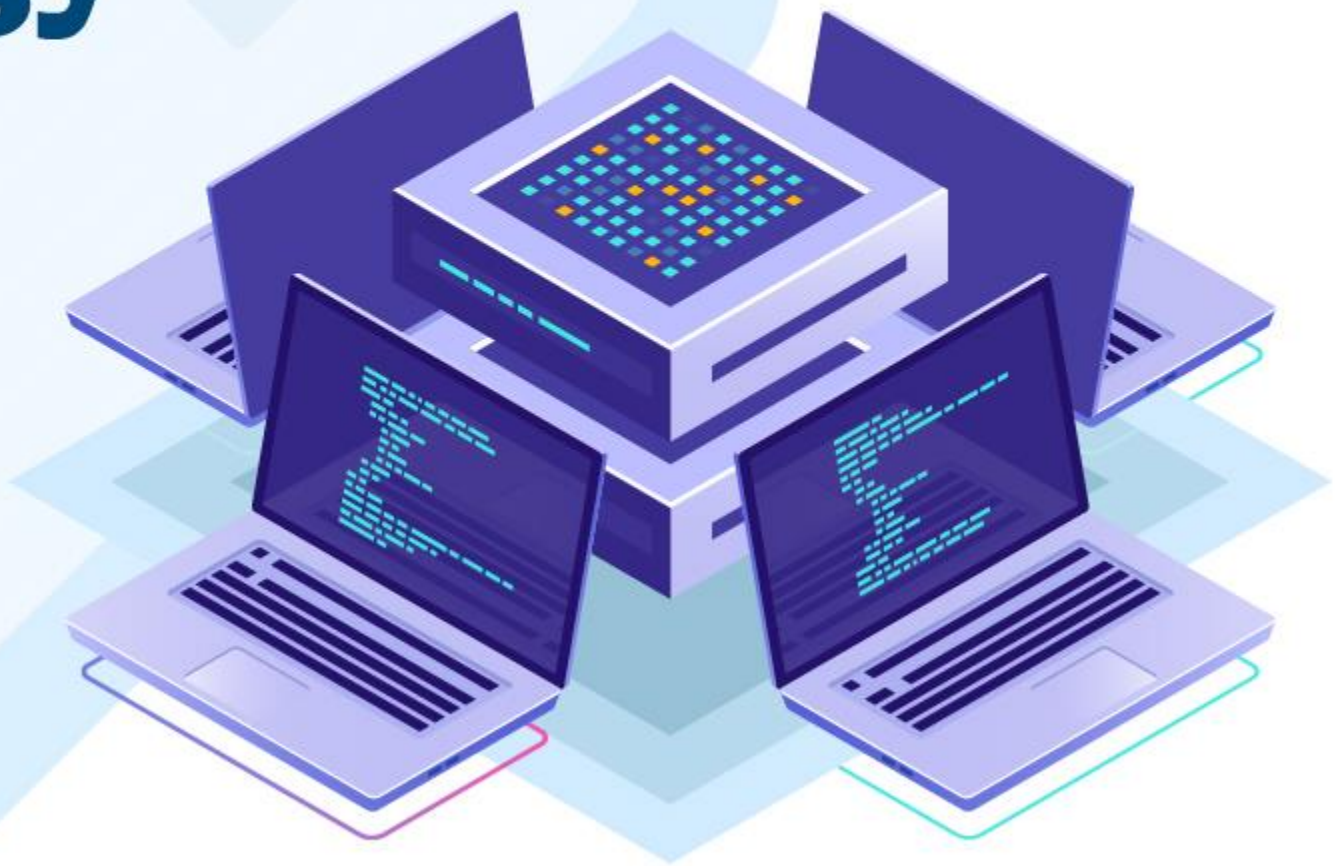
# Information Technology

2023-2024

Spring Semester

- Mobile and Sensor Networks
- Dr. Ahmed Abdelreheem

Lec_2



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# Outlines

- **Module 01: Introduction and history of wireless networks**
- Module 02:  Wireless Physical and Mac Layers
- Module 03: Mobile Network Layer
- Module 04: Cellular Technology Concepts and Standards
- Module 05: Case Studies: WLAN and Sensor Networks



