

[3GPP](#)[3GPP Commits to Develop 6G Specifications](#)[New ETSI Standard enables Next Generation Emergency Services Communications](#)[New ETSI White Paper: Unlocking Digital Transformation with Autonomous Networks](#)

INTRODUCTION

Capacity limitations of 2nd generation mobile communication systems, an increasing demand for the support multimedia services (not mainly voice) and higher data rates as well as the request for a world wide mobile communication system triggered the introduction of a 3rd generation under the ITU-R umbrella IMT-2000 (see requirements in ITU-R M.1034 and ITU-R M.1457).

Among the terrestrial systems of IMT-2000 family the most successful 3rd generation mobile cellular technology was developed by 3GPP™ under the name Universal Mobile Telecommunications System (UMTS™).

NOTE 1: There are/were also other names used for this system: Universal Terrestrial Radio Access (UTRA), Freedom of Mobile Multimedia Access (FOMA), 3GSM, ...).

NOTE 2: In the second half of the 1990s different regional proposals for the 3rd generation were developed based on CDMA (e.g. in ETSI SMG); their harmonization led to the foundation of the 3rd Generation Partnership Project ([3GPP](#)) and finally to UMTS.

UMTS is offering greater spectral efficiency than GSM™ and has 2 modes:

- an FDD mode (Frequency Division Duplex) where uplink (user equipment UE => UTRA network = UTRAN) and downlink (UTRAN => UE) communication are separated in the frequency domain via different frequency bands; this mode is also called Wideband CDMA (WCDMA) or Direct Spread CDMA;
- a TDD mode (Time Division Duplex) where uplink (UE => UTRAN) and downlink (UTRAN => UE) communication are separated in the frequency domain via different time slots; note: The 3.84Mchip/s option was also called TD-CDMA or HCR (high chip rate) TDD.

Both modes use direct sequence CDMA (code division multiple access) to separate the different users, i.e. each symbol of one user is multiplied by a user specific spreading code. With this CDMA technique multiple users can transmit in the same (larger) band and the decoder, knowing the user's spreading code, can pick up the data of this user. The data of other users appears as noise in this decoding process.

Using a wide frequency band makes the system inherently resistant to many of the aspects of radio communication which plague narrow band systems, such as bursty noise, multipath reflections, and other interfering transmissions.

Both modes were originally (in the first release: Release 99) defined with a 10ms radio frame divided into 15 slots, a chiprate of 3,84Mchips/s and a channel spacing of 5MHz (note: GSM has just a channel spacing of 200kHz).

In terms of maximum user bit rates the requirements of the first UMTS release were (according to [ETSI TR 101 111](#)):

- **Rural Outdoor:** at least 144 kbit/s (goal to achieve 384 kbit/s), max. speed: 500 km/h
- **Suburban Outdoor:** at least 384 kbps (goal to achieve 512 kbit/s), max. speed: 120 km/h
- **Indoor/Low range outdoor:** at least 2Mbps, max. speed: 10 km/h

It is desirable that the definition of UTRA should allow evolution to higher bit rates.

In the 2nd release (Release 4) a further TDD option with 1,28Mchips/sec and 1,6MHz channel spacing was developed for China (but may be deployed also elsewhere), called TD-SCDMA or LCR (low chip rate) TDD. In Release 7 (5th release), a further TDD option with 7,68Mchips/sec and 10MHz channel spacing was developed; called VHCR (very high chip rate) TDD.

Maximum commonality between FDD and TDD variants is assured by a single set of higher layer protocols and shared physical layer parameters, as far as possible. A flexible radio protocol allows multiplexing of several services (speech, video, data...) on a single carrier. Real-time and non-real-time services are catered for by configurable quality of service parameters (delay, bit error probability, frame error ratio). The architecture allows for point-to-point and also point-to-multipoint services (broadcast, multicast). And full interoperability (e.g. handover of voice calls) with [GSM/GERAN/EDGE](#) is also ensured.

