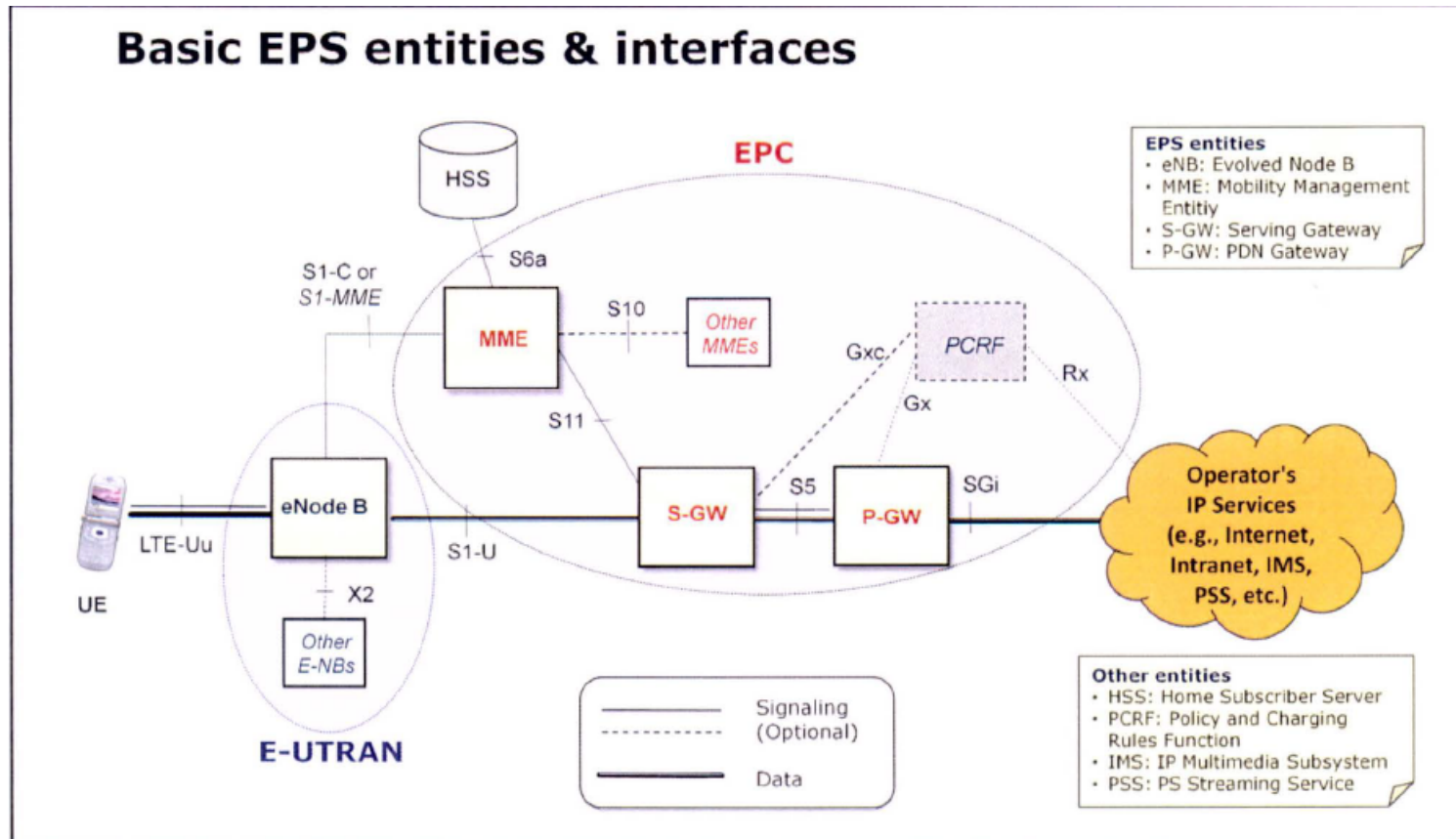


# Long Term Evolution (LTE) Air Interface

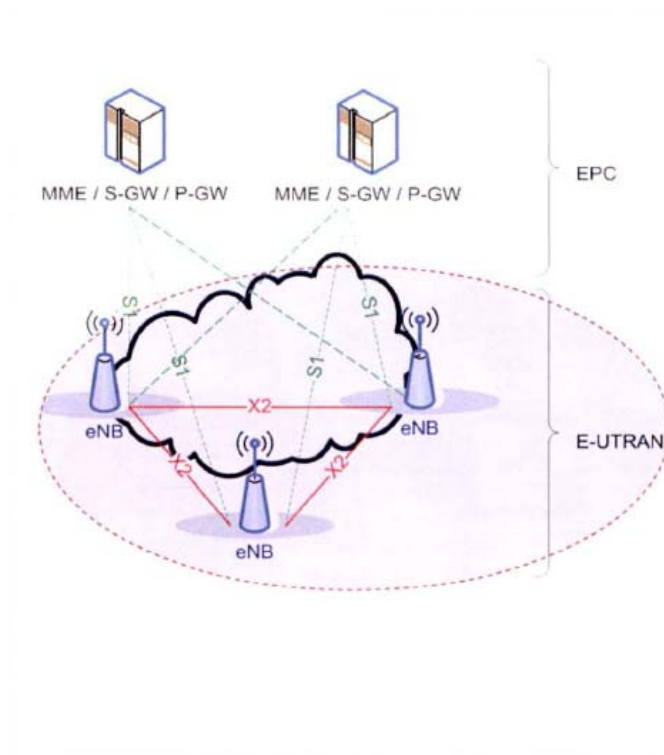
# Course Content

- Section 1: Introduction
- Section 2: Evolved Packet System Network Architecture & Protocols
- Section 3: OFDM Basics
- Section 4: E-UTRA Essentials
- Section 5: E-UTRA DL Channels, Signals & Operations
- Section 6: UL Channels, Signals & Operations
- Section 7: L TE Physical Layer
- Section 8: L TE MAC Layer
- Section 9: L TE RLC Layer
- Section 10: L TE PDCP Layer
- Section 11: LTE RRC Layer
- Section 12: LTE NAS Layer
- Section 13: E-UTRAN(eNodeB) and EPC (MME,HSS,S-GW,P-GQ,PCEF,PCRF,SPR,OFCS,OCS)
- Section 14: LTE-Uu,X2-AP,X2-U,S1-AP,S1-U,S6a,S11,S10,S5,SP,Gx,Rx,Gy,Gz and SGi
- Section 15: LTE call flows (Attach, Detach, Hand Overs, Paging, Service Request)

