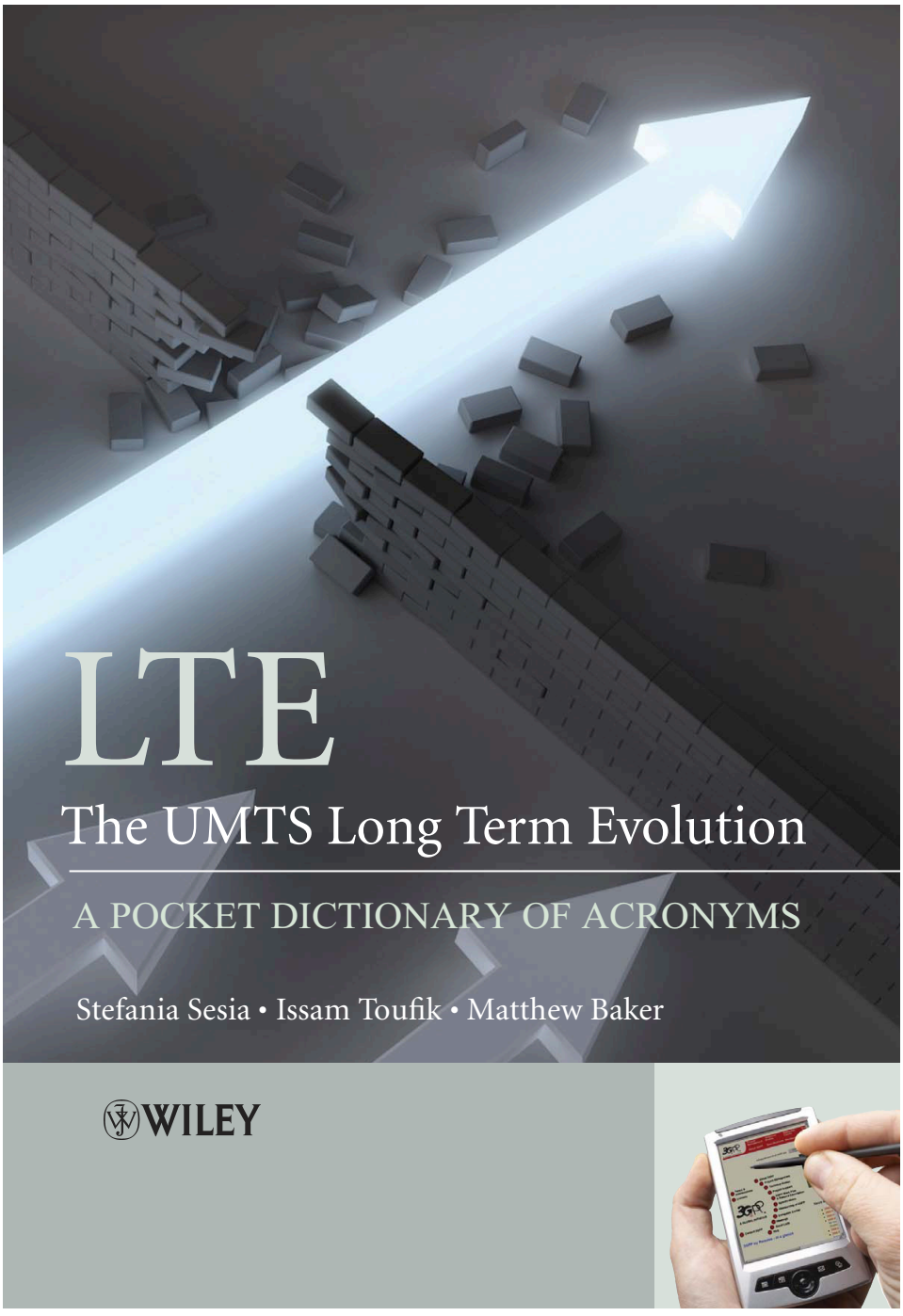
LTE
The UMTS Long Term Evolution
A POCKET DICTIONARY OF ACRONYMS
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WILEY

LTE – The UMTS Long Term Evolution

A Pocket Dictionary of Acronyms

Stefania Sesia, Issam Toufik and Matthew Baker

Dictionary of LTE Acronyms

The aim of this list is to provide definitions of the most common acronyms related to LTE. The definitions given here are intended for guidance only. For definitive information the reader should refer to the latest versions of the 3GPP specifications and other relevant documents.

In this list, the following acronyms occur many times and are not expanded on each occasion; however, their definitions can be found under their own entries in the list. GSM, GPRS, UMTS, HSDPA, HSUPA, HSPA, UTRA, UTRAN, E-UTRAN, E-UTRA, LTE, UE, eNodeB, EDGE, CDMA2000.

1xRTT CDMA2000 1x Radio Transmission Technology. The original version of the CDMA2000 system. It operates using a single (hence '1x') Radio Frequency (RF) carrier in each direction, each occupying the same bandwidth (1.25 MHz) as the earlier Interim Standard-95 (IS-95). See www.cdg.org.

3GPP 3rd Generation Partnership Project. The joint standardization partnership responsible for standardizing UMTS, HSPA and LTE. See www.3gpp.org.

3GPP2 3rd Generation Partnership Project 2. The joint standardization partnership responsible for standardizing CDMA2000 and its derivatives. See www.3gpp2.org.

AAA Authentication, Authorization and Accounting. These processes involve establishing a terminal's identity, configuring authorizations to access particular types of service, and monitoring traffic volumes for each user. See 3GPP TS29.273, and TS23.002 Sections 4.1.4.6 and 4.1.4.7.

ABM Asynchronous Balanced Mode. A mode of packet data transfer used, for example, by the Logical Link Control (LLC) layer for acknowledged bi-directional communication between a mobile station and a Serving GPRS Support Node (SGSN), which includes error recovery procedures and provides in-sequence delivery. Balanced mode implies that the station at either end of the link has the right to set-up, reset, or disconnect a link at any time (i.e. there is no master/slave relationship). See 3GPP TS44.064.

ABQP Aggregate Base Station Subsystem Quality of Service Profile. Defines the Quality of Service (QoS) profile for a Base Station Subsystem (BSS) packet flow context. See 3GPP TS48.018 Section 11.3.43 and TS24.008 Section 10.5.6.5.

AC Access Class. All UEs are randomly allocated to one of ten ACs, the allocated AC being stored in the Subscriber Identity Module/Universal Subscriber Identity Module (SIM/USIM). In addition, UEs may belong to a special AC (e.g. for emergency services or network operators). The AC is used in determining whether the UE may attempt to access the network. See 3GPP TS22.011 Section 4.

ACI Adjacent Channel Interference. Received interference arising from transmissions in an adjacent Radio Frequency (RF) channel.

ACIR Adjacent Channel Interference Ratio. The ratio of the total power transmitted from a source to the total interference power affecting a victim receiver, resulting from both transmitter and receiver imperfections. It is a function of the Adjacent Channel Leakage Ratio (ACLR) and the Adjacent Channel Selectivity (ACS), i.e. ACIR $\cong \frac{1}{\frac{1}{\text{ACLR}}+\frac{1}{\text{ACS}}}$.

