

Unit 3

Unit– III Wireless Applicati on Protocol and 3G Mobile Services	3a. Describe the given specification for compatibility requirements of IMT-2000 global standards. 3b. Explain features of the given next generation standard. 3c. Describe the function of the given section of UMTS network architecture. 3d. Compare features of the two given next generation mobile communication networks based on given criteria. 3e. State the procedure of scheduled maintenance of the given system	3.1 Mobile Internet standard, Wireless Application Protocol (WAP) Gateway and Protocols. 3.2 Wireless Markup Languages (WML) 3.3 International Mobile Telecommunications 2000 (IMT 2000) specification. 3.4 Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in third generation (3G) network. 3.5 UMTS Technology: Features, UMTS data rates, UMTS Spectrum, UMTS Architecture, applications and advantages. 3.6 Features of 4G and 4G LTE, VoLTE, 4.5G, 5G, 4G Architecture, applications of 4G
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3.1 Mobile Internet Standard

1. The mobile Internet refers to a **Browser-based Internet Service** accessed from handheld devices such as smart phones through a mobile or other wireless network.
2. Mobile Internet use has exceeded that on a desktop. Use of Mobile Internet has increased since 2007 due to many **smart phone** users, and since 2010 with the rise of **tablet** computer users.
3. Both platforms provide **better Internet access, screens, and mobile browsers**.
4. Mobile Internet is an **access** to the **internet** through **cellular telephone service providers**.
5. It is a **wireless access**, which can handoff to another radio tower while it is moving across the service area.

Advantage:

Mobile Internet standards have the advantages of improving the interoperability, usability, and accessibility of mobile web usage.

Goals of Mobile Internet standards:

The important goals of Mobile Internet standards are:

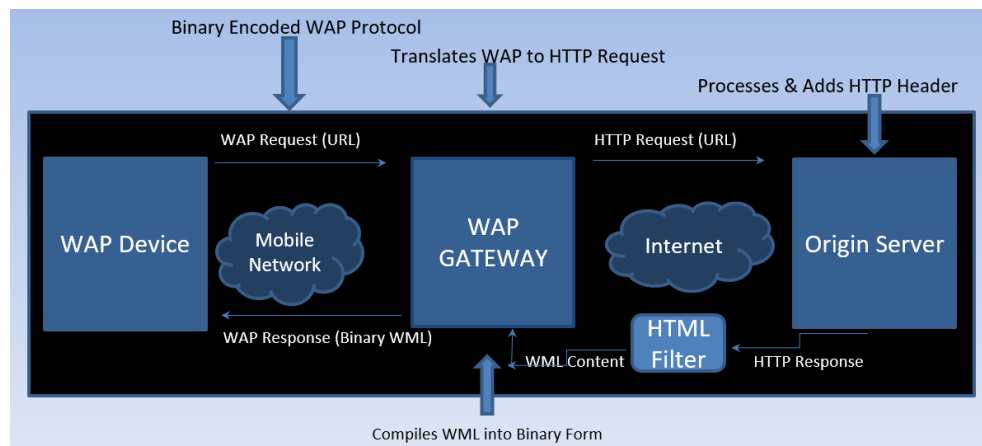
1. To minimize bandwidth requirement.
2. To maximize the number of supported networks.

❖ WAP ❖

1. **Wireless Application Protocol** commonly known as WAP is used to enable the access of internet in the mobile phones or PDAs.
2. An open, global specification that empowers mobile users with wireless devices to easily access and interact with internet information and services instantly.
3. Purpose of WAP is to **enable easy, fast delivery of relevant information and services to mobile users.**
4. WAP is used to **access services and information.**
5. WAP is for handheld devices such as mobile phones, pagers, smart phones, and communication.
6. WAP uses the **mark-up language WML** (not HTML). WML is defined as **an XML 1.0 application.**



