What are the key features of Wireless Local Loop (WLL) systems?
8. How does paging technology work, and what are its applications?
9. What are the advantages and limitations of satellite-based mobile systems?
10. What are the expected benefits and innovations of 6G wireless technology?

Daily Quiz

1. How are the wireless systems classified? State the major changes in the classified wireless system.
2. Explain the term evolution of mobile radio communication fundamentals.

Weekly Assignment

History and Evolution of Mobile Radio Systems:

1.Who is credited with making the first mobile phone call?
a) Alexander Graham Bell b) Thomas Edison c) Martin Cooper d) Nikola Tesla

2.What was the weight of the first commercially available handheld mobile phone?
a) Less than 1 pound b) 2-3 pounds c) 5-6 pounds d) Over 10 pounds

3.Which company introduced the concept of the "bag phone" for mobile communication? a) Motorola b) Nokia c) Apple d) Samsung

4.In which decade did the transition from analog to digital mobile communication systems occur? a) 1950s b) 1970s c) 1990s d) 2000s

5.What was the primary limitation of early mobile radio systems? a) Limited coverage area b) High cost c) Large size d) Short battery life

Weekly Assignment

General Model of Wireless Communication Link:

6.What is the primary function of a transmitter in a wireless communication link?
a) To receive signals b) To amplify signals c) To extract information from signals d) To generate and send signals

7.Which of the following is NOT a key component of a wireless communication link?
a) Receiver b) Modulator c) Antenna d) Router

8.What does modulation refer to in wireless communication?
9.a) Signal amplification b) Signal encryption c) Signal conversion to radio waves d) Signal error correction

9.What type of communication allows data transmission in both directions but not simultaneously? a) Simplex b) Half-duplex c) Full-duplex d) Multiplex

10.How does signal propagation work in wireless communication?
a) Signals travel through physical wires b) Signals are sent via satellite c) Signals propagate through the air or space d) Signals are converted to digital form for transmission

Weekly Assignment

Types of Mobile Wireless Services/Systems:

11.What is the primary purpose of cellular networks?
a) Data storage b) Voice communication c) Video streaming d) GPS navigation
12.What is a base station in a cellular network?
a) A mobile phone store b) A central call center c) A tower that communicates with mobile devices d) A network security system
13.Wireless Local Loop (WLL) systems are designed to provide:
a) Long-distance wireless communication b) Local telephone service via wireless connections c) Internet access through satellites d) Radio broadcasting services
14.In the context of mobile communication, what does "paging" refer to?
a) Searching for available Wi-Fi networks b) Sending short text messages c) Locating and alerting mobile devices d) Tracking GPS coordinates

Weekly Assignment

Satellite Systems:

15.Which type of satellite orbits the Earth at the same speed that the Earth rotates, maintaining a fixed position relative to the Earth's surface?
a) Geostationary satellite b) Low Earth Orbit (LEO) satellite c) Medium Earth Orbit (MEO) satellite d) Polar satellite
16.What is the primary advantage of satellite-based mobile systems?
a) Low latency b) Global coverage c) High data transfer rates d) Low cost
17.Which satellite system is commonly used for satellite radio broadcasting?
a) GPS b) Inmarsat c) XM Satellite Radio d) Iridium

Weekly Assignment

Types of Mobile Wireless Services/Systems:Future Trends in Personal Wireless Systems:

18.What is one of the expected benefits of 6G wireless technology?
a) Slower data speeds b) Reduced energy efficiency c) Increased latency d) Faster and more reliable connectivity
19.How might artificial intelligence (AI) impact future personal wireless systems?
a) Decrease network security b) Improve battery life in mobile devices c) Reduce the need for wireless networks d) Decrease the demand for data
20.Which technology is often associated with the Internet of Things (IoT) in personal wireless systems?
a) Dial-up modems b) Bluetooth c) Fax machines d) Satellite phones

Weekly Assignment

Types of Mobile Wireless Services/Systems:s

Answers:

1.c) Martin Cooper
2.b) 2-3 pounds
3.a) Motorola
4.c) 1990s
5.a) Limited coverage area
6.d) To generate and send signals
7.d) Router
8.c) Signal conversion to radio waves
9.b) Half-duplex
10.c) Signals propagate through the air or space
11.b) Voice communication
12.c) A tower that communicates with mobile devices
13.b) Local telephone service via wireless connections
14.c) Locating and alerting mobile devices
15.a) Geostationary satellite
16.b) Global coverage
17.c) XM Satellite Radio
18.d) Faster and more reliable connectivity
19.b) Improve battery life in mobile devices
20.b) Bluetooth

Old Question Papers

Roll No. | | | | | | | | | | |

B. Tech.

(SEM. VIII) THEORY EXAMINATION, 2014-15

WIRELESS & MOBILE COMMUNICATION

Time : 3 Hours] [Total Marks : 100

Note : Attempt all questions.

1 Attempt any four parts : 5×4=20

(a) Explain the term Evolution of mobile radio communication fundamentals.

(b) A transmitter has a power output of 150 watt at a carrier frequency of 32.5 MHz. It is connected to an antenna with gain of 12 dBi. The receiving antenna is 10 km away and has gain of 5 dBi. Calculate the power delivered to the receiver, assuming free space propagation. Assume also that there are no losses or mismatches in the system.

(c) Define the Brewster angle. Calculate the Brewster angle for a sine wave imping on the ground having a permittivity of $\varepsilon r = 4$.

(d) Explain the term multipath measurement using relevant diagram.

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Old Question Papers

(e) Explain the outdoor models given below :
(i) Durkin's Model
(ii) Okumura Model.

2 Attempt any four parts : 5×4=20
(a) Draw the block diagram of survey of equalization and explain it.
(b) Derive the impulse response model of multipath channel.
(c) What is the basic mechanism of vocoder and explain any two types of vocoders.
(d) Explain the different type of equalization techniques used in wireless communication with support of mathematics and block diagram.
(e) Explain the different type of diversity techniques used in wireless communication system.

3 Attempt any two parts : 10×2=20
(a) What are the different methods used for improving coverage and capacity in cellular system ? Describe all the method in detail with support of figures.
(b) Define frequency reuse concept. And explain the different type of channel assignment strategies and hand-off strategies in communication system.

(c) Given a cellular system with a total bandwidth of 30 MHz which uses two 25 kHz simplex channels to provide full duplex voice channels and control channels. Assuming that system uses a nine cell reuse pattern and 1 MHz of the total bandwidth is allocated for control channel :
(i) Calculate the total available channel
(ii) Determine the number of control channels
(iii) Determine the number of voice channels per cells.
(iv) Discuss the strategies for distribution of control and voice channels in each cell.

4 Attempt any two parts of the following : 10×2=20
(a) Describe the Forward CDMA channel and reverse CDMA channel using proper block diagram.
(b) Explain the GSM architecture and frame structure in mobile radio communiction using system in detail.
(c) A FDD cellular communication system uses a total of 945 radio channels available for handling traffic. The total area of entire system is 2450 sqkm with the 7 sqkm as the area of a cell :
(i) Calculate the system capacity if the cluster size is 7.
(ii) Calculate the system capacity if the cluster size is 4.

Thank You