Marwadi
University

01CE0701 – Mobile Computing

Unit - 8
Introduction of 4G

Outline

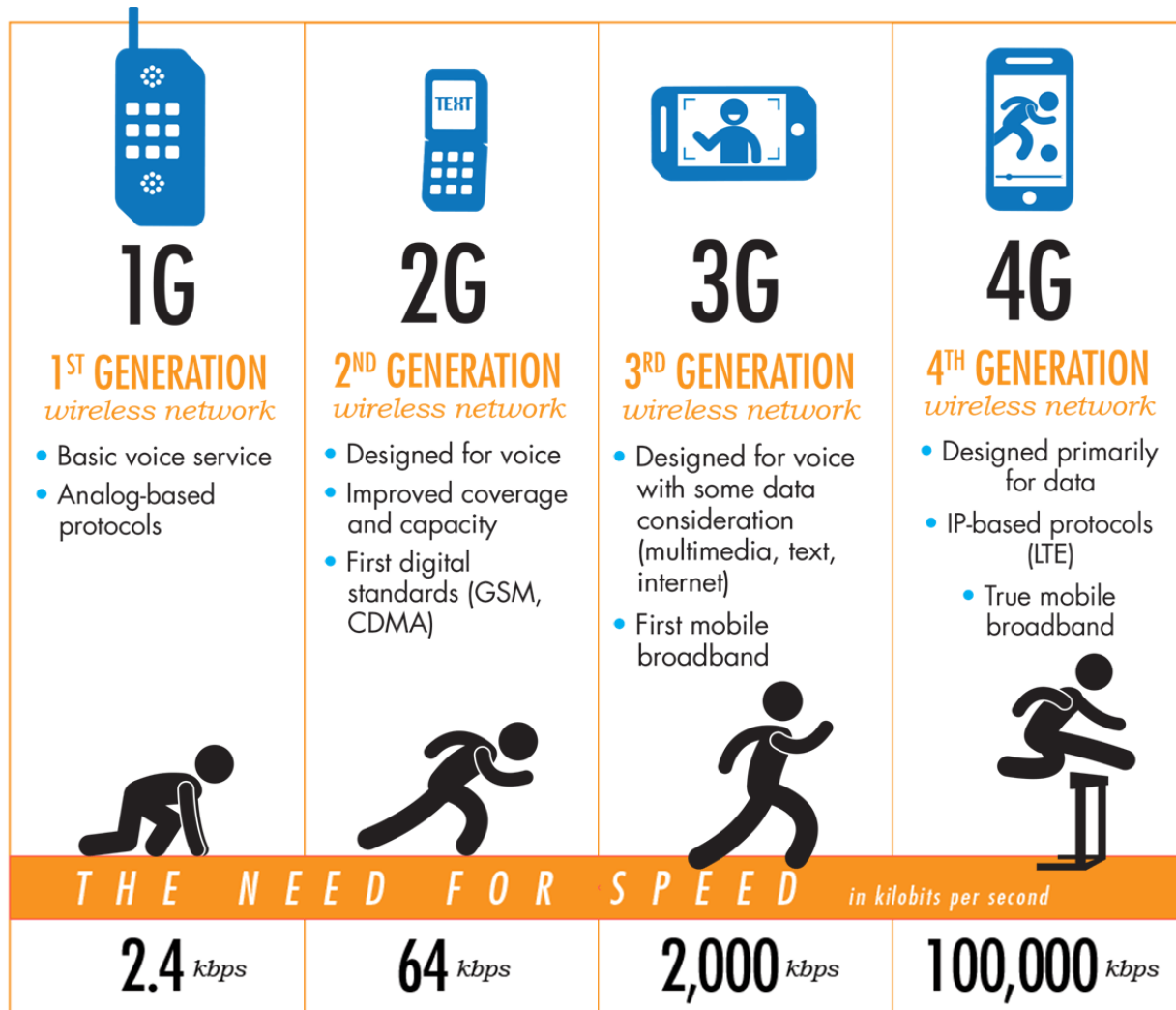- Introduction
- Features and Challenges
- Application of 4G
- 4G network architecture

Introduction

Marwadi University

- **Evolution (Based on Technology)**

1G

1ST GENERATION
wireless network
- Basic voice service
- Analog-based protocols

2G

2ND GENERATION
wireless network
- Designed for voice
- Improved coverage and capacity
- First digital standards (GSM, CDMA)