WAP Model/Architecture

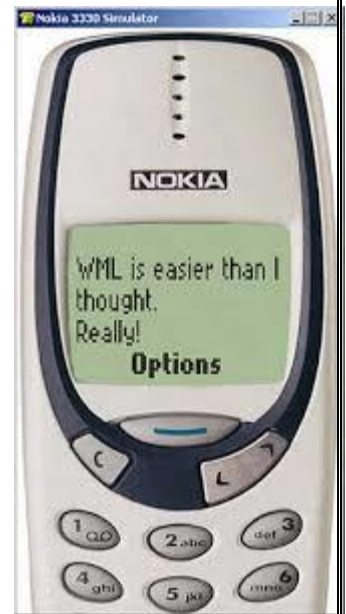


3.2 WML (Wireless Markup Language)

1. WML stands for **Wireless Markup Language**
2. It is an **application of XML** which is defines in a document type definition.
3. WML documents have **extension .wml**
4. It takes care of **small screen and the low bandwidth** of transmission.
5. WML is the markup language **defined in the WAP specification.**
6. **WAP sites are written in WML**, while websites are written in HTML.

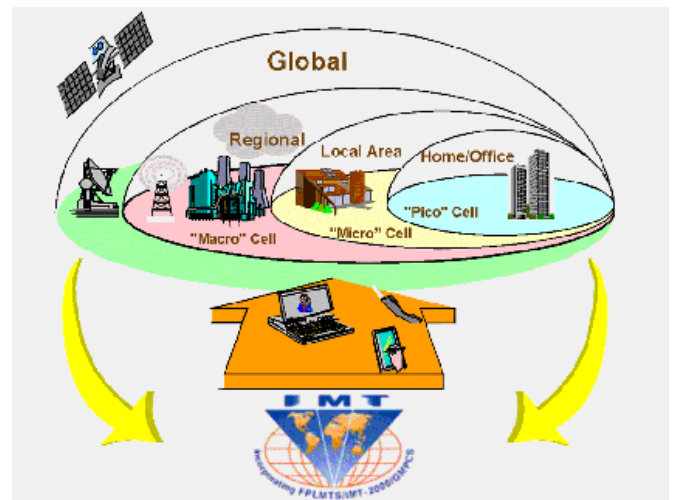
Features of WML:

1. **Text and Images:** WML gives a clue about how the text and images can be presented to the user. ...
2. **User Interaction:** WML supports different elements for input like password entry, option selector and text entry control. ...
3. **Navigation:** WML offers hyperlink navigation and browsing history.



3.3 IMT 2000 Global Standards:

1. The International Telecommunications Union (ITU) regulated a plan to implement a global frequency band in the range of 2000 MHz which will support a wireless communication standard **for all countries** throughout the world known as **International Mobile Telephone 2000 (IMT-2000)**.
2. IMT-2000 **provides an international framework** for wireless network access by connecting different systems including the terrestrial and/or satellite systems.



IMT 2000 defines 3G system which has following characteristics:

1. Global seamless mobility and service delivery.
2. It defines global standards which are flexible to meet local requirements and permits current systems to evolve towards 3G systems.

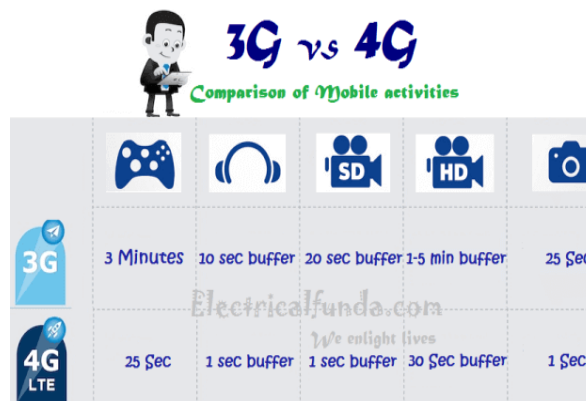
IMT 2000 Features / Goals:

1. Worldwide common spectrum (1.8-2.2 GHz band).
2. Data rates: 9.6 kbps or more for global (mega cell), 144 Kbps or more for vehicular (macro cell), 384 Kbps or more for pedestrian (micro cell) and up to 2 Mbps for (pico cell indoor environments).
- 3 Global seamless roaming.
4. Multiple radio environment (cellular, cordless, satellite, LANS, wireless local loop (WLL)).
5. Enhanced performance and security.
6. Wide range of telecommunications services such as voice, data, multimedia, etc.