ACK ACKnowledgment. A signal transmitted to indicate that one or more blocks of data have been successfully received and decoded. It is used in Hybrid Automatic Repeat reQuest (HARQ), as well as in Radio Link Control (RLC) level ARQ.

ACLR Adjacent Channel Leakage Ratio. A measure of the power which leaks into certain specific nearby Radio Frequency (RF) channels as a result of transmitting in a given channel. It provides an estimate of how much a neighbouring radio receiver will be affected by the Out Of Band (OOB) emissions from a transmitter. It is defined as the ratio of the filtered mean power in a set bandwidth within the wanted channel to the filtered mean power in an adjacent channel. See 3GPP TS36.101 Section 6.6.2.3.

ACRR Adjacent Channel Rejection Ratio. Used in the context of repeaters. It is the ratio of the Root Raised Cosine (RRC) weighted gain per carrier of the repeater in the pass band to the RRC weighted gain of the repeater on an adjacent channel. See 3GPP TS 36.106 Section 13.

ACS Adjacent Channel Selectivity. A measure of a receiver's ability to receive a wanted signal at its assigned channel frequency in the presence of an adjacent channel interfering signal at a given frequency offset from the centre frequency of the assigned channel, without the interfering signal causing a degradation of the receiver performance beyond a specified limit. ACS is predominantly defined by the ratio of the receive filter attenuation on the assigned channel frequency to the receive filter attenuation on the adjacent channel. See 3GPP TS36.101 Section 7.5.

ADC Analogue to Digital Converter. A processor which samples and quantizes an analogue input signal to convert it to a digital output signal.

ADM Asynchronous Disconnected Mode. A mode of packet data transfer used by the Logical Link Control (LLC) layer for unacknowledged communication between a mobile station and a Serving GPRS Support Node (SGSN), without prior establishment of a logical connection. Error recovery procedures are not provided, and in-sequence delivery is not guaranteed. See 3GPP TS44.064.

ADSL Asymmetric Digital Subscriber Line. It is a means of providing high-speed data transmission over conventional twisted-pair copper telephone lines, by frequency-division multiplexing with analogue voice traffic. Higher download speeds are provided than upload speeds.

AES Advanced Encryption Standard. See Federal Information Processing Standards Publication 197, available from www.csrc.nist.gov.

AF Application Function. An element offering applications that require the control of Internet Protocol (IP) bearer resources, such as dynamic policy or charging control. See for example 3GPP TS23.207 Section 5.2.4 and TS23.203 Section 6.2.3.

AKA Authentication and Key Agreement. The process by which the Authentication Centre (AuC) and UE exchange information by which they can each verify a secret key held by the other, and then calculate keys to be used for ciphering and integrity protection of data transmitted between the UE and the network. See 3GPP TS33.102 Section 6.3 and TS33.401 Section 6.1.

AM Acknowledged Mode. One of three Radio Link Control (RLC) modes (the other two being Transparent Mode (TM) and Unacknowledged Mode (UM)). It includes Automatic Repeat reQuest (ARQ) for error-free packet delivery. See 3GPP TS36.322.

AMBR Aggregated Maximum Bit-Rate. The upper limit on the aggregate bit rate that can be expected to be provided across all non-Guaranteed Bit Rate (GBR) bearers. Excess traffic may, for example, be discarded by a rate-shaping function. Each non-GBR bearer could potentially utilize the entire AMBR, for example when the other non-GBR bearers are not carrying any traffic. See 3GPP TS23.401 Section 4.7.3.

AMC Adaptive Modulation and Coding. A form of link adaptation which adjusts the transmitted information data rate by varying the modulation order and the Forward Error Correction (FEC) code rate. This is typically done to match an estimate of the instantaneous radio channel capacity.

AMD Acknowledged Mode Data. The type of Protocol Data Unit (PDU) used to carry user plane data in Radio Link Control (RLC) Acknowledged Mode (AM). The PDU header contains special fields to support the RLC Automatic Repeat reQuest (ARQ) mechanism. See 3GPP TS36.322 Section 6.

AMN Artificial Mains Network. A model of the mains electricity supply to which equipment is connected, used for ElectroMagnetic Compatibility (EMC) emissions testing. See 3GPP TS36.113 Section 8.3.2 and www.iec.ch.

A-MPR Additional Maximum Power Reduction. An additional value of maximum allowed uplink power reduction used to meet additional adjacent carrier leakage ratio and spectrum emission requirements which are signalled by the network in a specific deployment scenario. See 3GPP TS36.101 Section 6.2.4.

AMR Adaptive Multi-Rate. A type of source coding, often used for digital speech transmission, whereby the bit rate of the generated data stream is adapted by varying the encoded quality of the signal. The different output data rates are provided by switching between different source codecs. See 3GPP TS26.071 and TS26.171.

ANR Automatic Neighbour Relation. A function by which eNodeBs can automatically determine which cells are their neighbours. See 3GPP TS36.300 Section 22.3.2.

AoA Angle-of-Arrival. The angle (usually azimuth) from which a signal arrives relative to a reference angle of an antenna array.

AoD Angle-of-Departure. The angle (usually azimuth) at which a signal is transmitted relative to a reference angle of an antenna array.

AP Application Protocol. Many APs are part of the Control-plane of E-UTRAN and operate across the S1 and X2 interfaces (S1-AP and X2-AP respectively), performing functions such as setting up Evolved Packet System (EPS) bearers. See 3GPP TS36.401 Section 11.1.2.

APN Access Point Name. Identifies a Gateway GPRS Support Node (GGSN) or Packet Data Network GateWay (P-GW). It includes an APN network identifier which defines the Packet Data Network (PDN) to which the UE requests connectivity, and may also include an APN operator identifier which defines in which Public Land Mobile Network (PLMN) the P-GW or GGSN is located. See 3GPP TS23.003 Sections 9 and 19.4.2.2.

ARFCN Absolute Radio Frequency Channel Number. An ARFCN defines a pair of Radio Frequency (RF) channel frequencies for uplink and downlink use. See 3GPP TS45.005 Section 2 for the ARFCN for GSM, TS25.101 Section 5.4 for the UARFCN for UMTS and TS36.101 Section 5.4 for the EARFCN for LTE. ARFCN and UARFCN are based on a 200 kHz channel raster, while EARFCN is based on a 100 kHz channel raster.

ARIB Association of Radio Industries and Businesses. One of the Japanese Standards Development Organisations (SDOs) in 3GPP (the other being TTC). See www.arib.or.jp.

ARP Allocation and Retention Priority. A parameter of the Quality of Service (QoS) profile of an Evolved Packet System (EPS) bearer. It is designed to facilitate decisions as to whether a bearer establishment/modification request can be accepted. See 3GPP TS23.401 Section 4.7.3.

ARQ Automatic Repeat reQuest. A scheme whereby the receiving terminal requests retransmission of packets which are detected to be erroneous. It is used in Radio Link Control (RLC) Acknowledged Mode (AM), as well as being a component of Hybrid ARQ (HARQ).