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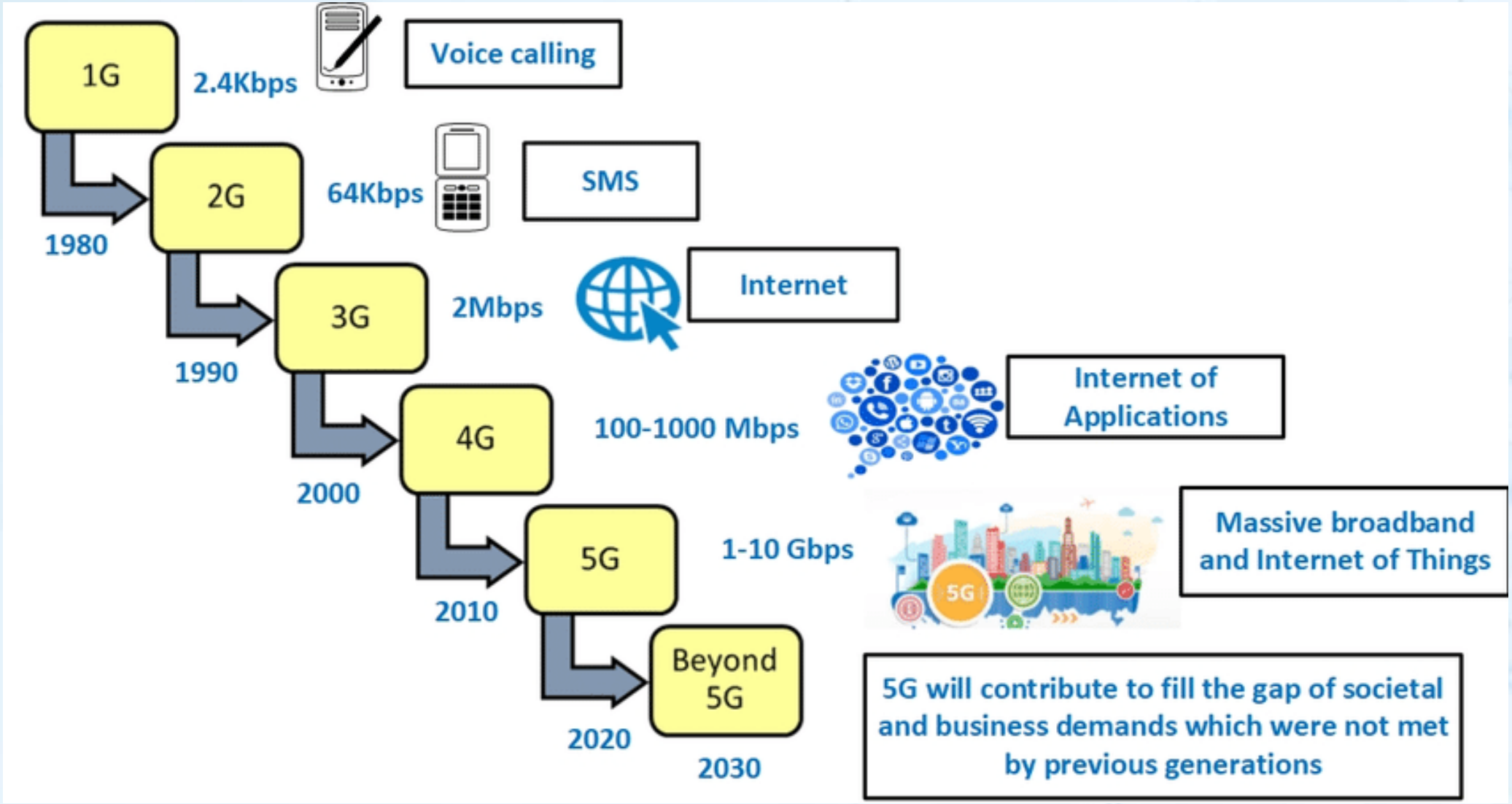
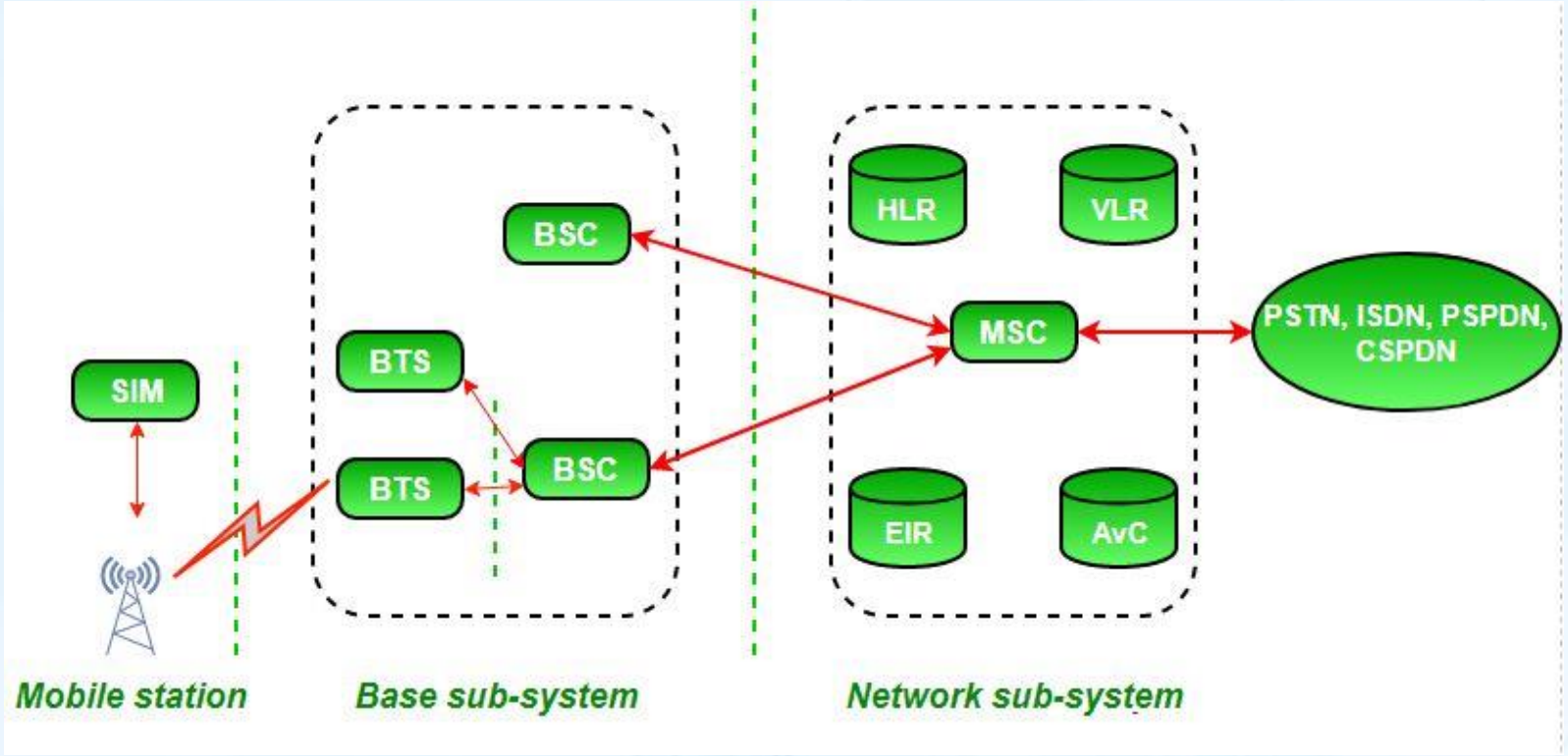
# Mobile Communication Generations