IMT 2000 Services:

1. It provides global seamless **roaming** and service delivery across IMT 2000 networks.
2. Supports **for emergency and priority calls**.
3. It supports **multiple environments**.
4. It provides **security**.

- **Need of 3G technology (For understanding purpose only)**



1. Existing mobile networks such as 2G and 2.5G are not compatible around the world as worldwide devices need to have many technologies in a single device.
2. Developing a single standard, which will be accepted all over the world is, required, for that purpose 3G technology was introduced in 2001.
3. Existing technologies (GSM/CDMA) were designed for handling voice traffic and voice-oriented services.
4. After the introduction of 2G and 2.5G technologies into the market, people wanted to have more services other than voice services.

5. Through mobile networks, the requirement for data transmission has been gradually growing together with the popularity of the Internet.

6. Therefore, some up-gradation had to be introduced into existing networks as they have limited capability. They do not provide variable data speed, flexibility, supporting quality of service solutions, etc.

7. For all these reasons, 3G is needed which provides higher bandwidth, video streaming, video calls, gaming for customers and high-speed teleworking, video conferencing, real time financial information etc. for the business.

- **Need of 4G technology: (For understanding purpose only)**

1. There are two reasons why we have migrated from 3G to 4G. One is increasing growth of overall subscribers and other is massive demand of new data services which can be either audio, data, video, and images etc. (interactive or non. interactive services).

2. The expected features of 4G system are much higher data rates up to 100 Mbps, higher bandwidth requirement etc.

3. 4G technology provides better connectivity as compared to the 3G technology. 4G offers twice internet speed than 3G. Due to all these reasons, 4G is required.

4. 4G technology provides better signal reception, fast internet access, good voice quality, efficient access to cloud storage, multiple device connectivity, improved video calls / conferencing, real time connection with many users.

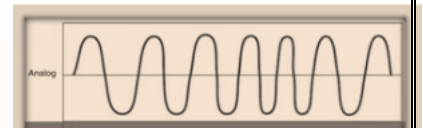
❖ Various Generations of Mobile Phones:

1. **The first-generation** wireless networks are based on analog technology, and they are used only for analog voice services.
2. **The second-generation wireless systems (2G)** employ digital modulation and advanced call processing capabilities. Typical examples include Global System for Mobile (GSM), cordless telephone (CT2) etc.
3. **The third-generation wireless systems (3G)** are developed to provide universal access throughout the world. They have used broadband ISDN to provide access to information networks like internet, communications using Voice Over Internet Protocol
4. **(VoIP)**, voice-activated calls etc. The fourth-generation wireless systems (4G) are currently under deployment but continue to evolve.
5. **The next generation cellular networks** have been designed to support high speed data communications traffic in addition to the voice calls.

6. The new technologies and standards are being implemented so that the wireless networks can replace the fiber optic or copper cables. The wireless networks are used as replacement for wires within offices, buildings, homes with the use of Wireless Local Area Networks (WLANS).
7. The Bluetooth modem standard can connect several devices with invisible wireless connections within a person's personal workspace. It was conceived as a wireless alternative to RS232 cables.
8. WLANS and Bluetooth use low power levels. They don't need a license for spectrum use. They are used for adhoc wireless communication of voice and data anywhere in the world.