AS Access Stratum. Consists of the functions and protocols used to transfer information across a specific Radio Access Technology (RAT).

AS Angular Spread. A measure of the width of a transmitted (or received) signal beam or set of signal paths, usually in the azimuth plane.

A-SEM Additional Spectrum Emission Mask. Specifies additional spectral emission constraints for particular deployment scenarios. A UE is instructed when it has to apply an A-SEM by signalling from the network, typically as part of a cell handover/broadcast message. See 3GPP TS36.101 Section 6.6.2.2.

ASME Access Security Management Entity. The entity which receives the top-level keys in an access network from the Home Subscriber Server (HSS). For E-UTRAN access networks, the role of the ASME is assumed by the Mobility Management Entity (MME). See 3GPP TS33.401.

ASN.1 Abstract Syntax Notation 1. A standardized notation used to describe structures for representing, encoding, transmitting, and decoding data; it is used for some UMTS and LTE protocol specifications (e.g. Radio Resource Control (RRC) signalling definition. See 3GPP TS36.331.

ATIS Alliance for Telecommunications Industry Solutions. The North American Standards Development Organization (SDO) in 3GPP. See www.atis.org.

ATT Attenuator. Used in conformance testing, to set the desired power of received signals or interference, for example modelling propagation loss. See 3GPP TS36.508 Annex A and TS36.141 Annex I.

AuC Authentication Centre. Can be considered to be a subset of a Home Subscriber Server (HSS). It stores an identity key for each mobile subscriber registered with a Home Location Register (HLR). This key is used to generate security data. See 3GPP TS23.002.

AWGN Additive White Gaussian Noise. Noise with a flat power spectrum and Gaussian amplitude distribution. It is generally added to a received signal to simulate the effect of thermal noise and other sources of noise or interference.

BCC Base station Colour Code. The least-significant 3 bits of a Base Station Identification Code (BSIC). See 3GPP TS23.003.

BCCH Broadcast Control CHannel. In LTE, it represents the logical channel carrying broadcast system information. See 3GPP TS36.321.

BCH Broadcast CHannel. In LTE, the transport channel carrying broadcast system information except that which is contained in the Master Information Block (MIB). See 3GPP TS36.321.

BCM Bearer Control Mode. BCM can indicate ‘mobile station only’ or ‘mobile station / network’. When the BCM is ‘mobile station only’, the mobile station requests any additional Packet Data Protocol (PDP) contexts for the PDP Address / Access Point Name (APN) pair. In the case of ‘mobile station/network’ , both the mobile station and the Packet Data Network GateWay (P-GW) or Gateway GPRS Support Node (GGSN) may request additional PDP contexts. See 3GPP TS29.060 Section 7.7.83.

BER Bit Error Rate. A measure of received signal quality: the proportion of received bits which is decoded erroneously.

BI Backoff Indicator. Indicates the upper limit for a random backoff period by which a UE has to delay a new random access attempt if a response has not been received to a first random access attempt. The BI may be used for example in network overload situations. See 3GPP TS36.321 Sections 5.1 and 7.2.

BLER Block Error Rate. A measure of received signal quality: the proportion of received data blocks which is decoded erroneously. Usually this refers to transport blocks, and the errors are detected by Cyclic Redundancy Check (CRC) failure.

BM-SC Broadcast-Multicast Service Centre. The interface between external broadcast/multicast content providers and the core network. See 3GPP TS23.246 Section 5.1.

BP Bandwidth Part. A part of the total downlink system bandwidth, which is further subdivided into a number of sub-bands. It is applicable to periodic 'UE-selected sub-band' Channel Quality Indicator (CQI) reporting on the Physical Uplink Control CHannel (PUCCH). The UE selects one sub-band from the BP and the corresponding CQI value is reported. See 3GPP TS36.213 Section 7.2.2.

BPSK Binary Phase Shift Keying modulation. A modulation scheme conveying one bit per symbol, whereby the values of the bit are represented by opposite phases of the carrier.

BS Base Station. The entity in a radio access network responsible for radio transmission and reception in one or more cells to and from the UE. In LTE the BS is known as the eNodeB.

BSIC Base Station Identification Code. A 6-bit code which allows a mobile station to distinguish between different neighbouring GSM base stations. It is made up of a Network Colour Code (NCC) and a Base station Colour Code (BCC). See 3GPP TS23.003.

BSR Buffer Status Report. Medium Access Control (MAC)-level messages transmitted by the UE to the serving eNodeB to provide the eNodeB with information about the amount of data in the uplink buffers of the UE. See 3GPP TS36.321 Section 5.4.5.

BSS	Base Station Subsystem. Either a full GSM/EDGE Radio Access Network (GERAN) network, or only the access part of a GERAN, offering the allocation, release and management of specific radio resources to establish means of connection between a mobile station and the GERAN.
BTS	Base Transceiver Station. The base station in a GSM system.
BW	Bandwidth. A measure of the width of a range of frequencies, measured in Hertz.
C/I	Carrier-to-Interference Ratio. The ratio between the power of the Radio Frequency (RF) carrier bearing the wanted signal and the total power of interfering signals.
CAC	Call Admission Control. The process by which the network decides whether or not to admit a new call.
CAZAC	Constant Amplitude Zero Auto-Correlation. A property exhibited by certain sequences, such as Zadoff-Chu (ZC) sequences, whereby the sequences have constant amplitude and zero circular autocorrelation at all points except zero lag.
CB	Circular Buffer. A buffer in which data is read in and out cyclically, such that when the end of the buffer is reached the process continues at the beginning. See 3GPP TS36.212 Section 5.1.4.1.2.
CBC	Cell Broadcast Centre. The part of the Core Network (CN) which manages Cell Broadcast Service (CBS) messages. See 3GPP TS23.002 Section 4a.5.1.
CBE	Cell Broadcast Entity. An information source, external to the 3GPP system, which provides the content of a Cell Broadcast Service (CBS). This may include emergency public warnings. See 3GPP TS23.401 Section 5.12 and TS23.041 Section 4.

CBS Cell Broadcast Service. A service analogous to Teletex, which broadcasts unacknowledged messages to all mobile terminals within a particular region. See 3GPP TS23.041.

CC Convolutional Code. A type of Forward Error Correction (FEC) code in which k input bits to be encoded are fed into a shift register with a number stages corresponding to the memory of the CC, and n output bits are taken from the shift register as a linear combination of the content of the shift register. The code rate is given by k/n.

CCCH Common Control CHannel. In LTE, a logical channel used to deliver control information (in both uplink and downlink directions) during connection establishment. See 3GPP TS36.321.

CCE Control Channel Element. A set of 36 resource elements to which part or all of a Physical Downlink Control CHannel (PDCCH) message can be mapped. See 3GPP TS36.211 Section 6.8.1.

CCO Cell Change Order. A message from E-UTRAN to a UE in RRC_CONNECTED mode, instructing it to move to a GSM/EDGE Radio Access Network (GERAN), including information facilitating access to and/or connection establishment in the target cell. See 3GPP TS36.331 Section 5.4.3.

