ERICSSON

LTE LONG TERM EVOLUTION

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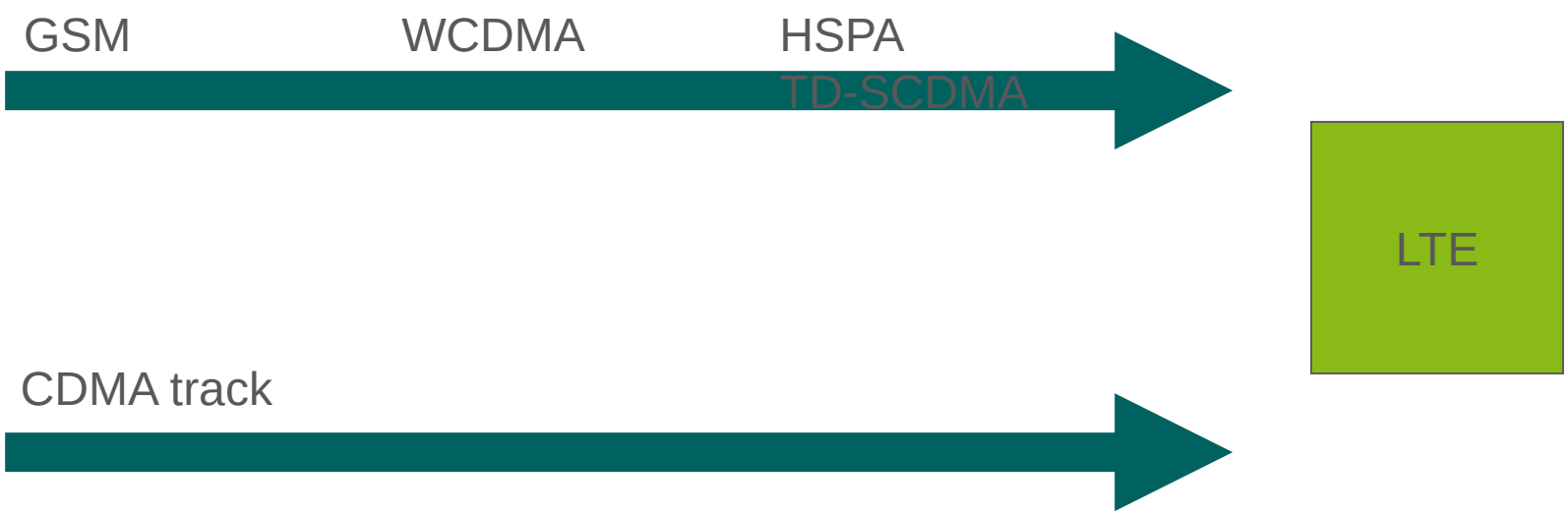
HISTORY OF MOBILE COMMUNICATION

- 1G – ~1980s
  - analog traffic digital signaling
- 2G ~1990s (GSM, PDC)
  - TDMA, SMS, circuit switched data transfer 9,6kbps
- 2.5 G ~ 2000s (GPRS, EDGE)
  - Packet switched data transfer 50-150 kbps
- 3G ~2000s (WCDMA, CDMA 2000)
  - 2 Mbps
- 4G ~2010s (LTE/SAE)
  - Max 300Mbps (DL)
- 4G+ IMT Advanced , ITU
  - ~1Gbps
- 5G (future) ITU
  - 12* speed

MOBILE SYSTEM EVOLUTION



STANDARDIZATION

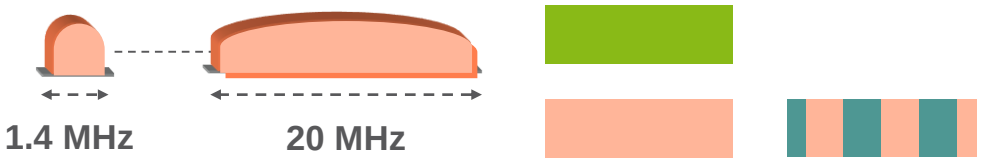
- In 3GPP (3rd Generation Partnership Project)
- LTE – radio network evolution (Long Term Evolution)
- SAE – System Architecture Evolution of the packet core NW
- Radio access NW (RAN) – E-UTRAN
- Core NW – EPC (Evolved Packet Core)