❖ First Generation

1. Analog Technology
2. Only Voice call
3. Maximum speed
2.4kbps
4. Data Transmission at
150Mhz
5. Drawbacks-
 - a. Poor Battery life and voice quality.
 - b. Big size Mobile phones
 - c. No security



❖ Second Generation

1. The second generation of cellular telephony was developed to improve the quality of communication.
2. The second generation was designed for digital voice.
3. 2G networks began to emerge around 1980's but their actual implementation started by 1990's.
4. 2.5G and 2.75G are the upgraded versions of 2G.
5. Features-Write from the table of comparison



Services:

- | | |
|------------------|-------------|
| 1.Digital voice. | 2.Web. |
| 3.E-mails | 4. Browsing |
| 5.Performance | |

Although 2G systems provided a huge improvement over 1G and increased the number of subscribers the standards were poor.

2G systems were unable to handle complex data and they could not use the available bandwidth efficiently.

Limitations of 2 G:

- | | |
|---------------------------------|---------------------------------|
| 1. Less capacity | 2.Limited roaming capabilities. |
| 3. Limited packet data support. | 4.No multimedia. |



2G GSM
Global Systems for Mobile Communication

- 1991 in Finland by Radiolinja (now part of Elisa Oyj)
- Digital Modulation - TDMA & CDMA - 900 MHz
- Maximum Speed 14.4 Kbps DL/UL
- Voice Call & SMS
- Smaller and More Secure Mobile Phones

2.5G GPRS
General Packet Radio Service

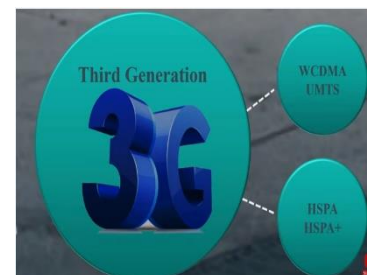
- 1993 By ETSI - Packet-switched Technologies
- Maximum Speed 53.6 Kbps Downlink
28.8 Kbps Uplink
- Introduced MMS - Multimedia Message Service
- Supports IP to Connect to Internet

2.75G EDGE
Enhanced Data rates for GSM Evolution

- 2003 By AT&T
- Maximum Speed 236.8 Kbps Downlink - 59.2 Kbps Uplink
- 8PSK Encoding

❖ Third Generation

- The 3G systems have evolved due to the need for high speed, fast data transmission and better quality of Service(QoS)
- The 3G systems were launched in 2001 and it provides the network for transporting rich multimedia contents.



The well-known examples of 3G system are

- i. IMT-2000
- ii. CDMA
- iii. W-CDMA(UMTS)



Advantages of 3G Wireless Networks:

1. The users will get high-speed network for their communication which is better than the 2G technology, particularly in data communication.
2. The user will get wireless broadband.
3. Using 3G technology customers can see video or satellite-based programs like TV programs.
4. The many in one service will be available on the same network. Due to the use of the DTH & 3G technology, to avoid time loss and keeping records for different service providers everyone will use this multi-purpose services.
5. 3G provides uninterrupted video streaming on phones.
6. Video calls and large MMS can be sent.
7. 3G is cheaper for network providers.
8. 3G enables video calls, videoconferencing etc.
9. Everyday 3G networks allow people to access music, picture, and videos.
10. Very faster than previous networks.

Applications of 3G Networks:

1. Mobile TV.
2. Mobile internet connectivity.
3. Downloading various applications.
4. Multimedia services.
5. Improved music on your Mobile.

Various 3G Standards:

1. CDMA 2000.
2. WCDMA - UMTS.
3. 3GTD-SCD
4. IMT 2000.

❖ CDMA 2000:

1. The CDMA 2000 is updated technology of 2G and 2.5G CDMA technology. As compared to 2G and 2.5G systems, 3G systems supports much higher data rates.
2. The structure of CDMA 2000 and 2G CDMA system is same with a channel bandwidth of 1.25 MHz per radio channel.
3. CDMA 2000 provides high data rate internet access in existing systems. The standards of CDMA 2000 are based on IS-95, IS-95 A and 2.5G IS-95 B standards.
4. CDMA 2000 is designed for forward and backward compatibility in mobile phones.