CCSA China Communications Standards Association. The Chinese Standards Development Organization (SDO) in 3GPP. See www.ccsa.org.cn.

CDD Cyclic Delay Diversity. A form of transmit diversity whereby a different phase shift is applied to each Orthogonal Frequency Division Multiplexing (OFDM) subcarrier on at least one of the multiple transmit antennas from which the subcarrier is transmitted, thereby increasing the frequency selectivity of the radio channel. In the time domain this is equivalent to introducing a delay which is cyclic because it is applied before insertion of the Cyclic Prefix (CP).

CDL Clustered Delay Line. A type of channel model in which the received signal is composed of a number of separate delayed clusters. Each cluster comprises a number of multipath components with the same delay but different Angle of Departure (AoD) and Angle of Arrival (AoA).

CDM Code Division Multiplex(ed/ing). A method of multiplexing different data signals by means of different codes, rather than different frequencies or timeslots. The codes used for different signals may be orthogonal to each other, or may be pseudo-random. They have a wider bandwidth than the data signals. CDM is the main multiplexing mode in UMTS.

CDMA Code Division Multiple Access. A scheme allowing multiple users to access a given radio channel by the use of CDM to multiplex the data signals of the different users. CDMA is the main multiple access mode of UMTS.

CDN Coupling/Decoupling Network. A capacitor/inductor network used to connect equipment being tested for ElectroMagnetic Compatibility (EMC) compliance to a power supply. The coupling network allows Radio Frequency (RF) common mode current disturbance signals through the various conductors to the equipment under test, while the decoupling network is designed to handle signals emitted by the equipment under test. See 3GPP TS36.113 and IEC 61000 (www.iec.ch).

CF Contention-Free. Referring to the random access procedure, CF is an access mode in which only one user has permission to access a given transmission resource. CF random access operates in LTE by assigning a dedicated Random Access CHannel (RACH) preamble signature to a particular UE for transmission in a particular RACH slot. This is in contrast to contention-based random access, where multiple users may transmit a signal in the same time-frequency resources, and a contention resolution procedure is then required to separate the different users. See 3GPP TS36.321 Section 10.1.5.2.
Referring to turbo-code interleaver design, CF describes an interleaver in which the turbo-decoder can operate to perform the necessary exchanges of mutual information between the consitutent decoders without reading and writing from the same memory block at the same time. The turbo-code interleaver adopted for LTE is CF.

CFI Control Format Indicator. Indicates the number of Orthogonal Frequency Division Multiplexed (OFDM) symbols used for control signalling in each downlink subframe. See 3GPP TS36.212 Section 5.3.4.

CFO Carrier Frequency Offset. The difference between a reference frequency and the frequency of a received Radio Frequency (RF) carrier. Typically the reference frequency is provided by a local oscillator in the radio receiver.

CGI Cell Global Identification. The globally unique identity of a cell in GSM/EDGE Radio Access Network (GERAN) or CDMA2000.

CHAP Challenge Handshake Authentication Protocol. Used by the Point-to-Point Protocol (PPP) to validate the identity of users. See IETF RFC1994, www.ietf.org.

CID Cell IDentifier. In LTE, an identifier of a particular cell, either a Physical CID or a Global CID. Up to 504 Physical CIDs are available.

CID Context IDentifier. A RObust Header Compression (ROHC) parameter which is associated with each compressed data flow and which identifies the state maintained by the compressor and decompressor in order to compress/decompress the headers of the packet stream. The CID is transmitted together with the compressed headers and feedback information. See IETF RFC3095, www.ietf.org.

CINR Carrier-to-Interference-and-Noise Ratio. The ratio between the power of the Radio Frequency (RF) carrier bearing the wanted signal and the total power of interfering signals and thermal noise.

CIR Channel Impulse Response. The time-domain complex signal received at the output of a radio propagation channel in response to the transmission of a single signal impulse of vanishingly short duration. It provides information on the power, phase and delay of the different paths of the channel.

CKSN Ciphering Key Sequence Number. In a UMTS authentication challenge, the CKSN enables the network to verify the instance of the ciphering key and integrity key which are stored in the mobile terminal without invoking the authentication procedure. See 3GPP TS24.008 Section 10.5.1.2.

CM Cubic Metric. The CM of a given signal is a measure of the transmit power de-rating needed to enable a Power Amplifier (PA) to transmit the signal compared to the de-rating required for transmission of a reference signal for the same Adjacent Carrier Leakage Ratio (ACLR). The CM characterizes the effects of the third-order (cubic) non-linearity of the PA. See for example 3GPP TS25.101 Section 6.2.2.

CMC Connection Mobility Control. Comprises the functions executed by the eNodeB to manage mobility and handover in both idle and connected modes. See 3GPP TS36.300 Section 16.1.3 and TS36.133.

CMHH Constant Modulus Householder. A Householder matrix is given by $\mathbf{W}_{\mathrm{H}} = \mathbf{I} - 2\mathbf{u}\mathbf{u}^{\mathrm{H}}/\mathbf{u}^{\mathrm{H}}\mathbf{u}$ where $\mathbf{I}$ is the identity matrix and $\mathbf{u}$ is a predefined column vector. If all the column vectors in the matrix have equal magnitude, the matrix is said to possess the constant modulus property. Codebooks comprised of CMHH matrices were considered for precoding in LTE. In such an application, the constant modulus property limits the Peak to Average Power Ratio (PAPR) of the transmitted signals.

CN Core Network. The part of the 3GPP system which is independent of the connection technology (e.g. the Radio Access Technology (RAT)) of the terminals. The terminals connect to the core network via the access network (which is RAT-specific).

COFDM Coded Orthogonal Frequency Division Multiplexing. An OFDM scheme associated with a Forward Error Correction (FEC) code.

CP Cyclic Prefix. A set of samples which are duplicated from the end of a transmitted symbol and appended cyclically to the beginning of the symbol. This can form a type of guard interval to absorb Inter-Symbol Interference (ISI). The cyclic construction preserves orthogonality of the subcarriers in an OFDM transmission.

CPICH Common PIlot CHannel. A Wideband Code Division Multiple Access (WCDMA) downlink physical channel transmitted from every NodeB to provide the default phase reference for demodulation of the other downlink channels. It is used for signal quality measurements for handover from an LTE cell to a WCDMA cell. See 3GPP TS25.211 Section 5.3.3.

CPICH Ec/No Common PIlot CHannel (CPICH) Ec/No. The CPICH received energy per chip divided by the noise power density in the band. A measurement used for handover to Wideband Code Division Multiple Access (WCDMA) cells. See 3GPP TS25.215 Section 5.1.5.

C-plane Control-plane. Carries signalling (for example for Radio Resource Control (RRC)), as opposed to user data, which is carried by the User-plane (U-plane). See 3GPP TS36.300 Section 4.3.2.

CPT Control Protocol Data Unit Type. A field in the header of LTE Radio Link Control (RLC) Control Protocol Data Units (PDUs), indicating the type of the RLC Control PDU. In Release 8, the only type of RLC Control PDU defined is the STATUS PDU; the CPT field allows more types to be defined in a later release. See 3GPP TS36.322 Section 6.2.1.6.