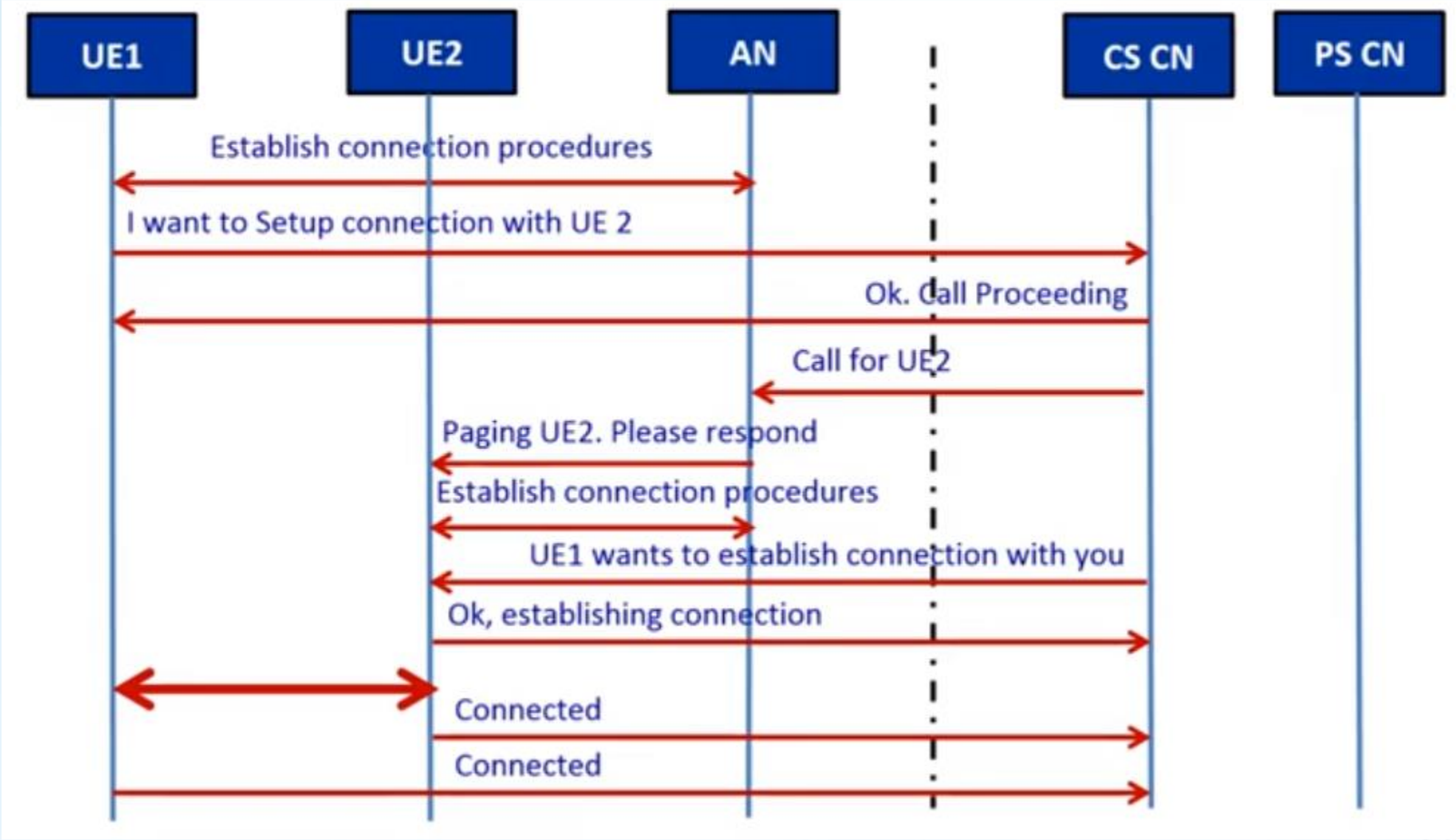
# 2G GSM Architecture

- **The Base Transceiver Station (BTS)**
  - Encoding, encrypting, multiplexing, modulating, and feeding the RF signals to the antenna
  - Time and frequency synchronizing
- **The Base Station Controller (BSC)**
  - Control of frequency hopping
  - Reallocation of frequencies among BTSs
  - Time and frequency synchronization
  - Power management
  - Time-delay measurements of received signals from the MS
- **Mobile Services Switching Center (MSC)**
  - The MSC performs the switching of calls between the mobile and other fixed or mobile network users
  - the management of mobile services such as registration, authentication, location updating, handovers, and call routing to a roaming subscriber.
  - It also performs such functions as toll ticketing, network interfacing, common channel signaling, and others.
- **Home Location Register (HLR)**
  - The HLR is a database used for storage and management of subscriptions.
  - it stores a subscriber's service profile, location information, and activity status. When an individual buys a subscription in.