# LTE Architecture



# E-UTRAN Entities



## eNB functions

- Radio Resource Management
- E-UTRAN synchronization and interference control
- IP header compression
- Encryption/Integrity protection of user data
- MME selection (among MME pool)
- Routing of User Plane data from/to S-GW

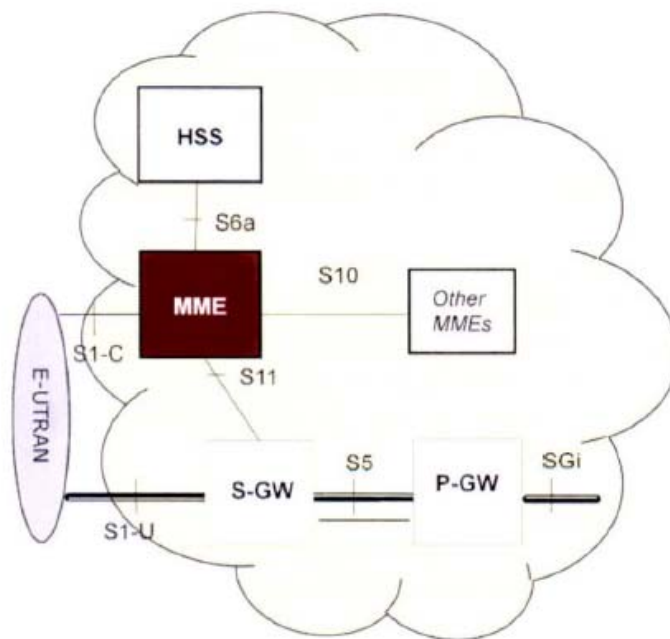
## S1 interface

- Can be split in S1-U (S-GW) & S1-C (MME)
- Many-to-Many S1 supports network sharing, redundancy, and load balancing

## X2 interface

- Used for inter-eNB handover, load balancing, and interference cancellation

# E-UTRAN Entities



## MME main functions

- NAS signaling and its security
- AS Security Control
- Tracking Area List Management
- PDN GW and Serving GW selection
- MME selection for inter-MME handover
- Inter CN node signaling for mobility between 3GPP Access Networks
- Roaming and Authentication
- EPS bearer management