CQI Channel Quality Indicator. Information signalled by a UE to the base station to indicate a suitable data rate (typically a Modulation and Coding Scheme (MCS) value) for downlink transmissions, usually based on a measurement of the received downlink Signal to Interference plus Noise Ratio (SINR) and knowledge of the UE's receiver characteristics. See 3GPP TS36.213 Section 7.2.3.

CR Change Request. A formal description of a proposed or agreed change to a 3GPP specification. Any change to a 3GPP specification v3.0.0 or above needs to be formulated and agreed by means of a CR.

CRC Cyclic Redundancy Check. An error detecting code appended to a block of data to be transmitted. The value of the CRC is calculated only from the block of data itself. The length of the CRC determines the number of errors which can be detected in the block of data on reception. A CRC is not able to correct errors or determine which bits are erroneous.

C-RNTI Cell Radio Network Temporary Identifier. A UE identifier allocated by an eNodeB and unique within one cell controlled by that eNodeB. The C-RNTI can be reallocated when a UE moves to a new cell. See 3GPP TS36.321 Section 7.1.

CS Circuit Switched. A CS connection reserves dedicated transmission resources for data transfer at a fixed rate for the duration of the communication session. The reserved resources are not accessible to any other user.

CSFB Circuit Switched FallBack. CSFB in the Evolved Packet System (EPS) enables the provisioning of voice and other CS-domain services by reuse of GSM/EDGE Radio Access Network (GERAN) or UTRAN CS infrastructure when the UE is served by E-UTRAN. This function is only available if E-UTRAN coverage is overlapped by GERAN or UTRAN coverage.

CSG Closed Subscriber Group. A set of subscribers who are permitted to access a particular cell to which access is restricted. See 3GPP TS25.367 and TS36.304.

CSI Channel State Information. A general term for information describing characteristics of the radio channel, typically indicating the complex transfer function matrix between one or more transmit antennas and one or more receive antennas.

CSIT Channel State Information at the Transmitter. Channel State Information (CSI) which is available at the transmitter side of the channel, for example as a result of feedback signalling from the receiver (closed loop) or open loop estimation exploiting reciprocity.

CTF Channel Transfer Function. A set of coefficients describing the complex impulse response (or frequency-domain characteristic) of a radio channel from one or more transmit antennas to one or more receive antennas.

CW Continuous-Wave. An unmodulated Radio Frequency (RF) carrier of constant amplitude and frequency, used to model interference in some RF performance requirements. See 3GPP TS36.101.

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d.c. direct current. In general, a signal of fixed polarity (i.e. non-oscillating). Used to refer to the subcarrier corresponding to zero-frequency in a baseband Orthogonal Frequnecy Domain Multiplexed (OFDM) signal.

DAC Digital to Analogue Converter. A processor which converts a sampled, quantized digital input signal into a continuous-time analogue-valued output signal.

DAI Downlink Assignment Index. A field in the downlink resource grant signalled to a UE, indicating how many subframes in a previous time window have contained transmissions to that UE. This is applicable only when LTE is operated in Time Domain Duplex (TDD) mode, and enables the UE to determine whether it has received all the downlink transport blocks for which it should transmit a combined ACKnowledgement/Negative ACKnowledgement (ACK/NACK). See 3GPP TS36.213 Section 7.3.

DCCH Dedicated Control CHannel. In LTE, a logical channel used to deliver dedicated control information relating to a specific UE (in both uplink and downlink directions), when the UE has a Radio Resource Control (RRC) connection with the eNodeB. See 3GPP TS36.321.

DCI Downlink Control Information. The term used to describe the control signalling messages transmitted on the Physical Downlink Control CHannel (PDCCH), including for example downlink resource assignments (for the Physical Dwonlink Shared CHannel (PDSCH)) and uplink transmission grants (for the Physical Uplink Shared CHannel (PUSCH)). See 3GPP TS36.212 Section 5.3.3.

DFT Discrete Fourier Transform. A transformation which acts on a sampled time-domain signal of finite duration to give the corresponding series of frequency-domain components. For a series of time-domain samples $x_0, \ldots, x_{N-1}$, the DFT $X_0, \ldots, X_{N-1}$ is given by $X_k = \sum_{n=0}^{N-1} x_n e^{-j\frac{2\pi kn}{N}}$.

DFT-S-OFDM Discrete Fourier Transform- Spread- Orthogonal Frequency Division Multiplexing. A transmission scheme similar to Orthogonal Frequency Division Multiplexing (OFDM), but with a Discrete Fourier Transform (DFT) precoding stage applied before the Inverse Fast Fourier Transform (IFFT) at the transmitter, resulting in a single-carrier signal with significantly lower Peak to Average Power Ratio (PAPR) than OFDM. It is also known as Single Carrier-Frequency Division Multiplexing (SC-FDM), and is the basis of the LTE uplink.

DHCP Dynamic Host Configuration Protocol. A protocol used to allocate Internet Protocol (IP) addresses and other configuration parameters to devices in an IP network. See IETF RFC1531, www.ietf.org.

Diffserv Differentiated Services. Diffserv is a coarse-grained mechanism for classifying data traffic into classes depending on the Quality of Service (QoS) requirements of each data traffic flow. It facilitates interoperability between different networks, enabling data from each class to be handled with appropriate priority and latency. See IETF RFC2475, www.ietf.org.

DL DownLink. The radio link in the direction from the base station to the mobile terminal.

DL-SCH DownLink Shared CHannel. An LTE transport channel used to transport downlink user data or Radio Resource Control (RRC) messages, as well as system information which are not transported via the Broadcast CHannel (BCH). See 3GPP TS36.321.

DM RS DeModulation Reference Signal. Reference Signals (RS) which are embedded in the Physical Uplink Control CHannel (PUCCH) and Physical Uplink Shared CHannel (PUSCH) transmissions to provide the phase reference for demodulation of the PUCCH/PUSCH data. See 3GPP TS36.211 Section 5.5.2.

DoA Direction of Arrival. The angle (usually azimuth) from which a signal arrives relative to a reference angle of an antenna array.

DRA Dynamic Resource Allocation. The process of assigning resource blocks to different radio bearers in each subframe. This function is managed by the eNodeB. See 3GPP TS36.300 Section 16.1.4.

DRB Data Radio Bearer. A radio bearer which carriers user data as opposed to control plane signalling.

DRX Discontinuous Reception. The periodic switching off of a receiver, usually to save energy. DRX cycles can be configured in the LTE downlink so that the UE does not have to decode the Physical Downlink Control CHannel (PDCCH) or receive Physical Downlink Shared CHannel (PDSCH) transmissions in certain subframes. See 3GPP TS36.321 Section 5.7 for connected mode, and TS36.304 Section 7.1 for idle mode.

DSAC Domain Specific Access Control. A mechanism which allows the utilization of a specific Core Network (CN) domain resource while another domain is restricted, for example when a natural disaster occurs. See 3GPP TR23.898.