SAE/LTE

- **LTE**: Long Term Evolution (radio access)
- **EPS**: Evolved Packet System (full 3GPP system incl. LTE)
  - Also **SAE/LTE** (System Architecture Evolution)

Flexible use of spectrum

- Flexible bandwidth
- FDD & TDD capability



Reduced Cost

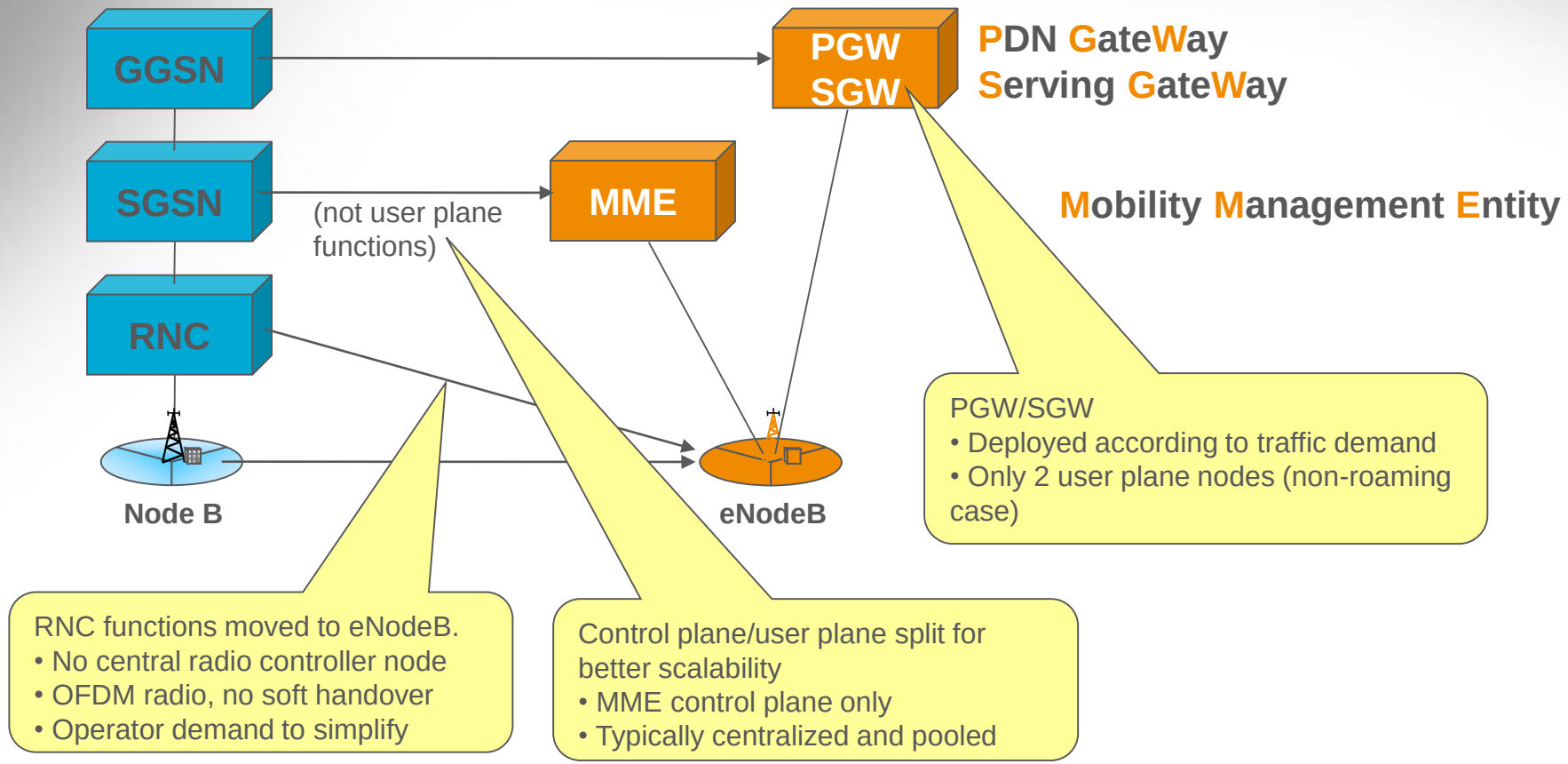
- Flat architecture – fewer nodes
- Packet Switched only
- Self configuration