Advantages of CDMA 2000:

1. End to end latency is low.
2. Good voice clarity.
3. High speed broadband data connectivity.

4. Increased throughput capacity of data and voice.
5. Long term robust and evolutionary path with forward and backward compatibility.
6. Flexible network architecture.
7. User, application, and flow-based quality of service.
8. Flexible spectrum allocation.
9. Multimode, global, multi-band roaming features.
10. Improved privacy with security.
11. Total cost of ownership is lowered.

❖ Quality of Service in 3G Networks:

1. Quality of Service (QoS) is an important concept in any network, which finally determines the network efficiency and satisfaction of customers.
2. Quality of service should be provided on an end-to-end basis from the end-user's point of view.
3. Quality of service characteristics must be simple and less in number.

Requirements for Quality of Service

1. Mechanism:

Based on the capability of dynamic change in QoS parameters, it should utilize resources efficiently, during communication.

2. It should work with current QoS schemes.
3. With appropriate mapping, it should provide end-to-end QoS to the users. The end-to-end service uses the bearer service of the primary networks on the application level

Types of Bearer Services:

1. **Local bearer service:** It offers a connection between TE (Terminal equipment) and MT (Mobile terminal). A TE can be PDA or PC connected via MT.
2. **3G bearer service:** It offers 3G Quality of service.
3. **External bearer service:** In the call, it offers a connection to the other party. Several network services are utilized in this service.

❖ UMTS (Universal Mobile Telecommunications Service)

1. UMTS is a third generation (3G) broadband, packet-based transmission of text, digitized voice, video, and multimedia at data rates up to 2 megabits per second (Mbps).
2. UMTS stands for **Universal Mobile Telecommunications Services** i.e. a 3G cellular-system technology standard capable of accommodating 3G multi-mobile services.
3. **It permits access of services like Voicemail, Internet TV, Video Calling and Conferences.**

4. Objective behind UMTS

2g and 2.5G systems are incompatible with advanced technologies and provides less data. These systems are enhanced with new features to design a UMTS system, which is capable of working across world with high data speed i.e. **2048Kbps**.

UMTS Features

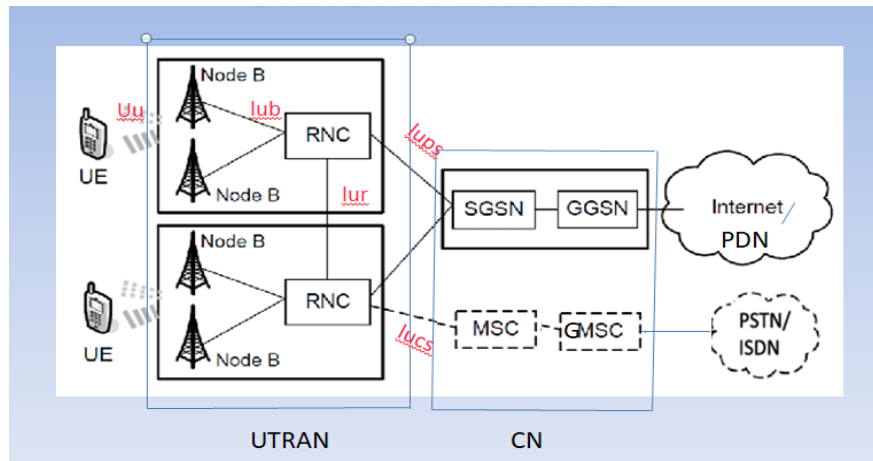
1. It describes the protocols and the radio interface in core network
2. UMTS is a 3G architecture
3. It supports both CDMA and GSM
4. It **supports both circuit and packet switch transmission**
5. It provides mobile services across world
6. It provides high bandwidth and availability
7. It permits multi-mobile services, interpersonal communication, voice-mail, messaging, video-conferencing
8. It refers to **WCDMA** protocols



