

4G & 5G Mobile Technology

LTE Introduction

LTE Introduction

❖ LTE Requirements

- High data rates
 - Downlink ≥ 100 Mbps
 - Uplink ≥ 50 Mbps
- Low latency
 - Less than 5 ms
- High spectral efficiency
- Spectrum flexibility

LTE Introduction

❖ LTE-Advanced 4G Requirements

- Higher data rates
 - Downlink ≥ 3 Gbps
 - Uplink ≥ 1.5 Gbps
- Higher spectral efficiency
 - 16 bps/Hz in Release 8
 - 30 bps/Hz in Release 10
- Increased number of simultaneously active subscribers
- Improved performance at cell edges
 - At least 2.4 bps/Hz/cell

LTE Introduction

❖ 3GPP Specifications

	LTE (Rel-8)	LTE-A (LTE-Advanced) (Rel-10 and beyond)
Downlink Data Rate	300 Mbps	3 Gbps
Uplink Data Rate	75 Mbps	1.5 Gbps
Downlink Spectral Efficiency	16 bps/Hz	30 bps/Hz
Uplink Spectral Efficiency	4.32 bps/Hz	15 bps/Hz
Bandwidth	1.4, 3, 5, 10, 15, 20 MHz	Continuous Spectrum

LTE Introduction

❖ LTE Architecture

- UE: User Equipment

- Smartphone
- SmartWatch
- SmartCar
- Tablet, Pad
- Laptop, PC
- IoT, Drone
- ITS, CPS
- etc.

— User Data Flow

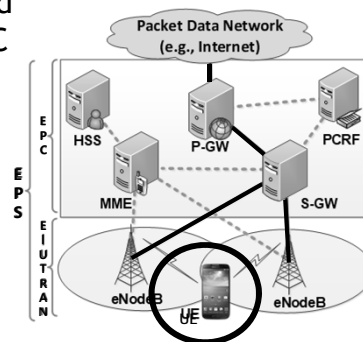
..... Control Data Flow

EPS: Evolved Packet System

EPC: Evolved Packet Core

E-UTRAN: Evolved Universal Terrestrial RAN

RAN: Radio Access Network



LTE Introduction

❖ LTE Architecture

- EPS network is comprised of the EPC and the E-UTRAN

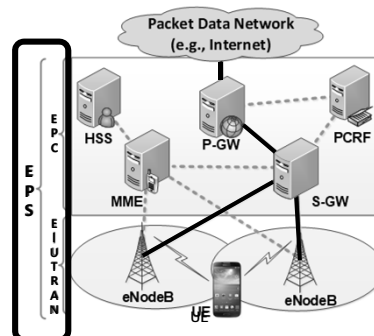
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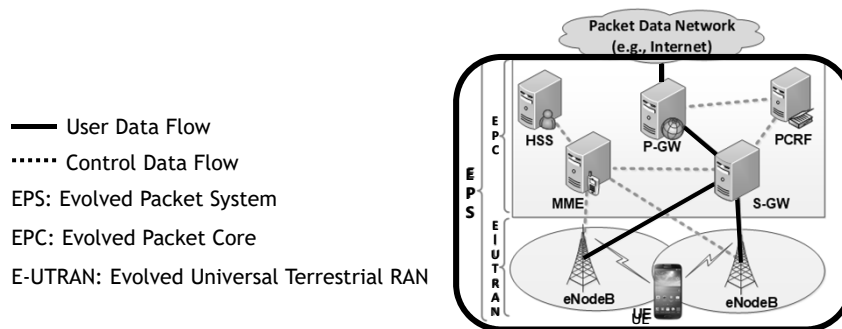
E-UTRAN: Evolved Universal Terrestrial RAN



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❖ LTE Architecture

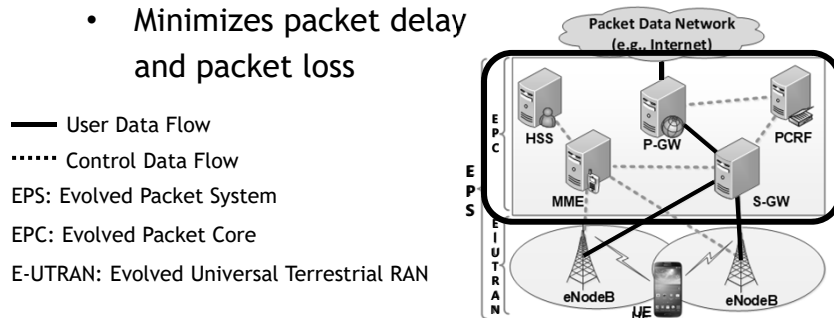
- EPS network is comprised of the EPC and the E-UTRAN



LTE Introduction

❖ LTE Architecture

- EPC controls the network services and connectivity of the UE (User Equipment)
 - Seamless connectivity during Handover
 - Minimizes packet delay and packet loss



LTE Introduction

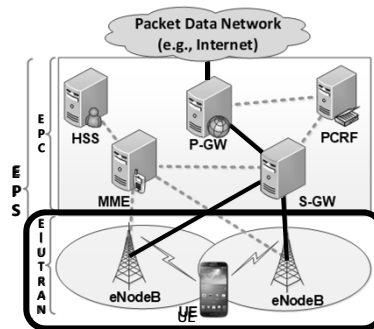
❖ LTE Architecture

- E-UTRAN controls all radio functions
 - Controls the RAN, Wireless Channels, and eNBs
 - 4G: eNB = eNodeB = evolved Node B
 - 3G: NB = Node B
 - 2G: GSM BTS (Base Transceiver Station)
 - 1G: BS (Base Station)