- **Visitor Location Register (VLR)**
  - temporary information about subscribers that is needed by the MSC in order to service visiting subscribers.
  - if the mobile station makes a call, the VLR will have the information needed for call setup without having to interrogate the HLR each time
- **Authentication Center (AUC)**
  - a protected database that stores a copy of the secret key stored in each subscriber's SIM card, which is used for authentication and ciphering of the radio channel.
- **Equipment Identity Register (EIR)**
  - a database that contains a list of all valid mobile equipment on the network, where its International Mobile Equipment Identity (IMEI) identifies each MS.

# Call Setup in 2G



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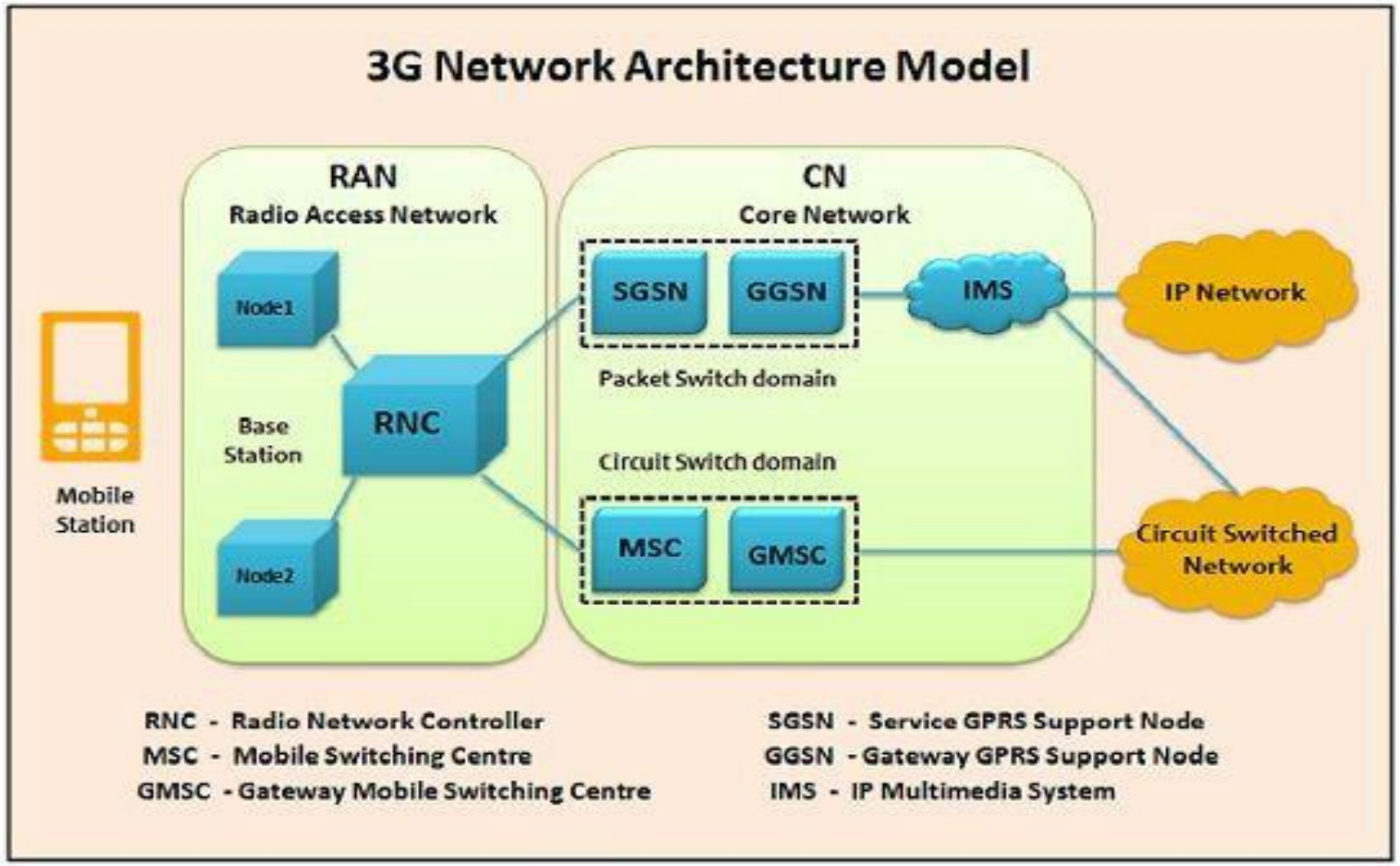
# 3G Architecture

- **Node B**
  - performs the air interface processing (channel coding, rate
  - adaptation, spreading, synchronization, power control).
- **RNC (Radio Network Controller) (equivalent to GSM BSC)**
  - Responsible for radio resource management and control of the Node Bs.
  - Handoff decisions, congestion control, power control, encryption, admission control, protocol conversion
- **GMSC (Gateway MSC)**
  - Switch at the point where UMTS is connected to external CS networks. All
  - incoming and outgoing CS connections go through GMSC.
- **SGSN (Serving GPRS Support Node)**
  - Similar to that of MSC / VLR but is used for Packet Switched (PS) services.
  - The part of the network that is accessed via the SGSN is often referred to as the PS domain.
- **GGSN (Gateway GPRS Support Node)**
  - Functionality is close to that of GMSC but is in the relation to PS services.