❖ UMTS Architecture

Components of UMTS

- The UMTS network architecture can be categorized into three components:
- **UE (User equipment)** i.e. A multimedia terminal able to provide video, data, and voice simultaneously. It consist of two sections i.e. mobile equipment and Universal subscriber identity module.
- **UTRAN:** It is a terrestrial radio access network which contains RNC, Node B and RNS in it.
- **Core Network:** core network is also divided into two sub parts i.e. Circuit switched and packet switched elements to carry data in a circuit and packet form respectively.



1. The cellular network uses primarily UMTS (Universal Mobile Telecommunication Service), a popular 3G mobile communication technology supporting both voice and data services.
2. Fig. depicts the key components in a typical UMTS network: When making a voice call or accessing a data service, a mobile device directly communicates with a cell tower or node-B, which forwards the voice/data traffic to a Radio Network Controller (RNC).
3. In case of mobile voice, the RNC delivers the voice traffic toward the PSTN or ISDN telephone network, through a Mobile Switching Center (MSC) server.
4. In case of mobile data, the RNC delivers the data service request to a Serving GPRS Support Node (SGSN), which establishes a tunnel with a Gateway GPRS Support Node (GGSN) using GPRS Tunneling Protocol (GTP), through which the data enters the ,IP network (and the public Internet).
5. The UMTS network has a hierarchical structure: where each RNC controls and communicates with multiple node-Bs, and one SGSN serves multiple RNCs. UMTS offers a data downloading speed up to 2 Mbps.

Difference between GSM and UMTS

GSM	UMTS
Slow data rate	Fast data rate
2G and 2.5 are example of GSM	3G system is an example of UMTS
Dependent on TDMA	Dependent on CDMA
Old technologies	Improve version of 2G i.e. new technology standard

UMTS introduced new cellular capabilities like **video calling and mobile television**. But more importantly, **it allows for much higher data transfer rates and uses less power to upload or download data than the older GSM technology**

Following are the three types of UMTS channels:

1. Physical channel
2. Logical channel
3. Transport channel

Advantages of UMTS:

1. Broad offer of services.
2. Speed, variety, and user-friendliness of service significantly improved compared with GSM.
3. High -speed data transmission.
4. Improved voice quality.
5. Global roaming across networks.
6. Improved security.

Disadvantages of UMTS:

1. Expensive input fees for 3G service licenses.
2. It is challenging to build the necessary infrastructure for 3G.
3. Expense of 3G phones.

UMTS Applications

- | | |
|---------------------------------------|--------------------------------|
| • Streaming / Download (Video, Audio) | Videoconferences. |
| • Fast Internet / Intranet. | Mobile E-Commerce (M-Commerce) |
| • Remote Login | Multimedia-Messaging, E-Mail |
| • Mobile Entertainment (Games) | |

❖ **4G**

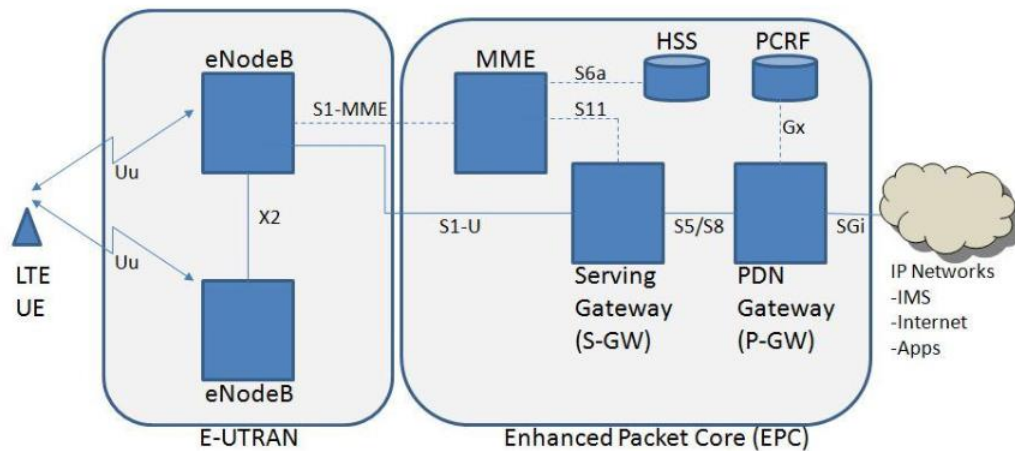
1. 4G stands for fourth generation cellular system.
2. 4G is evolution of 3G to meet the forecasted rising demand.
3. It is an integration of various technologies including GSM, CDMA, GPRS, IMT-2000, Wireless LAN.
4. Data rate in 4G system will range from 20 to 100 Mbps.