3G

3RD GENERATION
wireless network
- Designed for voice with some data consideration (multimedia, text, internet)
- First mobile broadband

4G

4TH GENERATION
wireless network
- Designed primarily for data
- IP-based protocols (LTE)
- True mobile broadband

THE NEED FOR SPEED *in kilobits per second*

| 2.4 *kbps* | 64 *kbps* | 2,000 *kbps* | 100,000 *kbps* |

5G

up to **20** Gbps

Introduction of 4G

- 4G stands for Fourth Generation.

- 4G also known as Fourth-generation cellular communication system or Fourth-generation mobile technology.

- 4G is the fourth Generation of mobile network technology, which is the successor of 3G and preceded by the 5G network.

- It provides high data transmission speed and is suitable for HD video calling, fast download and upload, live streaming, online gaming, etc.

- A 4G system must adhere to the capabilities and features specified by the ITU(International Telecommunication Union), including transmission technology and data speed. 4G network provides up to 100 Mbps speed to users, far higher than a 3G network.

- 4G enables users to stream high-definition audio and videos without interruption due to its high speed.

- It also facilitates wireless broadband that allows the users to access the internet without any need for fixed wired.

▶ 4G network is divided into two categories:
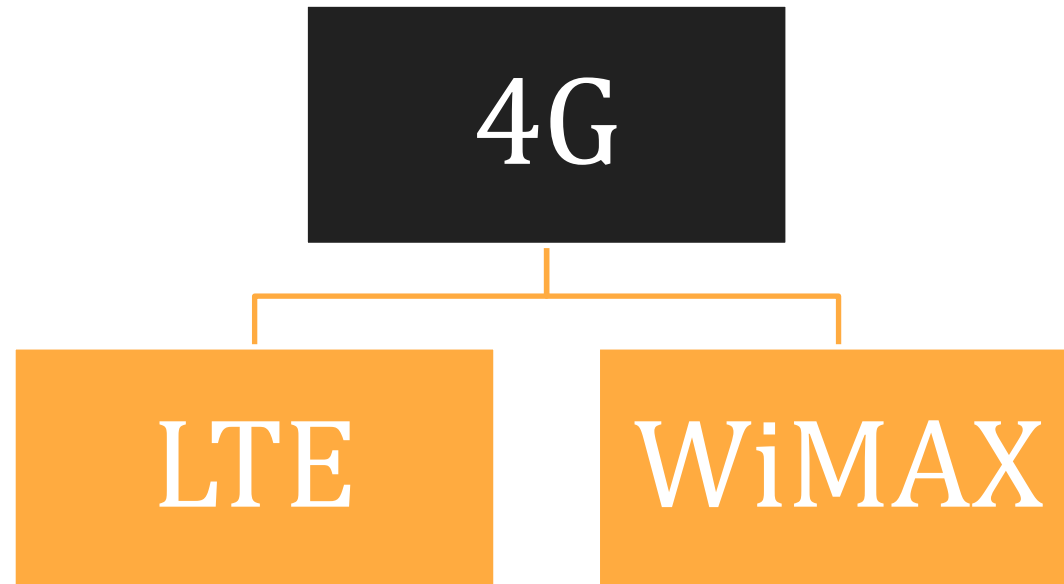
▶ LTE: Long Term Evolution

▶ WiMAX: World wide interoperability for microwave access

❑ LTE:

▸ LTE stands for Long-Term evolution.

▸ It is technically different from 4G, i.e., 4G and 4G LTE are not technically the same.

▸ LTE acted as an improvement of its predecessor, 3G, but did not fulfil the requirements of becoming the next generation or 4G.

▸ LTE provides much more speed and bandwidth than 3G.

▸ Sometimes LTE would be referred to as 4G LTE, which makes users think like they are using 4G, but in reality, it is still the LTE technology.

▸ The term LTE is specifically used for marketing purposes, as specified speed and technical specifications defined for 4G were not achievable when it was introduced.

▸ 4G is significantly faster. LTE offers only 100 Mbps, while true 4G offers up to 1,000 Mbps.

❑ **WiMAX:**

▶ WiMAX stands for World wide Interoperability for Microwave Access.

