

# WIRELESS MEDIUM ACCESS CONTROL AND CDMA, 3G AND 4G COMMUNICATION

## Lesson 14

### LTE and WiMax16e

# 3G+ (PRE-4G)

- File transfer at 10-100 Mbps
- High resolution 1024 × 1920 pixel hi-vision picture transfer at 24 Mb/s
- High resolution video transfer

# LONG TERM EVOLUTION (LTE)

Property	Description
Frequency bands	1.920–1.980 GHz, 2.110–2.170 GHz, 2.500–2.570 GHz, 2.570–2.620 GHz, 2.620–2.690 GHz. Around 700 MHz bands.
BTS and BSC transmitter	<ol style="list-style-type: none"><li>1. Multi-carrier OFDM</li><li>2. Direct Gateway Interface to Packet data network</li><li>3. LTE 2007 SIMO</li><li>4. LTE 2008 MIMO</li></ol>
Smart MIMO	<ol style="list-style-type: none"><li>1. Multi-code word (horizontal) for link adaption per stream and successive interference cancellation, closed loop and pre-coding</li><li>2. MIMO with the units as follows: channel encoder, beam former with pre-coding, interleaving and rate matcher</li></ol>
Modulation	Downlink 64 QAM, Uplink 16-QAM.

# LONG TERM EVOLUTION (LTE)

Property	Description
Spectrum Flexibility	1.4 MHz, 5 MHz, 10 MHz, 15 MHz and 20 MHz
FDD and TDD	Support to both FDD for uplink and downlink frequency as well as TDD for uplink and downlink frequency
LTE uplink peak data transfer rates	<ol style="list-style-type: none"> <li>1. Uplink 10 MHz Uplink (Multi-carrier 5 MHz + 5 MHz OFDM); with use of 16-QAM for the peak rate of 25 Mbps</li> <li>2. Uplink 10 MHz (Multi-carrier 5 MHz + 5 MHz OFDM) with use of 64 QAM for the peak rate of 50 Mbps</li> </ol>
LTE releases for high peak Data transfer rates	<ol style="list-style-type: none"> <li>1. LTE 2 × 2 Downlink 40 Mbps; Uplink 5 MHz + 5 MHz</li> <li>2. LTE 2 × 2 Downlink 154 Mbps; Uplink 20 MHz + 20 MHz</li> <li>3. LTE 4 × 4 Rel 8 Downlink 326 Mbps; Uplink 88 Mbps 20 MHz + 20 MHz</li> </ol>
Typical data rates	Downlink 5.9 Mbps to 21.5 Mbps
Latency	50 ms
Application	Seamless interfacing the Broadband Internet, TCP/IP, CDMA, GSM, HPSA networks

# LTE RSS

- RSS consists of a number of mobile stations (MSs), base transceivers (BTSs), and base station controllers (BSCs) BSC1, BSC2, ..., BSC $k$

# LTE NSS

- NSS consists of a number of serving Gateway to LTE Gateway Support System (GGSM)