- **Circuit Switched Domain (CSD)**
  - Circuit switched service including signaling
  - Resource reservation at connection setup
  - 3G versions of GSM components (MSC, GMSC, VLR, HLR)
- **Packet Switched Domain (PSD)**
  - Handles all packet data services
  - 3G versions of GPRS components (SGSN, GGSN)



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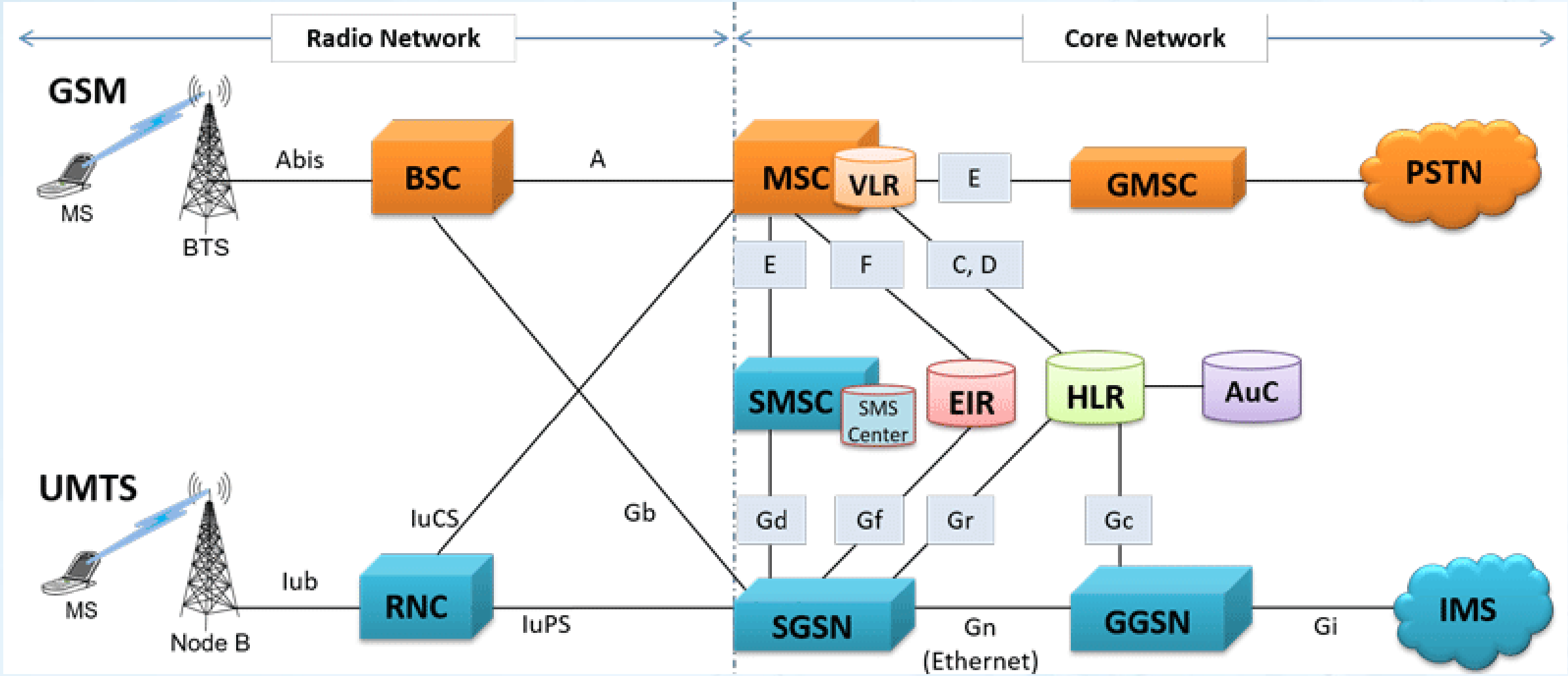
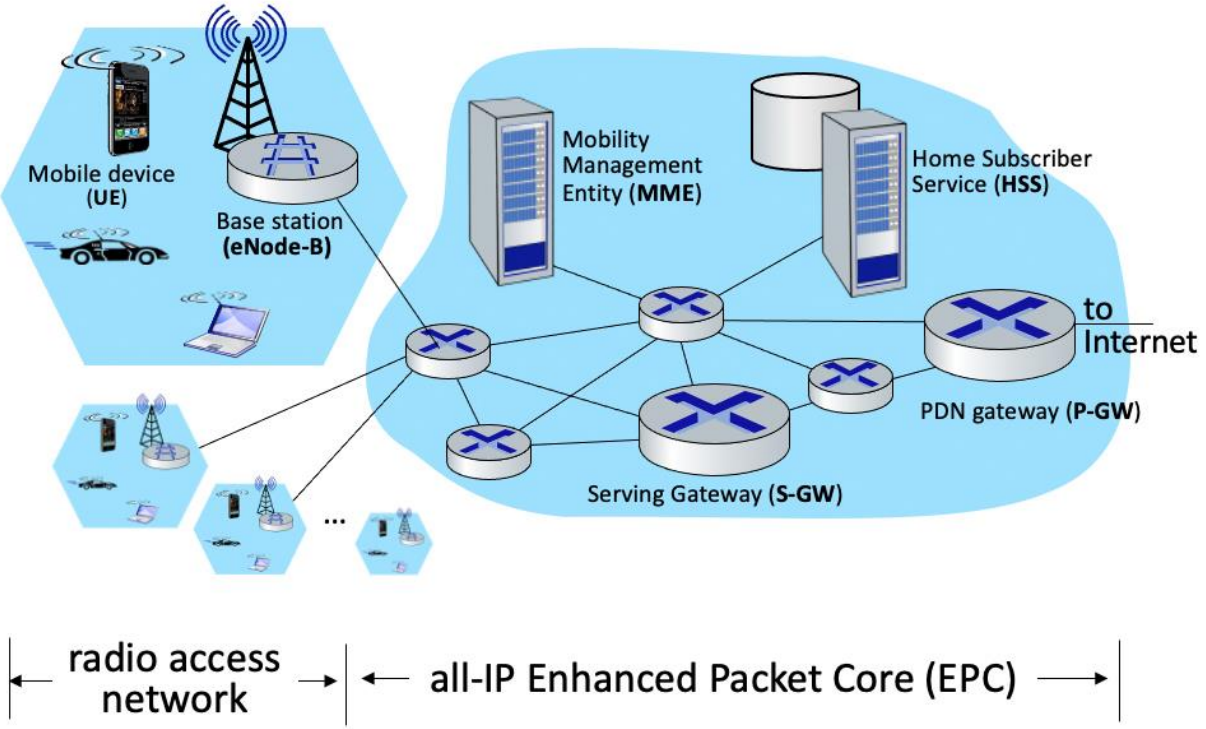
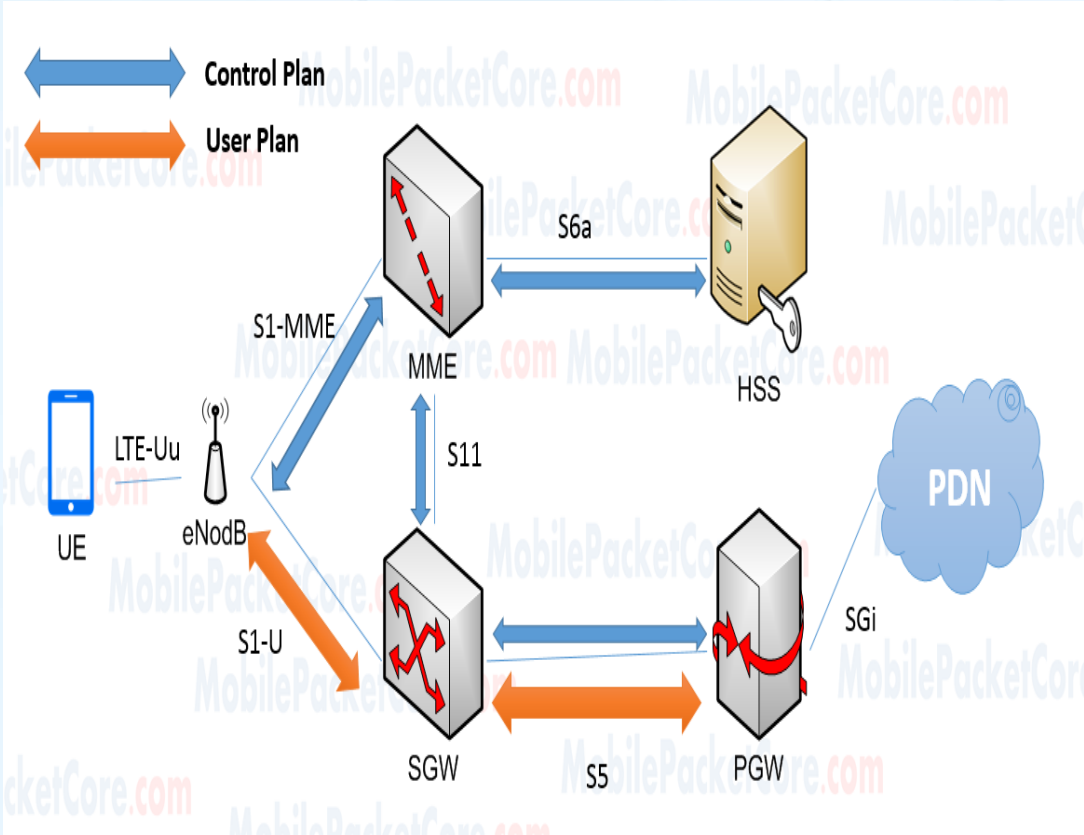
# 2G & 3G Architecture