Features:

1. Fully IP based Mobile System.
2. It supports interactive multimedia, voice, streaming video, internet and other broadband service.
3. It has better spectrum efficiency.
4. It supports Ad-hoc and multi hop network

- **4G Architecture**



1. Figure shows Generic Mobile Communication architecture.
2. 4 G network is an integration of all heterogeneous wireless access networks such as Ad-hoc, cellular, hotspot and satellite radio component.
3. Technologies used in 4 G are smart antennas for multiple input and multiple output (MIMO), IPv6, VoIP, OFDM and Software defined radio (SDR) System.

Smart Antennas:

1. Smart Antennas are Transmitting and receiving antennas.
2. It does not require increase power and additional frequency.

IPv6 Technology:

1. 4G uses IPV6 Technology in order to support a large number of wireless enable devices.
2. It enables a number of application with better multicast, security and route optimization capabilities.

VoIP:

1. It stands for Voice over IP.
2. It allows only packet to be transferred eliminating complexity of 2 protocols over the same circuit.

OFDM:

1. OFDM stands for Orthogonal Frequency Division Multiplexing.
2. It is currently used as WiMax and WiFi.

SDR:

1. SDR stands for Software Defined Radio.

2. It is the form of open wireless architecture.

MME- Mobility Management Entity

It is used for Paging ,Authentication, Handover and Selection of Serving Gateway

SGW- Serving gateway

It is used to Routing and Forwarding user data packet.

PDN-GW Packet Data Network Gateway

It is used for user equipment (UE) IP allocation

HSS -Home Subscriber Server

It is a user Database used for service subscriber, user identification and addressing

PCRF -Policy and Charging Rule Function

It provide quality of service and charging

eNode B-evolved Node B

It is used as radio resources management and radio bearer control

Advantages:

- 1 High speed
2. High data transfer speed.
- 3.Uninterrupted connectivity.
4. Good coverage.
5. It provides security, privacy, and safety.

Disadvantages:

1. Installation is required for every new device.
2. As 4G network needs a greater number of antennas and transmitters, user will experience poor battery life on their mobile devices.

The 4G is developed to **support the QoS** and data rate requirements of the advanced **applications** such as:

- 1.Wireless broadband access.
- 2.Multimedia Messaging Service (MMS).
3. Video chat.
4. Mobile TV.
5. HDTV.
6. Digital Video Broadcasting (DVB).
- 7.Voice and data.

• 4G LTE:

1. 4G LTE which means fourth generation long term evolution. It offers the users faster, more reliable mobile broadband internet for the devices such



as the smartphones, the tablets & the laptops. Its speed is much faster than the 3G.

2. 4G LTE is very fast and 10 times faster than the 3G network, it provides extremely high voice quality.
3. When downloading large files over a wireless network
4. 4G LTE network is very fast.

Features of 4G LTE:

1. Following are some important features of 4G LTE:
2. Peak data rates: Downlink - 1 Gbps; uplink-300 Mbps. .
3. Spectrum efficiency: 3 times greater than LTE.
4. 10 times faster than the 3G network.
5. Peak spectrum efficiency: Downlink 30 bps / Hz;uplink-15 bps/Hz.
6. 4G LTE is flexible and reliable.
7. Easy to standardize and it offers affordability.