▶ WiMAX is a type or representative of 4G wireless internet.

▶ It is similar to wireless broadband network, which enables the user to access the internet without the need for wires.

▶ However, it is a bit different from Wi-Fi, as unlike Wi-Fi (which covers a building or city), it is known as WLAN.

▶ WiMAX can cover vast distances such as cell phone networks with high-speed internet access similar to broadband. It is known as *WMAN.*

▶ A *WiMAX is a type of 4G network*, but all *4G networks are not WiMAX*.

▶ The peak data rates offered by WiMAX are 128 Mbps for downlink and 56 Mbps for uplink over 20 MHz wide channels.

Features and Challenges in 4G

Features of 4G

▶ It aims to provide high data transmission speed without interruption at any location.

▶ As per ITU standard, a 4G network system must have the highest data rates of 100Mbs for highly mobile stations like trains, cars etc.

▶ It provides seamless switching across heterogenous network areas.

▶ It is very well suitable for the transmission of voice, data, streaming videos, multimedia, wireless internet, and other broadband services.

▶ It provides high speed at a low cost. (Bandwidth of 4G is 5 – 20 MHz)

▶ Global mobility, service portability, scalable mobile networks.

▶ It provides IP based mobile system.

Challenges in 4G

▸ **Security:** In this digital world security is an important aspect in communication networks. As 4G network is not used for just communication but also it provides different functions like internet which is to be much secured. So we should estimate and solve the different security threats of 4G networks like IP spoofing, User ID theft, Denial of service, Intrusion attacks which may cause loss of information or leakage of information which is considered as great threat for the users.

▸ **Quality of service:** Quality of service is more important for 4G networks as we know that telecommunication is a real time communication like Voice over IP and video streaming .In real time traffics quality of service is very important as we should estimate some factors like bit rate, delay, packet drop probability to avoid network congestion in available bandwidth effectively.

▸ **Handover:** Handovers is defined as the switching of mobile nodes (MN) from one access point to other in current network or to a different network. 4G networks faces lot of challenges while handover in communication systems. If a mobile user is undergone handover process from communication systems like GPRS to WLAN at that time there is a potential risk of communication disturbance which makes the mobile user unhappy.

Application of 4G

Application of 4G

▶ **4G Ultra high speed internet access -** E-mail or general web browsing is available.

▶ **4G Multiple User Video conferencing -** subscribers can see as well as talk to more than one person.

▶ **4G Location-based services -** a provider sends wide spread, real time weather or traffic conditions to the computer or phone, or allows the subscriber to find and view nearby businesses or friends whilst communicating with them.

▶ **4G Tele-medicine -** a medical provider monitors or provides advice to the potentially isolated subscriber, while also streaming to them related videos and guides.

▶ **4G HDTV -** a provider redirects a high definition TV channel directly to the subscriber where it can be watched.

▶ **4G High Definition Video on demand -** a provider sends a movie to the subscriber.