# 4G LTE Architecture




- **The EPC**
  - mobility management, authentication, quality of service, routing upload and download IP packets, IP address allocation, and more.
  - The EPC has a “flat” IP architecture that allows the network to handle a great amount of data traffic in an efficient and cost-effective manner.
- The MME
  - handles all of the signaling exchanges between the UEs and the EPC, as well as those between the eNodeBs and the EPC.
  - connects to the eNodeB and performs authentication.
  - It connects to the HSS and requests the authentication information for the subscriber trying to connect to the network.



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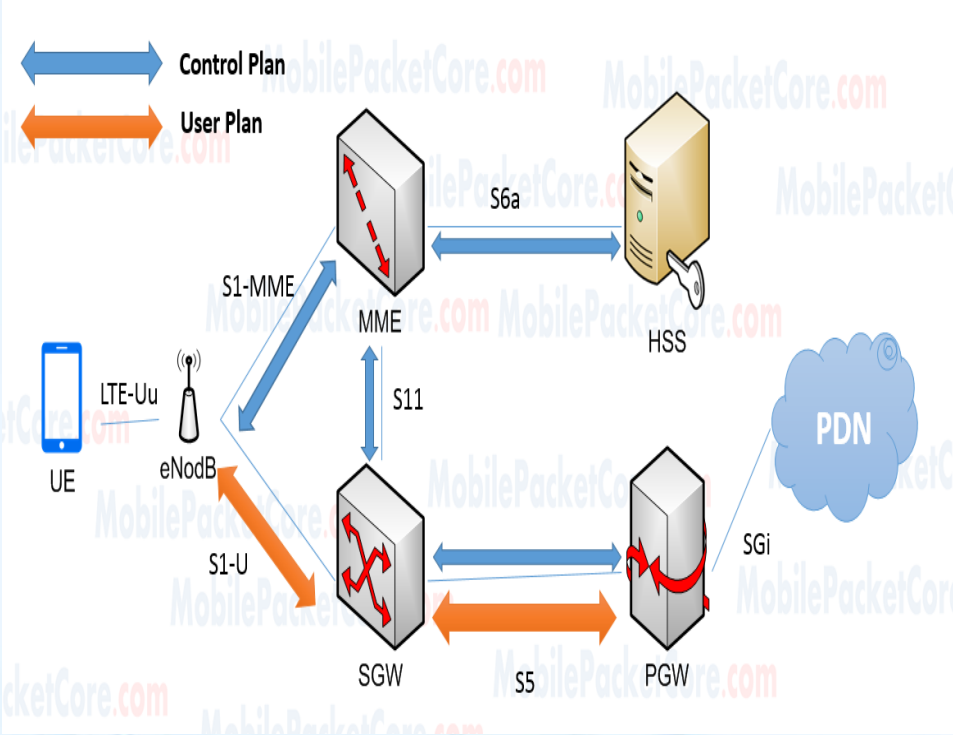
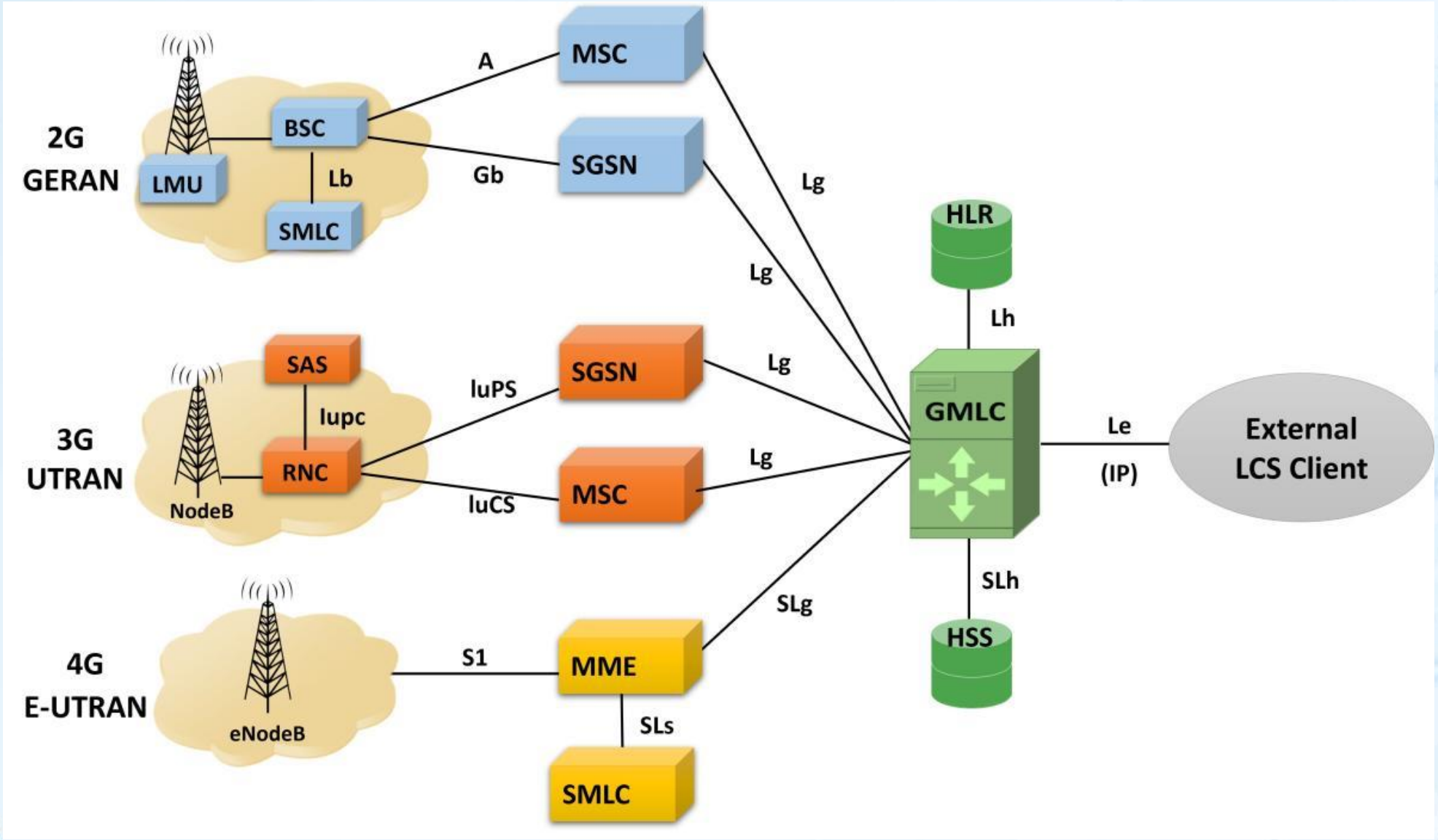
# 4G LTE Architecture