Excellent user performance

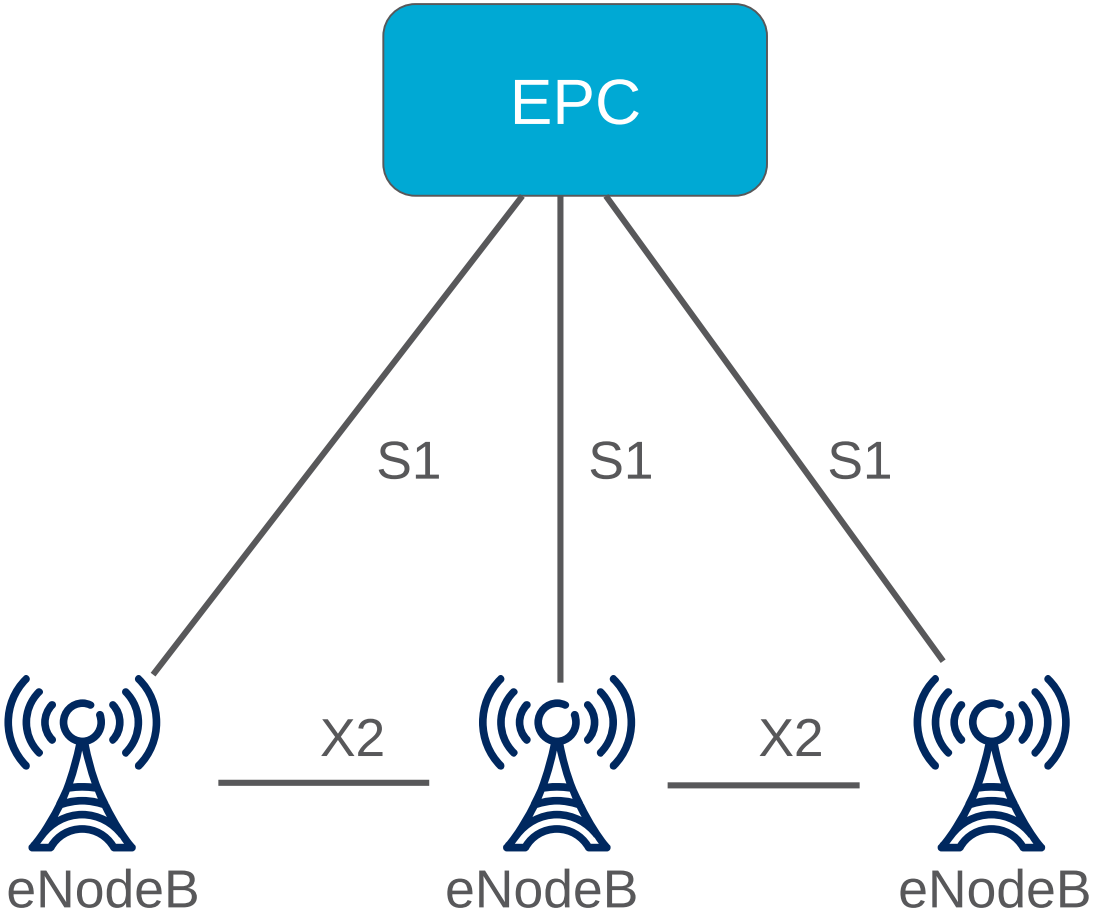
- Higher data rates:
  - 100Mbps downlink, 60Mbps uplink
- Lower latency
  - ~10ms RTT
- Well integrated with 2G/3G