EPS: Evolved Packet System

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LTE Introduction

❖ EPC Elements

- P-GW (Packet Data Network Gateway)
 - IP address allocation for the UE
 - Mobility anchor for non-3GPP handover
 - Policy enforcement and QoS enforcement
 - Packet filtering
 - P-GW = PDN-GW = PDN GW

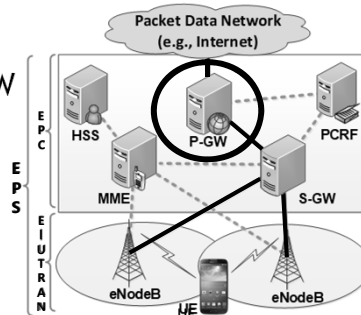
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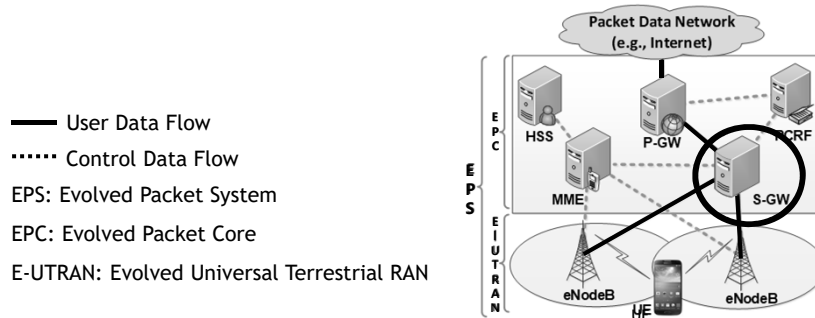


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❖ EPC Elements

▪ S-GW (Serving Gateway)

- Packet routing and forwarding
- Mobility anchor for inter-eNB handover
- Collects information for charging

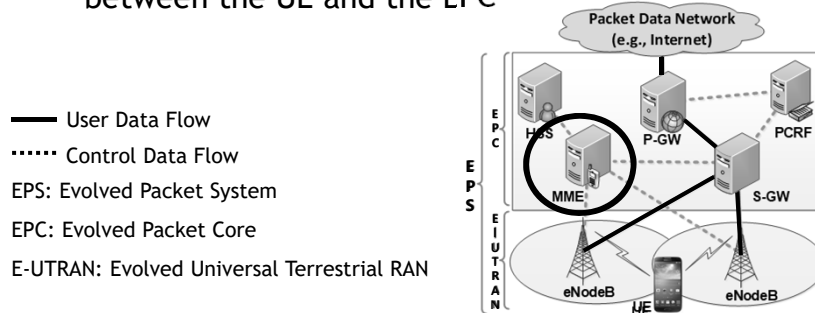


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❖ EPC Elements

▪ MME (Mobility Management Entity)

- User authentication
- Roaming
- Controls and Processes the signaling between the UE and the EPC



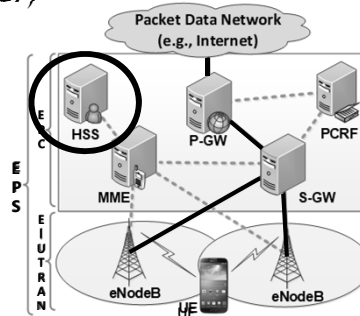
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❖ EPC Elements

▪ HSS (Home Subscriber Server)

- Database containing the user's subscription
- Compared to 3G, HSS is a combination of the HLR (Home Location Register) and the AuC (Authentication Center) 3G systems

— User Data Flow
 Control Data Flow
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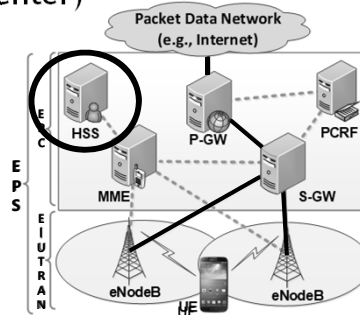


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❖ EPC Elements

▪ LTE HSS (Home Subscriber Server)

- 3G HLR (Home Location Register) stores all user subscription information
 - User ID, mobile phone number, address, etc.
- 3G AuC (Authentication Center) controls the security information based on user identity keys
 - Mutual network-terminal authentication
 - Radio path ciphering & integrity protection
 - etc.



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❖ EPC Elements

- PCRF (Policy Control & Charging Rules Function)
 - QoS (Quality of Service) and charging policy control
 - User based Service plan

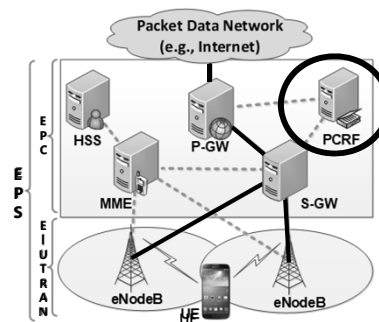
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References

References

- 3GPP TS 36.300 v12.5.0, “Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2,” Mar. 2015.
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