DS-CDMA Direct Sequence- Code Division Multiple Access. A method of Code Division Multiple Access (CDMA) whereby the signal of each user is spread in frequency by multiplying it by a wideband code sequence of 'chips'. This is used in UMTS.

DSP Digital Signal Processor. A processor for manipulating digital signals.

DTCH Dedicated Traffic CHannel. A logical channel used in LTE to deliver dedicated user data for a specific UE (in both uplink and downlink directions). See 3GPP TS36.321.

DTX Discontinuous Transmission. The periodic switching off of a transmitter, usually to save energy.

DUT Device Under Test. Typically refers to a device undergoing conformance testing.

DwPTS Downlink Pilot TimeSlot. A special downlink timeslot occurring in the second (and in some configurations the 7^{th}) subframe of each radio frame when LTE is operated in Time Division Duplex (TDD). Its length is variable, to allow for different DownLink (DL) – UpLink (UL) switching periods to be configured. The name DwPTS originates from Time Division Synchronous Code Division Multiple Access (TD-SCDMA). See 3GPP TS36.211 Section 4.2.

E Extension bit. A bit used in the header of Radio Link Control Protocol Data Units (RLC PDU), to indicate whether a data field or further header information follows. See TS36.322 Section 6.2.2.4.

EARFCN E-UTRA Absolute Radio Frequency Channel Number. See ARFCN.

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eBMSC evolved Broadcast-Multicast Service Centre. The interface between external broadcast/multicast content providers and the core network in LTE / System Architecture Evolution (SAE). See 3GPP TS36.300 Section 15.1.1.

ECGI E-UTRAN Cell Global Identifier. The globally unique identity of a cell in E-UTRA.

ECI E-UTRAN Cell Identifier. Used to identify a cell uniquely within a Public Land Mobile Network (PLMN). The ECI has a length of 28 bits and contains the eNodeB-IDentifier (eNB-ID). The ECI can address either 1 or up to 256 cells per eNodeB, depending on the length of the eNB-ID. See 3GPP TS36.300 Section 8.2.

ECM Evolved Packet System Connection Management. A Non-Access Stratum (NAS) state which reflects the connectivity (either 'Idle' or 'Connected') of a UE with the Evolved Packet Core (EPC).

EEA Evolved Packet System Encryption Algorithm. Used for ciphering, this may be either Advanced Encryption Standard (AES), SNOW 3G or null. All algorithms use a 128-bit input key. See 3GPP TS33.401.

EEC Ethernet Equipment Clock. The clock used for synchronizing network equipment that uses synchronous ethernet. The requirements for such clocks are specified by International Telecommunication Union (ITU) recommendations G.8262/Y.1362. See www.itu.int/itu-t.

EESM Exponential Effective Signal to Interference plus Noise Ratio Mapping. A method for predicting an SINR level which in an Additive White Gaussian Noise (AWGN) channel would give equivalent demodulation performance to that of a frequency-selective channel whose per subcarrier SINR values are known. The technique is particularly useful for evaluating the BLock Error Rate (BLER) performance of multicarrier transmission schemes. The effective SINR, γ_{eff}, is given by $\gamma_{\text{eff}} = -\beta \cdot \ln\left(\frac{1}{N}\sum_{k=1}^{N} e^{-\frac{\gamma_k}{\beta}}\right)$, where N is the number of subcarriers, γ_k is the SINR for the k^{th} subcarrier, and β is a parameter determined by link-level simulation.

EHPLMN Equivalent Home Public Land Mobile Network. Any PLMN which is listed in the Universal Subscriber Identity Module (USIM) of a mobile terminal as being equivalent to the Home PLMN (HPLMN). Any EHPLMN is treated as the HPLMN in all network and cell selection procedures. See 3GPP TS22.011 Section 3.2.2.1.

EIA Evolved Packet System Integrity Algorithm. Used for integrity protection of Radio Resource Control (RRC) and Non-Access Stratum (NAS) signalling, this may be either Advanced Encryption Standard (AES) or SNOW 3G. Both algorithms use a 128-bit input key. See 3GPP TS33.401.

EIR Equipment Identity Register. Stores the International Mobile Equipment Identities (IMEIs) of mobile stations in the GERAN/UTRAN/E-UTRAN systems, either white-listed, grey-listed or black-listed. It allows a mobile terminal's identity to be checked for blacklisting, e.g. for stolen or known-to-be-faulty terminals. See 3GPP TS23.002 Section 4.1.1.4.

EMC ElectroMagnetic Compatibility. EMC between two pieces of equipment implies that each is not unduly affected by electromagnetic radiation emitted by the other. Electromagnetic compatibility may be achieved by control of emissions, or control of susceptibility to emissions, or both.

EMM Evolved Packet System Connection Management. A Non-Access Stratum (NAS) state which reflects whether a UE is registered with the Mobile Management Entity (MME) – either 'registered' or 'deregistered'. See 3GPP TS24.301 Section 5.

eNB see eNodeB.

eNB-ID evolved NodeB IDentifier. Used to identify an eNodeB uniquely within a Public Land Mobile Network (PLMN). The eNB-ID can have either 20 bits or 28 bits. It is also comprised within the Global eNB-ID, which uniquely identifies an eNodeB globally. The Global eNB-ID is constructed from the Mobile Country Code (MCC), Mobile Network Code (MNC) and eNB-ID. See 3GPP TS36.300 Section 8.2.

eNodeB evolved NodeB. The base station in LTE systems. Each eNodeB serves one or more E-UTRAN cells.

EP Elementary Procedure. A basic interaction between two nodes (such as two eNodeBs via the X2 interface, or between an eNodeB and the Evolved Packet Core (EPC) via the S1 interface. An EP consists of an initiating message and sometimes a response. An example of an EP over the X2 interface is Handover Preparation. See 3GPP TS36.413 and TS36.423.

EPA Extended Pedestrian A. A propagation channel model based on the International Telecommunication Union (ITU) Pedestrian A model, extended to a wider bandwidth of 20 MHz. The pedestrian channel model represents a UE speed of 3 km/h, while the vehicular model (Extended Vehicular A (EVA)), represents UE speeds higher than 30 km/h.

EPC Evolved Packet Core. The Core Network (CN) in the LTE / System Architecture Evolution (SAE) system. The EPC is responsible for the overall control of the UE and establishment of the bearers. The main logical nodes of the EPC are the Packet Data Network GateWay (P-GW), Serving-GateWay (S-GW) and Mobility Management Entity (MME).

EPRE Energy Per Resource Element. The transmitted energy per Resource Element (RE).

EPS Evolved Packet System. The term describing LTE and System Architecture Evolution (SAE) together, comprising both an evolved core network and an evolved radio access network.

E-RAB E-UTRAN Radio Access Bearer. The concatenation of an S1 bearer and the corresponding radio bearer. See 3GPP TS23.401 Section 4.7.2.2.

ESD Electrostatic discharge. A sudden transfer of electric charge between two objects in close proximity, due to the two objects being at different relative potentials. ESD can cause failure of semiconductor devices. Base stations and UEs are tested for their ability to withstand ESD. See for example 3GPP TS36.113 Section 9.4 and TS36.124 Section 9.3.