ARCHITECTURE FOR LTE

FUNCTIONAL CHANGES COMPARED TO THE UMTS ARCHITECTURE

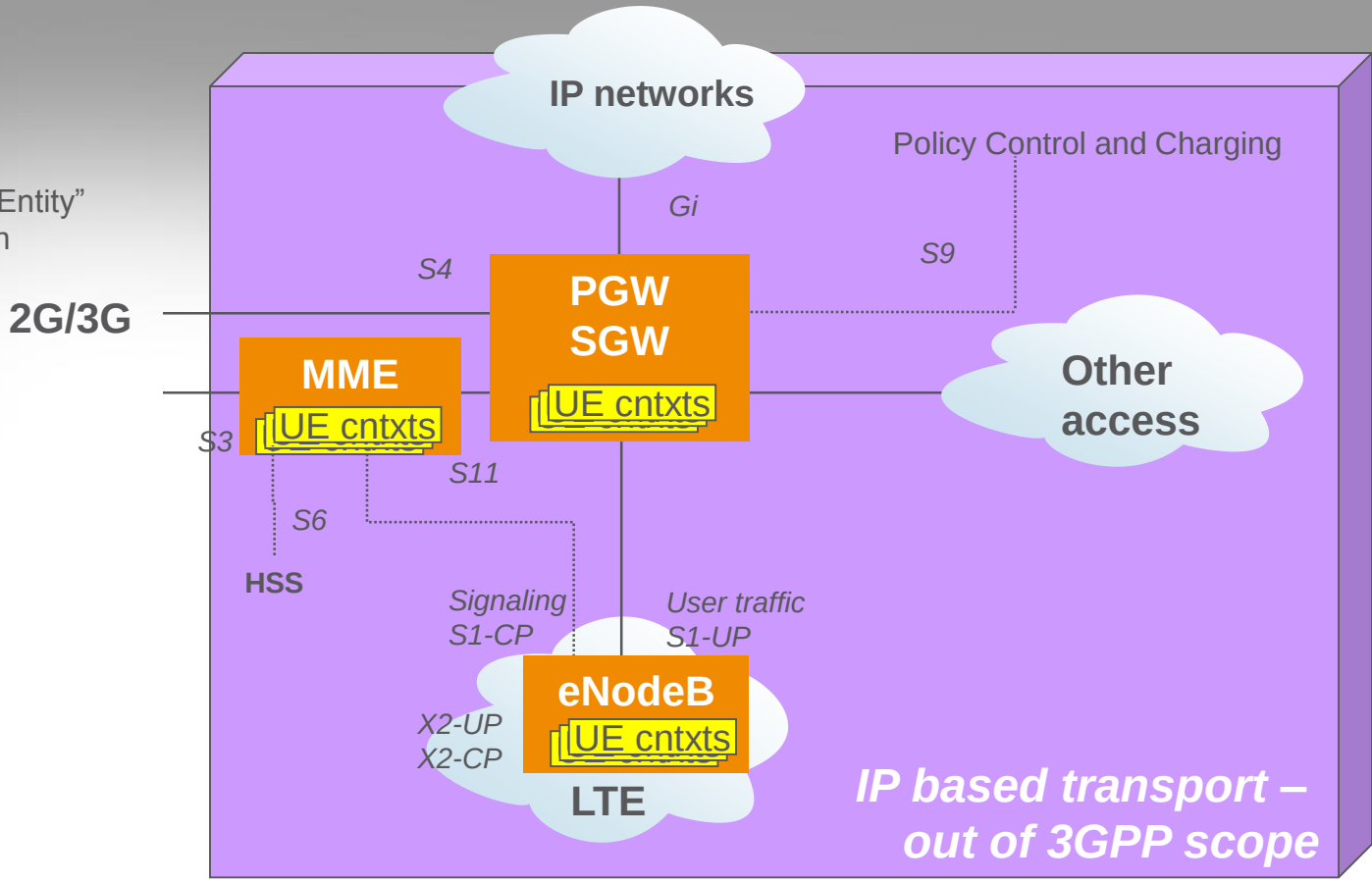


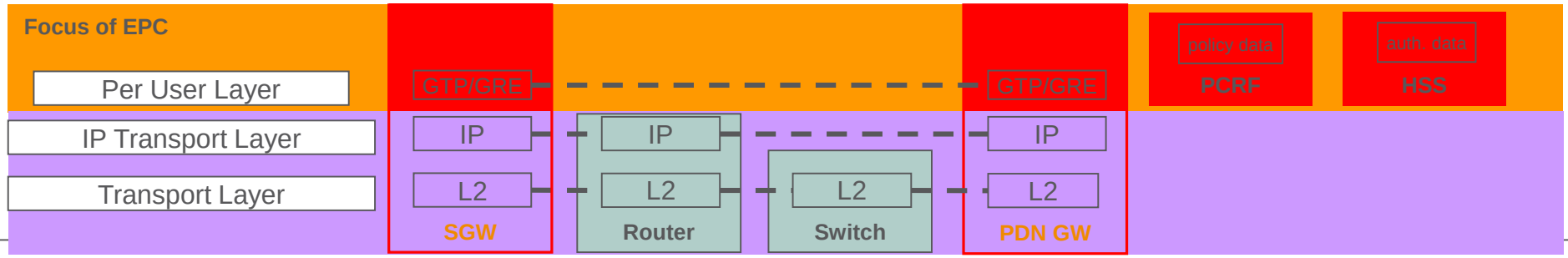
LTE/EPC ARCHITECTURE INTERFACES



EPC ARCHITECTURE SIMPLIFIED VIEW

MME = ”Mobility Management Entity”
eNodeB = the LTE base station





SAE-GW

- SAE: System Architecture Evolution
- P-GW: PDN GW
  - External IP point for interconnect
  - Packet routing & forwarding
  - Lawful intercept
  - Policy enforcement
  - In home or visited NW
- S-GW: Serving GW
  - In visited NW when roaming
  - Packet routing & forwarding
  - Anchor for U-plane in inter-eNB handovers and for mobility between LTE and other 3GPP technologies
  - LTE idle mode DL buffering
  - Charging per UE
  - Security for user data on S1