▶ **4G Video games on demand -** a provider sends game data directly to the subscriber where they can play in real time.
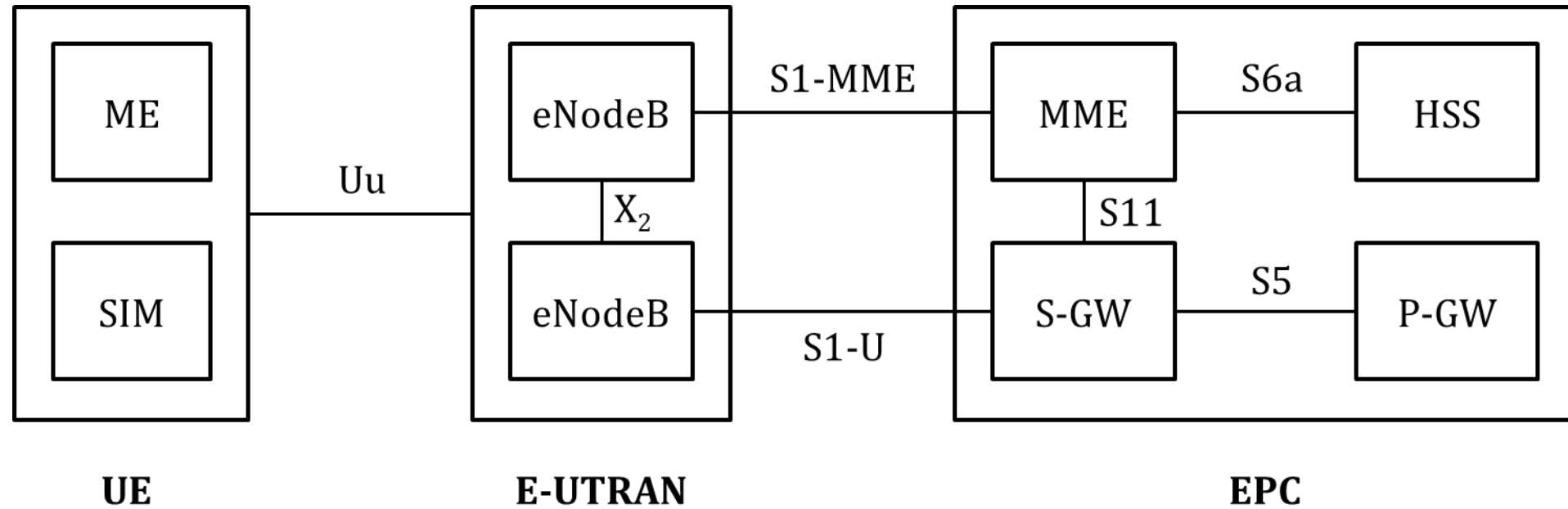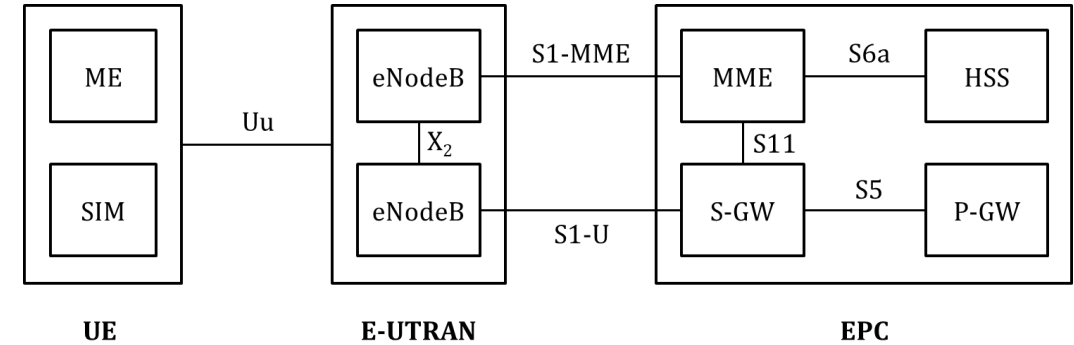
4G Network Architecture

Fig. 4G Network Architecture

The basic architecture contains the following network elements:

1. UE – User Equipment
2. E-UTRAN – Evolved Universal Terrestrial Radio
3. EPC – Evolved Packet Core.

The basic architecture contains the following network elements:

1. UE Entities – ME, SIM
2. E-UTRAN entities – eNodeB
3. EPC entities – MME, HSS, S-GW, P-GW

Difference interfaces between network elements and entities are-

- Uu
- S1-MME
- S1-U
- X2
- S5
- S6a
- S11

❑UE

▸ **UE:** UE stands for User Equipment. UE connects to an eNodeB over the LTE-Uu interface. UE entity is consists of two elements: ME & SIM.

▸ **ME:** ME stands for Mobile Equipment. It is user's cell phone.

▸ **SIM:** SIM stands for Subscriber Identity Module.

➥ Removable plastic card

➥ Stores Network Specific Data such as list of carrier frequencies and current LAI.

➥ Also stores short messages, charging information, telephone book etc.

▸ **Uu:** It is an interface for the control and user planes between UE and E-UTRAN.