ESM Evolved Packet System Session Management. A Non-Access Stratum (NAS) state which reflects whether an EPS bearer context is active or inactive. See 3GPP TS24.301 Section 6.

ESP Encapsulating Security Payload. The ESP header is part of the Internet Protocol Security (IPsec) suite of Internet Engineering Task Force (IETF) protocols. It is designed to provide security services in IPv4 and IPv6, including origin authenticity, integrity, and encryption for data packets. See IETF RFC2406, www.ietf.org.

E-TM E-UTRA Test Model. A test model used for LTE conformance testing. See 3GPP TS36.141, Section 6.1.1.

ETSI European Telecommunications Standards Institute. The European Standards Development Organisation (SDO) in 3GPP. See www.etsi.org.

ETU Extended Typical Urban. A propagation channel model based on the GSM Typical Urban model, extended to a wider bandwidth of 20 MHz. It models a scattering environment which is considered to be typical in a urban area.

ETWS Earthquake and Tsunami Warning System. A type of Public Warning System that broadcasts warnings of earthquakes and tsunamis to any UE which is capable of receiving them. The warnings are initiated by Warning Notification Providers, and delivered by means of cell broadcast messages. The information provided can include the type of emergency, as well as advice on action to take. See 3GPP TS23.828 and TS22.268.

EUT Equipment Under Test. Typically refers to equipment undergoing conformance testing.

E-UTRA Evolved Universal Terrestrial Radio Access. The LTE radio access technology.

E-UTRAN Evolved Universal Terrestrial Radio Access Network. Consists of eNodeBs, providing the User-plane (Packet Data Convergence Protocol (PDCP), Radio Link Control (RLC), Medium Access Control (MAC) and PHYsical (PHY) layers) and Control-plane (Radio Resource Control (RRC)) protocol terminations towards the UE. The eNodeBs can be interconnected with each other by means of the X2 interface. The eNodeBs are connected by means of the S1 interface to the Evolved Packet Core (EPC). See 3GPP TS23.002 Section 4.2.3.2.

EVA Extended Vehicular A. A propagation channel model based on the International Telecommunication Union (ITU) Vehicular A model, extended to a wider bandwidth of 20 MHz. The vehicular channel model represents UE speeds of 30, 120 km/h and higher, while the pedestrian model (Extended Pedestrian A (EPA)), represents a UE speed of 3 km/h.

EVM Error Vector Magnitude. A measure of the distortion introduced in a transmitted signal by the Radio Frequency (RF) imperfections of practical implementations. It is defined as the square root of the ratio of the mean error vector power between a reference signal (i.e. the signal defined by the physical layer specification equations) and the actual transmitted signal, normalized by the mean reference signal power, expressed as a percentage. See 3GPP TS36.101 Section 6.5.2.1 and TS36.104 Section 6.5.2.

FDD Frequency Division Duplex. A mode of bidirectional communication in which transmission and reception take place at the same time on different carrier frequencies.

FDE Frequency-Domain Equalizer. An equalizer which compensates for the transfer function of the radio propagation channel by filtering the received signal in the frequency domain. An FDE provides a low-complexity means for compensating frequency-selective channel gains for an Orthogonal Frequency Division Multiplexed (OFDM) signal.

FDM Frequency-Division Multiplexing. A method of multiplexing different data signals for transmission on a single communications channel, whereby each signal is assigned a non-overlapping frequency range within the main channel.

FDMA Frequency Division Multiple-Access. FDMA is an access method allowing multiple users to share the same frequency band by subdividing the band into different frequency channels. Each user is allocated a different frequency channel, thus allowing them to utilize the allocated radio spectrum without interfering with each other.

FDSS Frequency Domain Spectral Shaping. A pulse-shaping filtering process implemented in the frequency domain by element-wise multiplication of the filter coefficients and the spectrum of a transmitted signal.

FEC Forward Error Correction. A type of digital signal processing which improves data reliability by introducing parity information (redundancy) into a data sequence prior to transmission. This enables a receiver to detect and correct transmission errors.

FFS For Further Study. A term used in 3GPP to indicate that a topic will be discussed further, and any agreements will be based on further analysis.

FFT Fast Fourier Transform. An efficient algorithm to compute the Discrete Fourier Transform (DFT) and its inverse. Many such algorithms exist, but the most popular is the Radix-2 Cooley-Tukey which requires the number of points in the input sequence to be a power of 2.

FI Framing Info. A field in a Radio Link Control (RLC) Protocol Data Unit (PDU) header, which indicates whether the RLC Service Data Units (SDU) at the beginning and/or end of the Data field are segmented — i.e. it indicates whether the first byte of the Data field corresponds to the first byte of an RLC SDU, and whether the last byte of the Data field corresponds to the last byte of a RLC SDU. See 3GPP TS36.322 Section 6.2.2.6.

FIR Finite Impulse Response. The impulse response is a filter's response to a Kronecker delta input. The impulse response is said to be 'finite' when it settles to zero in a finite number of samples.

FMS First Missing Service Data Unit. The Sequence Number (SN) of the first missing Packet Data Convergence Protocol (PDCP) Service Data Unit (SDU). It is used in a PDCP Status Report to indicate which PDCP SDUs need to be retransmitted in a lossless handover. See 3GPP TS36.323 Section 6.3.9.

FQDN Fully Qualified Domain Name. An FQDN may be included in the identity of a Packet Data Network GateWay (PDN-GW). It is used to derive the Internet Protocol (IP) address of the PDN-GW by means of the Domain Name Service (DNS) function, taking into account the protocol type on the S5/S8 interfaces. See 3GPP TS23.003 Section 19.4.2.

FRC Fixed Reference Channel. A set of parameters used to describe a configuration for packet-based performance evaluation of 3GPP systems in which the adaptation of modulation and coding rate is in principle possible (e.g. LTE or HSDPA). In a FRC test, the modulation and coding scheme are fixed, i.e. they are not adapted based on UE feedback. The performance requirements specify minimum throughput which is to be met under this condition. See 3GPP TS36.101 Sections 8.2.1, 8.2.2, A.3.

FS Frame Structure. The term used to describe the pattern of subdivisions of radio frames in the time domain. In LTE, the frame structure can be type 1 or type 2; type 1 is applicable to both full duplex and half duplex Frequency Division Duplex (FDD), while type 2 is applicable to Time Division Duplex (TDD). See 3GPP TS36.211 Section 4.

FSTD Frequency Switched Transmit Diversity. General FSTD schemes transmit symbols from each antenna on a different set of subcarriers. In LTE, FSTD is only used in combination with Space Frequency Block Codes (SFBC) for the case of 4 transmit antennas at the eNodeB, in order to provide a suitable transmit diversity scheme where no orthogonal rate-1 block code exists. See 3GPP TS36.211 Section 6.3.4.3.

FTP File Transfer Protocol. A communication protocol used to exchange files through a Transmission Control Protocol / Internet Protocol (TCP/IP) network. See IETF RFC959, www.ietf.org.