MME MOBILITY MANAGEMENT ENTITY

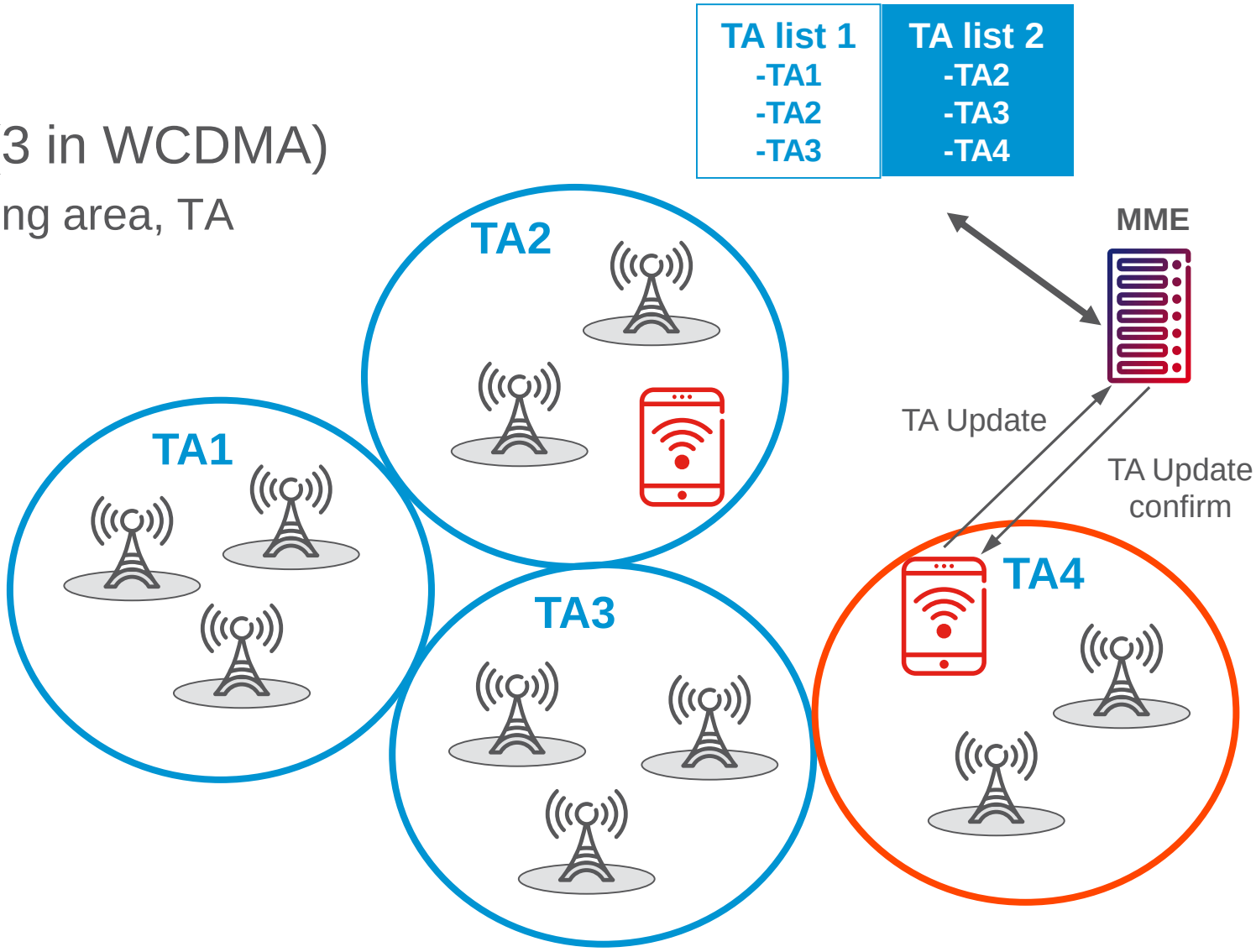
- UE attach/detach handling
- Security (authentication and authorization of users)
- EPS bearer handling
- Paging
- Mobility management of idle mode UEs

ENODEB

- Cell control and MME pool support
- Mobility control of terminals
- Control and User plane security
- Segmentation/Concatenation to adapt the payload to the transport block size
- HARQ (Hybrid Automatic Repeat reQuest) - error correction of the radio channel
- Scheduling with support for QOS
- Physical layer functionality i.e. OFDM modulation