➥ Uu interface provide logical channel represented by data radio bearers.
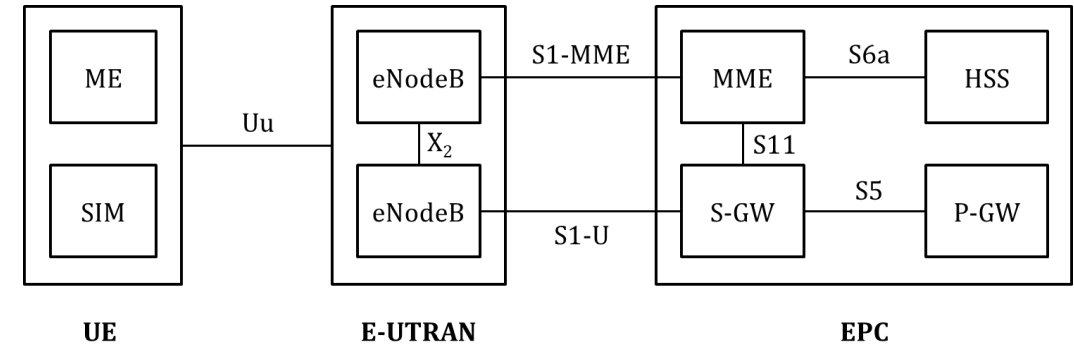
❑ E-UTRAN

▶ **E-UTRAN:** It stands for Evolved - Universal Terrestrial Radio.

↪ E-UTRAN is the air interface in an LTE cellular network.

▶ **eNodeB:** It stands for Evolved Node B.

↪ eNodeB provides users with the radio interfaces and performs Radio Resource Management (RRM) functions such as dynamic resource allocation.

↪ eNodeB measurement configuration and provision, radio admission control, connection mobility control and Radio Bearer (RB) control and Inter-Cell interference Coordination (ICIC).

▶ **X2:** It is an interface for the control and user planes between two eNodeB.

↪ X2 is used during handover and/or self organizing network related functions.
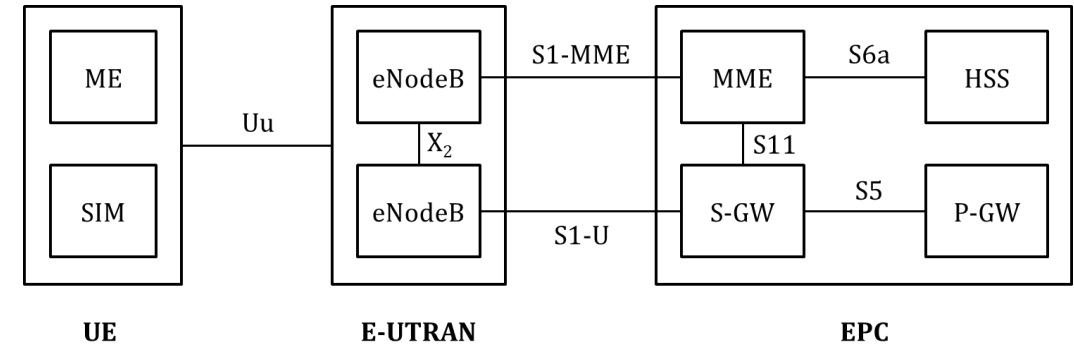
❑EPC

▶ **EPC:** It stands for Evolved Packet Core.
  ➥ It is a framework for providing converged voice and data on a 4G LTE network.

▶ **MME:** It stands for Mobile Management Entity.
  ➥ It manages UE access network and mobility, as well as establishing the bearer path for UE's.

▶ **HSS:** It stands for Home Subscriber Server.
  ➥ It is the concatenation of the HLR (Home Location Register) and the AUC (Authentication Center).
 ➥ These two functions being already present in 2G/GSM and 3G/UMTS networks.
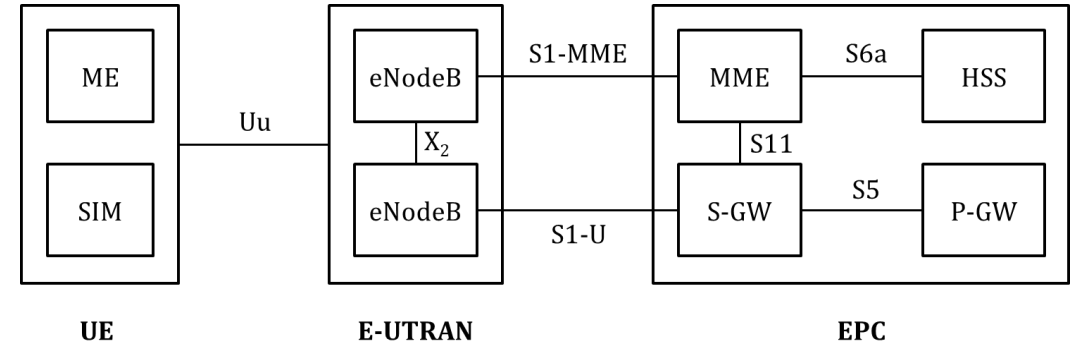
❑EPC