UMTS was originally specified for operation in bands in the 2 GHz range (see [3GPP TS 25.101](#)). Subsequently, it was extended to operate in a number of other bands, including those originally reserved for 2nd generation (2G) services.

UMTS was and still is continuously enhanced over several releases (also in parallel to developments of the 4th generation) e.g. by:

- high-speed download packet access (HSDPA) in Rel-5: see [3GPP TS 25.308](#)
- enhanced Uplink for FDD (also called HSUPA = high speed uplink packed access; or EDCH = enhanced dedicated channel) in Rel-6: see [3GPP TS 25.319](#): if combined with 16QAM: up to 11 Mbit/s
- higher order modulations (16QAM in UL in REL-7, 64QAM in DL in Rel-7, in UL in Rel-11)
- Multiple Input Multiple Output Antennas (MIMO) in Rel-7
- Dual-Cell HSDPA (DC-HSDPA) operation on adjacent carriers in Rel-8: if combined with 64QAM: up to 42 Mbit/s; if combined with MIMO: up to 84 Mbit/s
- MIMO with 64QAM for HSUPA in Rel-11: up to 34.5 Mbit/s
- 4 carrier HSDPA in Rel-10 (non-contiguous in Rel-11)
- 8 carrier HSDPA (8C-HSDPA) in Rel-11: up to 336 Mbit/s
- Dual carrier HSUPA (DC-HSUPA) in Rel-13: up to 23 Mbit/s

NOTE: The peak data rate figures above are given in ITU-R M.1457 for FDD.

Other enhancement areas were e.g. Home NodeBs, Machine Type Communication (MTC), Self Optimizing Networks (SON), WLAN interworking, Indoor Positioning, Active Antenna Systems (AAS), interference mitigation (a number of them were common WIs with the 4th generation in order to cater for commonalities and interworking).

From June 2016 onwards, UMTS was further developed/maintained by [3GPP TSG RAN WG6](#) ("GERAN and UTRAN radio and protocol") regarding its physical layer and layer 2/3 aspects. In June 2020 3GPP TSG RAN WG6 was closed and from this time onwards, this UMTS maintenance is carried out by 3GPP TSG RAN.

The radio related UMTS specifications are specified in [3GPP TS 25.-series specifications](#). See also ETSI [standards search](#).

E.g. physical layer general description ([3GPP TS 25.201](#)); UTRAN stage 2 ([3GPP TS 25.300](#)), Radio interface protocol architecture ([3GPP TS 25.301](#)), UTRAN over all description ([3GPP TS 25.401](#)). [3GPP TS 21.101](#) provides a list of all 3rd generation specifications (including core network and system aspects). The overall network architecture of the 3rd generation can be found in [3GPP TS 23.002](#).

HARMONISED STANDARDS FOR IMT-2000

The terrestrial technologies of the IMT-2000 family are specified by the 3GPP™ and 3GPP2 partnership projects, and by ETSI.

Radio equipment for the European market has to be conform to the [Radio Equipment Directive](#) (RED) which sets requirements on [safety](#), electromagnetic compatibility ([EMC](#)) and effective use of the [radio spectrum](#). Compliance to these requirements can be shown by compliance with so called Harmonised Standards.

Requirements for safety are available from CENELEC. ETSI provides input to the CENELEC standardization process.

Based on the European Commission Mandate M/536, ETSI has developed Harmonised Standards to enable radio equipment of the IMT-2000 family to be placed on the European market under the [Radio Equipment Directive](#) (RED). This addresses all IMT-2000 technologies that may potentially be deployed in Europe, not just those specified by ETSI and 3GPP.

The standards are developed and maintained by a joint Task Force within ETSI, known as TFES - there is one exception, [EN 301 908-10](#), which is maintained by ETSI technical committee DECT.

TFES is open to all ETSI members. As its activities take account of the work of other standards and specification groups, participants in those groups are welcome to contribute to the work. If an interested party is unable to participate through an ETSI membership, the TFES chair can extend an individual invitation.