## WiMAX™

## Flexible, accurate and fast

WiMAX™ (Worldwide Interoperability of Microwave Access) is based on modern communications technologies, such as OFDMA and MIMO. This establishes WiMAX™ as a cellular broadband standard, providing high performance in data rate, mobility and cell size. VoIP and roaming capabilities are additional focus areas for WiMAX™. This IEEE non-3GPP standardization approach is mainly driven by the traditional computer industry, which has created the Wi-Fi standard before. With its high IP capabilities, WiMAX™ is targeting the mobile Internet.

Originally only specified for the TDD mode, WiMAX™ Release 1.5 also includes FDD functionality to enable network operators to implement WiMAX™ in the ITU FDD frequency bands.

WiMAX™ Release 2.0 is the next evolutionary step, specified in IEEE 802.16m and also referred to as Advanced WiMAX™. A further increase in data rate, compared to IEEE 802.16e, will be achieved with higher channel bandwidth and up to 4x4 MIMO technology, making this standard also a candidate for the IMT Advanced technology.

## LTE Fundamentals

Long Term Evolution (LTE) will ensure the competitiveness of UMTS for the next ten years and beyond by providing a high-data rate, low-latency and packet-optimized system. Also known as E-UTRA (Evolved Universal Terrestrial Radio Access), LTE is part of 3GPP Release 8 specifications. LTE can be operated in either frequency division duplex (FDD) or time division duplex (TDD) mode, also referred to as LTE FDD and TD-LTE. The main key technology aspects of LTE are:

* New, Orthogonal Frequency Division Multiple Access (OFDMA) based multiple access schemes for both LTE FDD and TD-LTE
* Scalable bandwidth up to 20 MHz
* Support for Multiple Input Multiple Output (MIMO) antenna technology
* New data and control channels
* New network and protocol architecture (two node, IP based)

LTE (3GPP Release 8) supports theoretical peak data rates of 300Mbps in downlink and 75Mbps in uplink direction. The first commercial network was launched in Sweden in December 2009 whereas meanwhile LTE has become the fastest growing mobile communication technology ever. Commercially available end user devices support max. 100Mbps (DL) / 50Mbps(UL). Please note that achievable data rates in real life networks varies depending on e.g. network load and propagation conditions and is generally significantly lower than the maximum rates achieved in test lab environment.

## LTE-Advanced Fundamentals

In order to make LTE a true 4th generation (4G) technology, it was enhanced to meet the IMT-Advanced requirements issued by the International Telecommunication Union (ITU). The necessary improvements are specified in 3GPP Release 10 and also known as LTE-Advanced. IMT-conformant systems will be candidates for future spectrum bands that are still to be identified, which is another major reason for aligning LTE-Advanced with the call for IMT-Advanced technologies. This ensures that today’s deployed LTE mobile networks provide an evolutionary path towards many years of commercial operation. LTE-Advanced further increases peak data rates towards 1 Gbit/s in the downlink and 500 Mbit/s in the uplink.

The technology components of LTE-Advanced are:

* Carrier aggregation
* MIMO extension (up to DL: 8x8; up to UL: 4x4)
* Uplink access enhancements (clustered SC-FDMA and simultaneous data and control information (PUSCH and PUCCH) transmission
* Improving cell edge performance (enhanced inter-cell interference coordination (eICIC), relaying)