IDLE MODE MOBILITY AREA CONCEPT

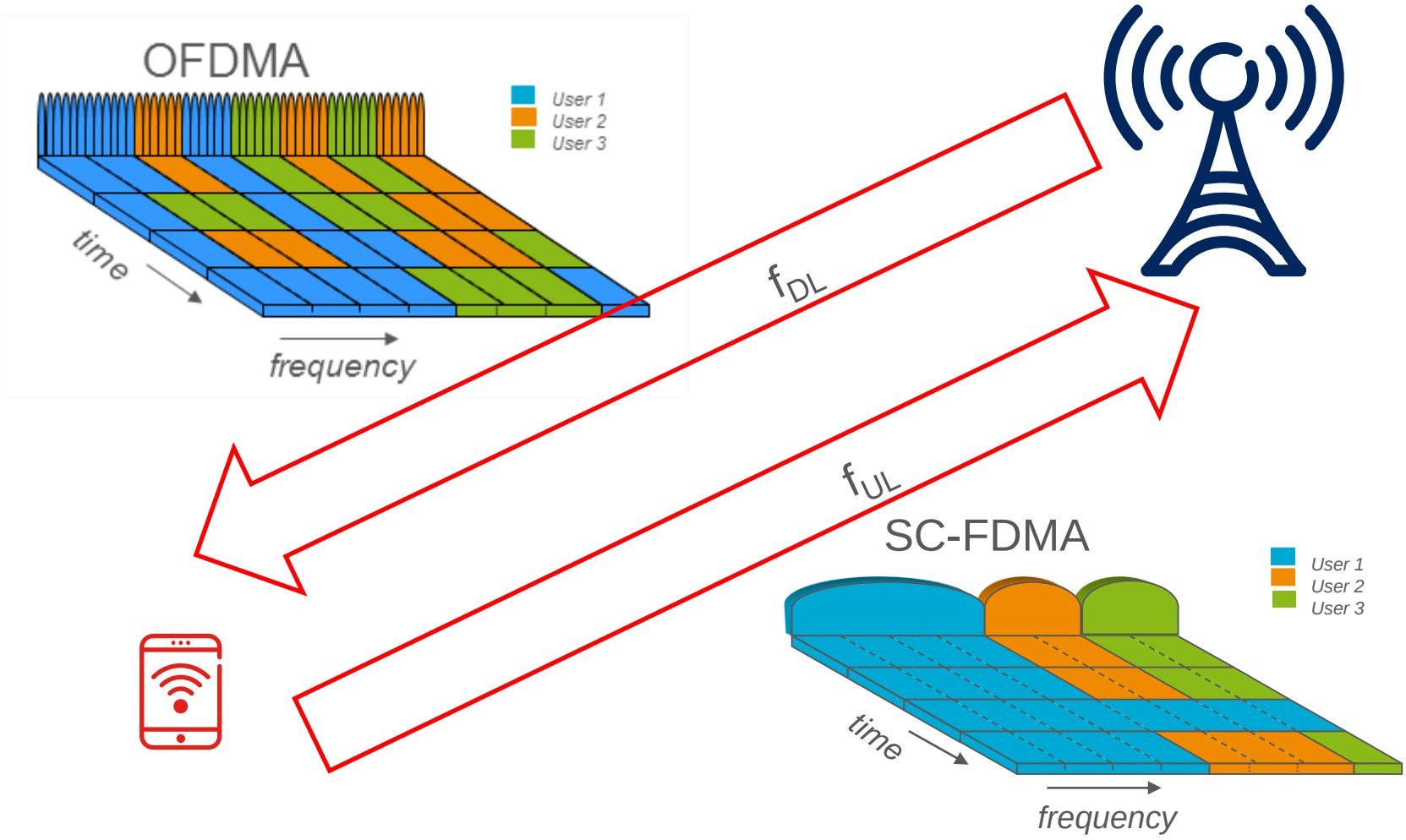
- 1 area (3 in WCDMA)
  - Tracking area, TA