# LTE CGSN

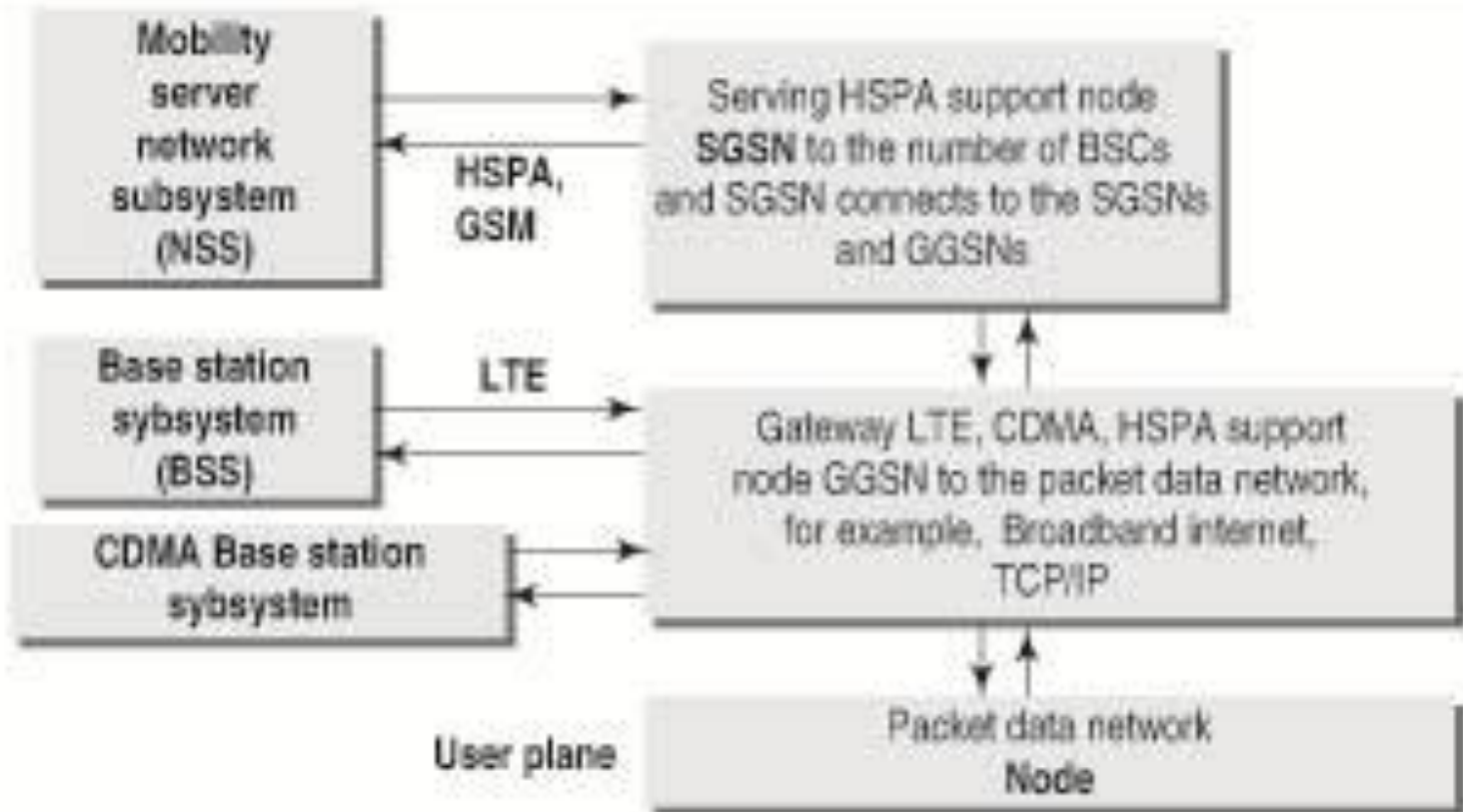
- Each GGSN interfaces to the packet data network node (Internet and other PDNs (public data networks))
- Direct access provided to the user plane

# LTE MIMO

- SIMO (2007)
- MIMO (2008)
- MIMO has a channel encoder, beam former with pre-coding, interleaving unit, rate matcher and an encoder



# LTE ARCHITECTURE



# WIMAX RELEASE 1.0 IEEE 802.16E

- Mobile broadband Internet
- Frequency Bands
- 1.920–1.980 GHz, 2.110–2.170 GHz, 2.500–2.570 GHz, 2.570–2.620 GHz, 2.620–2.690 GHz....up to 11 GHz

# WIMAX BTS TOWER

- 1. OFDM 128-FFT, 256-FFT, 512-FFT, 1K FFT, 2K-FFT
- 2. Sub-channelization (transmit channels are divided into a large number of parallel sub-channels and sub-sets of sub-carriers are assigned to individual user)

# WiMAX BTS TOWER

- 3. When user is close to BTS, the number of sub-channels is enhanced
- 4. Each MS is linked to a number of sub-channels. As a result multi-path interference is not present
- 5.  $2 \times 2$  MIMO WiMax Rel 1.0

# WIMAX BTS TOWER

- WiMax receiver— Card attached to mobile system
- Uplink power control — Full path loss compensation;
- Modulation — Longer range case modulations use QPSK and shorter ranges use 64 QAM
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# WIMAX BTS TOWER

- Encryption and authentication—  
Encryption AES; Authentication EAP
- TDD — Time division duplex for uplink and downlink frequency
- Smart MIMO — Single code word vertical; TDD MIMO; closed loop with precoding

# SUMMARY

- LTE
- NSS included Gateway support system
- Multi carrier OFDM
- Direct Gateway Interface to Packet data network
- SIMO, MIMO
- WiMax 16e

**End of Lesson 14**  
**LTE and WiMax16e**