▶ **S-GW:** It stands for Serving Gateway.
  - ➥ The main function of the S-GW is routing and forwarding of user data packets.
  - ➥ It is also responsible for inter-eNodeB handovers in the user plane and provides mobility between LTE and other types of networks, such as between 2G/3G.
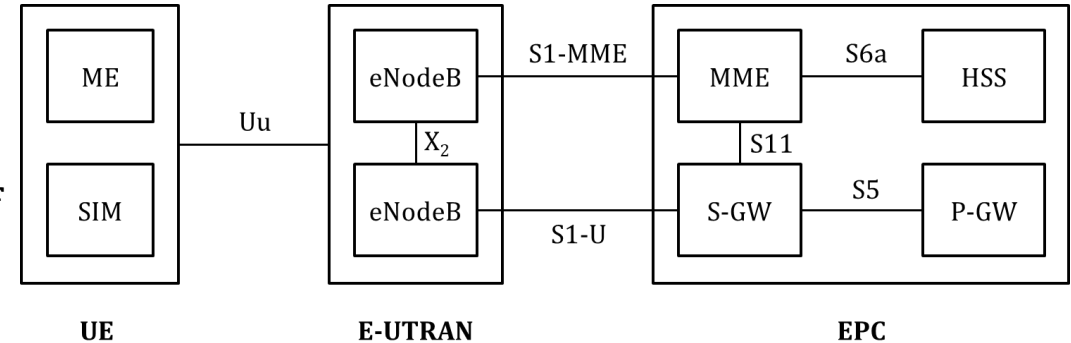
▶ **P-GW:** It stands for Packet Gateway.
  - ➥ It is also known as PDN-GW (Packet Data Network Gateway).
  - ➥ In 2G/3G network it is known as GGSN.
  - ➥ P-GW is to allocate IP addresses to the user equipment during default bearer setup.
  - ➥ The user equipment can still connect to multiple packet networks through multiple P-GWs.
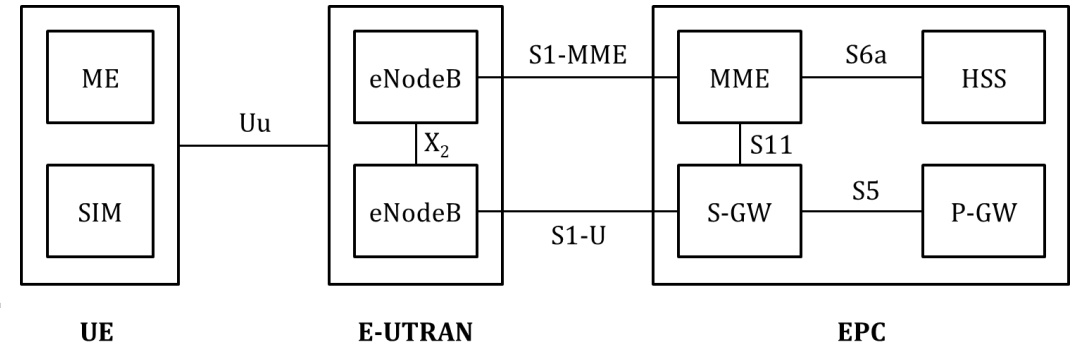
❑ EPC

▶ **S1-MME:** It is responsible for delivering signaling protocols between the eNodeB and the MME.

▶ **S1-U:** This interface provides non guaranteed data delivery of LTE user plane Protocol Data Units (PDUs) between the eNodeB and the S-GW.

▶ **S11:** This interface is based on GTP-Control (GTP-C) (interface between SGSN-GGSN) with some additional functions for paging coordination and mobility. (GTP – GPRS Tunneling Protocol)

▶ **S6a:** This interface is used for authentication, location & service information about the subscriber.

▶ **S5:** This interface provides user plane tunnelling and tunnel management between S-GW and P-GW.