• VOLTE (Voice over LTE):

1. The VoLTE (Voice over LTE) technology is set to play a major role in the future of cellular communications.
2. It will enable the wireless carriers to use the IP based 4G, LTE data network for voice calls.
3. The VoLTE features will simplify the infrastructure and management of wireless networks. These features will also free up bandwidth for new generation of data service

• New Services Offered by VOLTE:

The best example of new services offered by VOLTE is the High Definition (HD) voice. It has already been provided on the VOLTE compatible phones.

In addition, VoLTE can also offer video calling and conferencing.

• Features of VOLTE:

1. It uses the wireless IP based 4G LTE data networks for voice calls.
2. It simplifies the infrastructure of wireless networks.
3. It simplifies the management of wireless networks.
4. It frees up the bandwidth.
5. VOLTE is more efficient.
6. It is far more cost efficient.
7. High Definition (HD) voice.
8. Video calling and conferencing.
9. Improved quality in roaming.
10. VOLTE is a packet switched service.

Features of 4.5G:

1. It is the evolution of mobile broadband data rates on paired/unpaired spectrum.
2. It allows efficient IoT (internet of things) connectivity.
3. It allows mission-critical public safety.
4. It allows broadcasting over LTE
5. Peak Data rates (Downlink): 1 Mbps (LTE-M), 170 Kbps
6. Used Frequency BW: 1.08 Mbps.

❖ Next Generation Mobile Communication(5G) :

1. Digital cellular telephone.
2. Integration of cell phone and satellite communication.
3. Integration of cell phone and PC.
4. The combination of cell phone and satellite communication will enable the user to have the same telephone number throughout the world. The numbers for mobile and land phones would be the same.
5. The combination of mobile phone and PC is called Mobile Personnel Communication.



• Requirements for 5G networks:

The next generation Mobile Networks Alliance defines the following requirements for 5G networks.

1. Very high data rates of several tens of Gbps.
2. Several hundreds of thousands of simultaneous connections.
3. Enhanced spectral efficiency than 4G.
4. Improved coverage.
5. Improvement in signaling efficiency.
6. Latency should be reduced significantly.

The 5G network should be supported by the technologies such as LAS-CDMA Synchronized CDMA), OFDM, (Large Area MCCDMA, Smart antennas, Worldwide Wireless Web (W.W.W.W) and many more.

• Services:

1. The 5G systems will provide services like interactive multimedia, voice over IP, HD videos, Internet, and other high-quality services.
2. 5G may also provide support for use of various types of sensors, Internet of things, Virtual Reality (VR), and Augmented Reality (AR)

❖ Comparison

Sr.No	Features	1G	2G	3G	4G	5G
1	Generation	First	Second	Third	Fourth	Fifth
2	Year of Introduction	1970	1990	2001	2010	2020
3	Technology	Angular Cellular	Digital Cellular	Broadband, IP, FDD, TDD	IP-Broadband, Wi-Fi, MIMO	IPv6
4	Switching	Circuit	Circuit/Packet	Circuit/Packet	Packet	Packet
5	Frequency band	824-894 MHz	850-1900 MHz	1.6-2.5GHz	2-8GHz	15GHz
6	Data Speed	2.4kbps	9.6kbps	2Mbps	50Mbps	Higher than 1Gbps
7	Multiplexing	FDMA	CDMA, TDMA	CDMA	MC-CDMA, OFDM	MC-CDMA, OFDM
8	Core Network	PSTN	PSTN	Packet network	Internet	Internet
9	Services	Only voice	Digital Voice, data, SMS	Voice, High speed data, Video	Dynamic Information Access	Interactive multimedia, Voice over IP

Refer all Assignment Ques..

-----Happy Learning!!-----