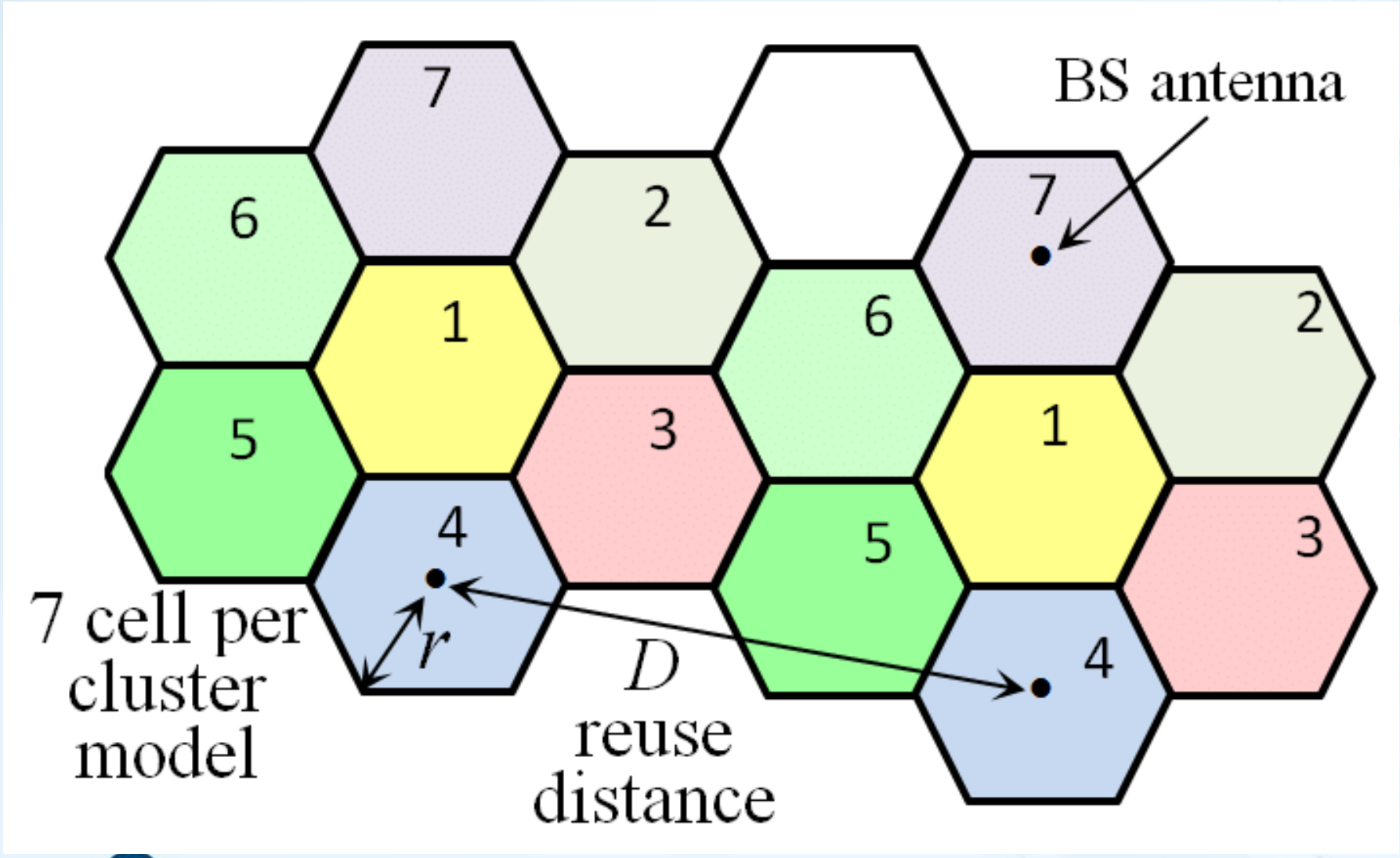
- **The S-GW**
- The S-GW (Serving Gateway) acts like an anchor for handover between neighboring eNodeBs routes and routes all the user data packets.
- The S-GW also handles mobility between LTE and other CS networks.
- **The P-GW (Packet Data Network Gateway)**
- ensures the UE's connectivity to external packet data networks, acting like the point of exit and entry of traffic for the UE.
- A UE can be connected to more than one P-GW while accessing multiple PDNs.
- The P-GW handles policy enforcement, user by user packet filtering, charging support, lawful interception and packet screening. It also acts like Another key role of the P-GW is to act as the anchor for mobility between 3GPP and non-3GPP technologies such as WiMAX
- **The HSS**
- a central database that contains user-related and subscription-related information. The functions of the HSS include mobility management, call and session establishment support, user authentication and access authorization.
- The HSS is based on the Home Location Register (HLR) and the Authentication Center (AuC) of 2G and 3G networks.

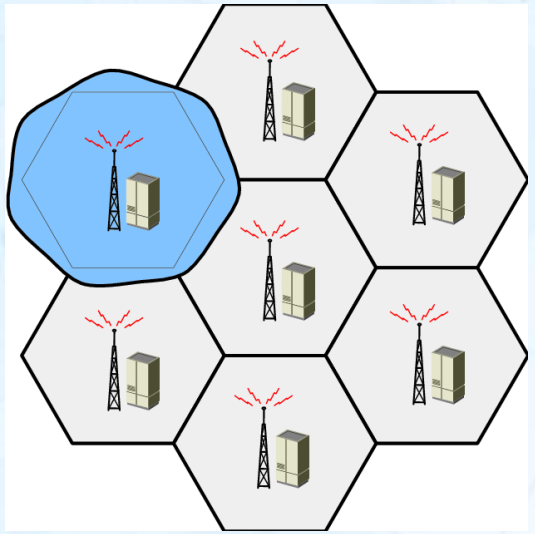


# 2G, 3G & 4G LTE Architecture



# Cellular Mobile Communication



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## QUESTIONS?