Mobile Communications

3GPP – Long Term Evolution

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References


**Long Term Evolution**

- **UTRAN – LTE**
  - Universal Mobile Telecommunications System (UMTS) terrestrial radio-access network (UTRAN) - long term evolution (LTE)
  - Evolution of UTRAN

- **Aimed at providing**
  - 300 Mbit/s in the downlink
  - 75 Mbit/s in the uplink
  - One-way latency less than 5 ms (between terminal and base station)
  - Handover in less than 1 RTT
  - Reduced cost in network deployment
Evolved UTRAN Architecture
Evolved UTRAN Architecture

- **EPC - Evolved Packet Core**
  - MME: Mobility Management Entity
  - S-GW: Serving Gateway
  - P-GW: Gateway for the Packet Data Network

- **E-UTRAN - Evolved UTRAN, known as LTE**
  - eNB - enhanced NodeB, base stations

- **Architecture simpler than UTRAN Release 6**
  - EPC/LTE – 2 user-plane nodes: eNB, S/P-GW
  - UTRAN R6 – 4 user-plane nodes: NodeB, RNC, SGSN, GGSN
  - **Consequences**
    - Ciphering and header compression performed at eNBs
    - Handovers between eNBs handled through X2 interface rather than by the RNC
Functional Split Between E-UTRAN and EPC

E-UTRAN
- eNB
  - Inter Cell RRM
  - RB Control
  - Connection Mobility Cont.
  - Radio Admission Control
  - eNB Measurement
    Configuration & Provision
  - Dynamic Resource Allocation (Scheduler)
  - RRC
  - PDCP
  - RLC
  - MAC
  - PHY

S1

EPC
- MME
  - NAS Security
  - Idle State Mobility Handling
  - EPS Bearer Control
- S-GW
  - Mobility Anchoring
- P-GW
  - UE IP address allocation
  - Packet Filtering

internet
Radio Interface – Protocol Architecture

User Plane

Control Plane

UE

PDCP

RLC

MAC

PHY

eNB

PDCP

RLC

MAC

PHY

Header compression
Ciphering

Scheduling

ARQ (incl. Seg/Conc.)
Re-ordering

HARQ

UE

NAS

RRC

PDCP

RLC

MAC

PHY

eNB

RRC

PDCP

RLC

MAC

PHY

MME

NAS
Radio Interface – Data flow through the stack

- IP via S1 or from UE’s stack
- PDCP: Header compression and ciphering
- RLC: Segmentation and concatenation
- MAC: Multiplexing
- L1: Coding, interleaving, modulation

Diagram shows the flow of data through the stack, starting with IP and UDP layers, followed by PDCP, RLC, MAC, and finally L1 layers.
Radio Interface – Cross layer Design
**Transmission and Duplex**

- **LTE downlink radio transmission**
  - Orthogonal frequency-division multiplexing (OFDM)
  - narrow-band subcarriers of ~15kHz; bandwidth up to 20 MHz

- **The LTE uplink radio transmission**
  - single-carrier frequency division multiple access SC-FDMA, FFT based

- **Duplex: FDD or TDD**
The LTE Radio Resource Block

- Addressable in the time-frequency space
  - Frequency domain
    - 12 subcarriers, 180 kHz
  - Time domain
    - Subframes of 1ms

- Resource Blocks are allocated to users/calls

- Wide range data rates supported by
  - Allocating resource blocks to users
  - Selecting modulation+coding schemes
  - To meet the current channel conditions