## S10 interface

- Supports mobility between MMEs

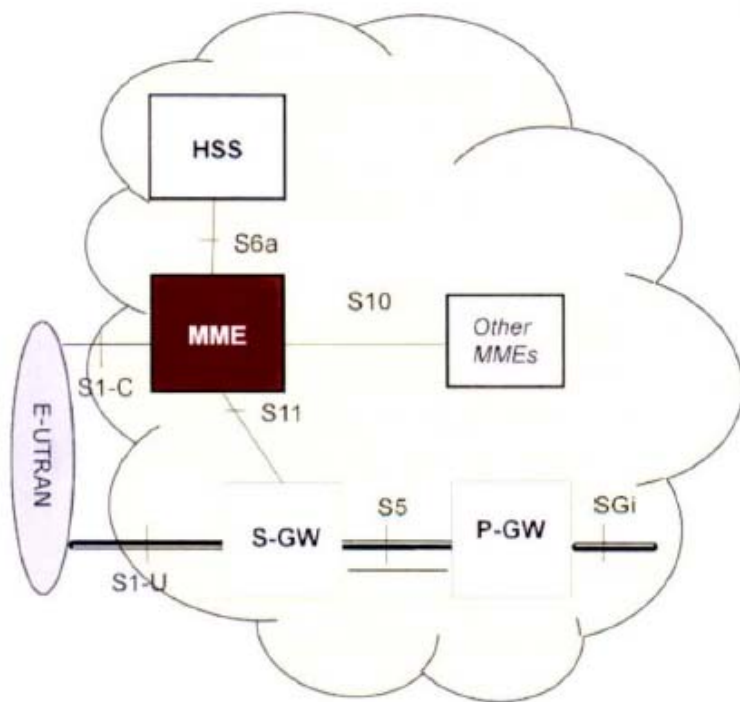
## S11 interface

- Supports EPS Bearer management between MME and S-GW (split case)

## S6a interface

- Used for subscription & security control between MME and HSS

# E-UTRAN Entities



## MME main functions

- NAS signaling and its security
- AS Security Control
- Tracking Area List Management
- PDN GW and Serving GW selection
- MME selection for inter-MME handover
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## S10 interface

- Supports mobility between MMEs

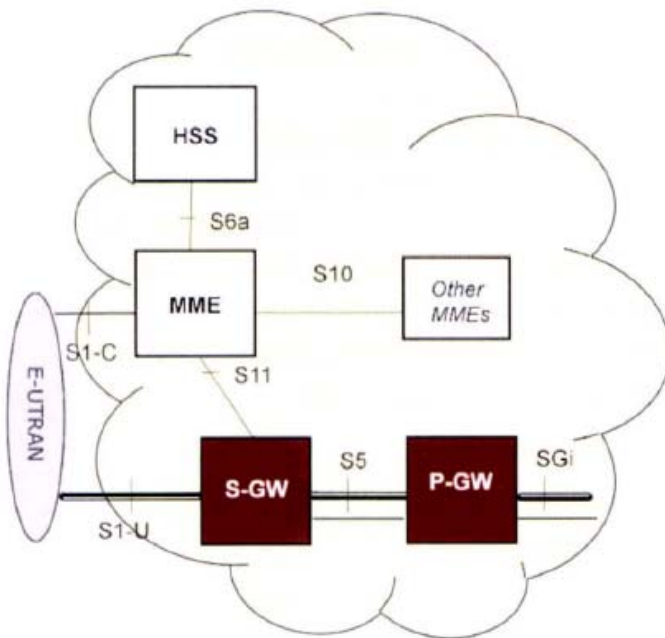
## S11 interface

- Supports EPS Bearer management between MME and S-GW (split case)

## S6a interface

- Used for subscription & security control between MME and HSS

# E-UTRAN Entities



## S-GW main functions

- E-UTRAN and inter-3GPP mobility anchoring
- E-UTRAN Idle mode DL packet buffering
- Packet routing and forwarding
- UL and DL charging per UE, PDN, and QCI
- Transport level QoS mapping/marking

## P-GW main functions

- UE IP address allocation
- Packet filtering and Policy enforcement
- Transport level QoS mapping/marking
- User Plane anchoring for 3GPP↔non-3GPP mobility

## S5 interface

- Between S-GW and P-GW (split case)
- Called S8 for inter-PLMN connection
- Can be based on GTP or Proxy Mobile IP

## SGi interface

- Access from/toward IMS & IP networks

# EPC Topology Options

- EPC entities can be split or combined based on operator choice and/or EPC vendor constraints
- Tradeoff between deployment cost vs. redundancy & scalability