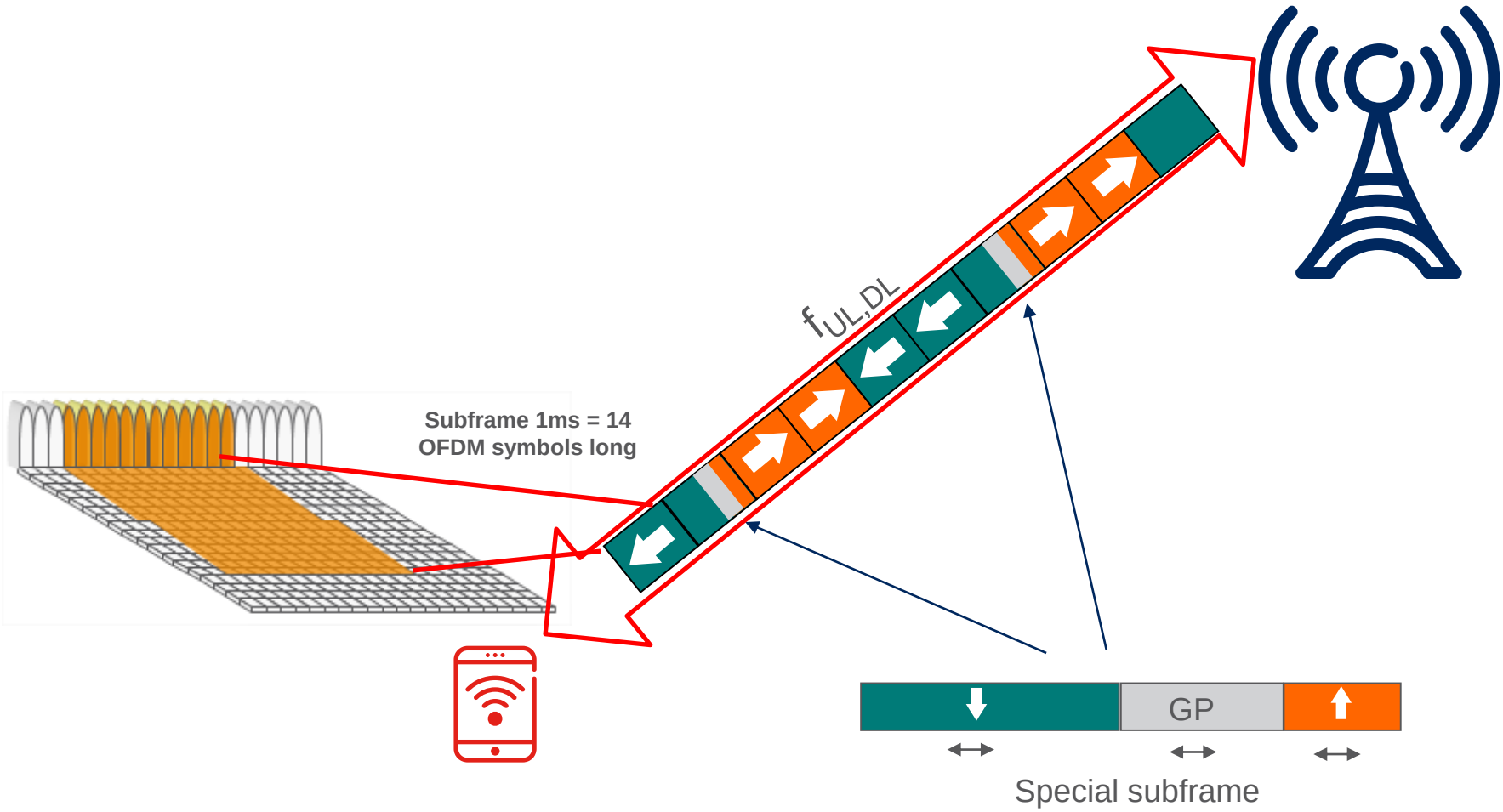
E-UTRAN RADIO INTERFACE

- OFDM (Orthogonal Frequency Division Access)
  - Data stream is distributed over many subcarriers
  - Good performance in delayed and strong multipath reflexes
- Both FDD (Frequency Division Duplex) and TDD (Time Division Duplex) are supported
  - FDD: different frequency bands are used for up-link and down-link transmission
  - TDD: up-link and down-link transmission are separated in time

LTE - FDD


OFDMA
User 1
User 2
User 3
time
frequency
f_{DL}
f_{UL}
SC-FDMA
User 1
User 2
User 3
time
frequency

LTE - TDD


Subframe 1ms = 14
OFDM symbols long
fUL,DL
GP
Special subframe

E-UTRAN RADIO INTERFACE

- MIMO (Multiple Input Multiple Output) antenna configurations
  - Increased spectrum efficiency and capacity
  - Radio channels can be separated up to 4 layers
  - 4 times higher data rates for a given bandwidth