# LTE technology and LTE test; a deskside chat

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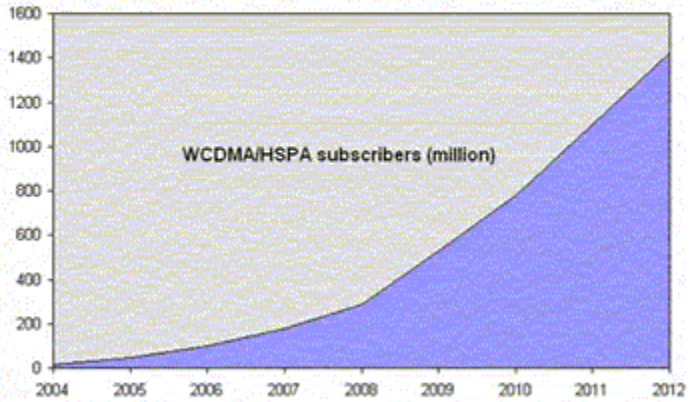
MIMO = Multiple Input Multiple Output
EPS = Evolved Packet System
UE = User Equipment
RRM = Radio Resource Management
OFDMA = Orthogonal Frequency Division Multiple Access
SC-FDMA = Single Carrier Frequency Division Multiple Access

# Motivation for LTE

# LTE market situation
## based on HSPA success story

- HSPA growth is based on the uptake of mobile data services worldwide. More than 250 networks worldwide have already commercially launched HSPA.
- Mobile data traffic is growing exponentially, caused by mobile internet offerings and improved user experience with new device types.
- LTE is accepted worldwide as the long term evolution perspective for today's 2G and 3G networks based on WCDMA/HSPA, GSM/EDGE, TD-SCDMA, and CDMA2000 technologies.




Sources: www.gsacom.com, R&S

# LTE background story
## the early days

- Work on LTE was initiated as a 3GPP release 7 study item "Evolved UTRA and UTRAN" in December 2004:
  - *"With enhancements such as HSDPA and Enhanced Uplink, the 3GPP radio-access technology will be highly competitive for several years. However, to ensure competitiveness in an even longer time frame, i.e. for the next 10 years and beyond, a long-term evolution of the 3GPP radio-access technology needs to be considered."*
- Basic drivers for LTE have been:
  - Reduced latency
  - Higher user data rates
  - Improved system capacity and coverage
  - Cost-reduction.

# Major requirements for LTE
## identified during study item phase in 3GPP

- Higher peak data rates: 100 Mbps (downlink) and 50 Mbps (uplink)
- Improved spectrum efficiency: 2-4 times better compared to 3GPP release 6
- Improved latency:
  - Radio access network latency (user plane UE – RNC - UE) below 10 ms
  - Significantly reduced control plane latency
- Support of scalable bandwidth: 1.4, 3, 5, 10, 15, 20 MHz
- Support of paired and unpaired spectrum (FDD and TDD mode)
- Support for interworking with legacy networks
- Cost-efficiency:
  - Reduced **CA**pital and **OP**erational **EX**penditures (CAPEX, OPEX) including backhaul
  - Cost-effective migration from legacy networks
- A detailed summary of requirements has been captured in 3GPP TR 25.913 „Requirements for Evolved UTRA (E-UTRA) and Evolved UTRAN (E-UTRAN)".

# Evolution of UMTS FDD and TDD
## driven by data rate and latency requirements


| 3GPP release | 3GPP Release 99/4 | 3GPP Release 5/6 | 3GPP Release 7 | 3GPP Release 8 | 3GPP Study Item initiated |
|---|---|---|---|---|---|
| App. year of network rollout | 2003/4 | 2005/6 (HSDPA)<br>2007/8 (HSUPA) | 2008/2009 | 2010 | |
| Downlink data rate | 384 kbps (typ.) | 14 Mbps (peak) | 28 Mbps (peak) | LTE: 150 Mbps* (peak)<br>HSPA+: 42 Mbps (peak) | 100 Mbps high mobility<br>1 Gbps low mobility |
| Uplink data rate | 128 kbps (typ.) | 5.7 Mbps (peak) | 11 Mbps (peak) | LTE: 75 Mbps (peak)<br>HSPA+: 11 Mbps (peak) | |
| Round Trip Time | ~ 150 ms | < 100 ms | < 50 ms | LTE: ~10 ms | |

*based on 2x2 MIMO and 20 MHz operation