GBR Guaranteed Bit Rate. A minimum bit rate requested by an application. In LTE, minimum GBR bearers and non-GBR bearers may be provided. Minimum GBR bearers are typically used for applications like Voice over Internet Protocol (VoIP), with an associated GBR value; higher bit rates can be allowed if resources are available. Non-GBR bearers do not guarantee any particular bit rate, and are typically used for applications as web-browsing. See 3GPP TS36.300 Sections 11.4 and 13.

GCL Generalized Chirp-Like sequences, better known as Zadoff-Chu (ZC) sequences. These are polyphase, non-binary unit-amplitude sequences which satisfy a Constant Amplitude Zero Autocorrelation (CAZAC) property. Such sequences exist for both odd and even sequence lengths. They are used in a number of instances in LTE, including the Random Access CHannel (RACH) and the uplink reference signals.

GERAN GSM/EDGE Radio Access Network. The radio part of GSM/EDGE, together with the network that connects the base stations and the base station controllers. GERAN also refers to a Technical Specification Group (TSG) within 3GPP which maintains and develops the GSM/EDGE specifications. See 3GPP TS43.051.

GGSN Gateway GPRS Support Node. A network node that acts as a gateway between a GPRS wireless data network and other networks. The GGSN stores subscriber data received from the Home Location Register (HLR) and the Serving GPRS Support Node (SGSN), as well as the address of the SGSN where each mobile station is registered. See 3GPP TS23.002 Section 4.1.3.2.

GNSS Global Navigation Satellite System. A general term for a satellite-based positioning system, consisting of a network of satellites transmitting high-frequency radio signals that can be picked up by a receiver and used to determine its location. Examples include GPS, GLONASS and Galileo.

GP Guard Period. A time period used to prevent overlap between two different signals. It may consist of a transmission gap or be filled with a signal whose correct reception is not essential. In LTE half-duplex Frequency Division Duplex (FDD) operation, a guard period is created by the UE by not receiving the last part of a downlink subframe immediately preceding an uplink subframe from the same UE. In Time Division Duplex (TDD) or half-duplex FDD systems, a guard period is used to prevent overlap between transmission and reception. See for example TS 36.211, Sections 6.2.5 and 6.2.6. In Orthogonal Frequency Division Multiplexed (OFDM) transmissions, a guard period filled with a cyclic prefix is used at the start of each data symbol to prevent Inter-Symbol Interference (ISI).

GPRS General Packet Radio Service. A mobile data service extension to the GSM system. It is often described as “2.5G”. See 3GPP TS43.064 and TS23.060.

GRE Generic Routing Encapsulation. Used for Proxy Mobile Internet Protocol (PMIP)-based S5/S8 at the Packet Data Network GateWay (PDN-GW) for uplink traffic. See IETF RFC2784, www.ietf.org.

GSM Global System for Mobile communications. A globally-deployed standardized digital mobile communication system, considered to be a second generation (“2G”) system. The specifications are maintained and developed by 3GPP. See www.3gpp.org.

GSN GPRS Support Node. A network node which supports the use of the GPRS in the Core Network (CN). See TS 23.401.

GTP GPRS Tunnelling Protocol. An Internet Protocol (IP)-based protocol used in GSM, UMTS and LTE networks. It consists of GTP for both User plane and Control plane (GTP-U and GTP-C respectively). See 3GPP TS29.274 for GTP within LTE networks.

GTP-C GTP-Control plane. This protocol tunnels signalling messages between the Serving GPRS Support Node (SGSN) and Mobility Management Entity (MME) over the S3 interface, between the SGSN and Serving Gateway (S-GW) over the S4 interface, between the S-GW and P-GW over the S5/S8interface, and betweens MMEs over the S10 interface. See 3GPP TS 23.401 Section 5.1.1.

GTP-U GTP-User plane. This protocol tunnels user data between the eNodeB and the Serving GateWay (S-GW), as well as between the S-GW and the Packet Data Network GateWay (P-GW) in the backbone network. GTP encapsulates all end user Internet Protocol (IP) packets. See 3GPP TS23.401 Section 5.1.2.1.

GUMMEI Globally Unique Mobility Management Entity Identifier. This consists of a Public Land Mobile Network (PLMN) identity, a Mobility Management Entity (MME) group identity and an MME code. The MME code is used in the eNodeB by the Non-Access Stratum (NAS) node selection function to select the MME. See 3GPP TS36.401 Section 6.2.3.

GUTI Globally Unique Temporary Identity. This is an unambiguous identification of the UE that does not reveal the UE or the user's permanent identity in the Evolved Packet System (EPS). It also allows the identification of the Mobility Management Entity (MME) and network. It can be used by the network and the UE to establish the UE's identity during signalling between them in the EPS. See 3GPP TS23.003 Section 2.8.

GW GateWay. A logical node in the Evolved Packet Core (EPC) network. GW nodes in the EPC include the Packet Data Network Gateway (P-GW), the Serving Gateway (S-GW) and the Multimedia Broadcast and Multicast Service (MBMS) GW. See 3GPP TS36.300.

HARQ Hybrid ARQ. The simultaneous combination of Automatic Retransmission reQuest (ARQ) and Forward Error Correction (FEC). It enables the overhead of error correction to be adapted dynamically depending on the channel quality. When HARQ is used, if the errors can be corrected by FEC then no retransmission is requested; if the errors can be detected but not corrected, a retransmission is requested.

HARQ ACK/NACK HARQ ACKnowledgement/Negative ACKnowledgement information. The information a receiver feeds back to the transmitter in order to acknowledge the correct reception of a packet or ask for a new retransmission. See 3GPP TS36.212 Section 5.2.3.1.

HD-FDD Half-Duplex Frequency Division Duplex. A duplex scheme whereby the uplink and downlink use different frequencies but not simultaneously, so as to avoid the need for a duplex filter in the receiver. It is not necessarily applicable in all frequency bands. See 3GPP TS36.211 Section 4.1.

HE Home Environment. The HE of a subscriber is responsible for the overall provision and control of the personal service environment to the subscriber.

HFN Hyper Frame Number. A number which is incremented each time the Packet Data Convergence Protocol (PDCP) Sequence Number (SN) wraps around. It is used for bearers which require in-sequence delivery, and as part of the PDCP Protocol Data Unit (PDU) counter for ciphering. It is assigned by the target eNodeB. See 3GPP TS36.323 Section 6.3.5.

HI HARQ Indicator. The indicator carried by the Physical Hybrid ARQ Indicator CHannel (PHICH) which indicates whether the eNodeB has correctly received a transmission on the Physical Uplink Shared CHannel (PUSCH). The indicator is set to 0 for a positive ACKnowledgement (ACK) and 1 for a Negative ACKnowledgement (NACK). See 3GPP TS36.212 Section 5.3.5.

HII High Interference Indicator. An indicator sent on the X2 interface between eNodeBs to indicate which resource blocks will be used for cell-edge UEs. See 3GPP TS36.423 Section 9.2.18.

HLR Home Location Register. The HLR can be considered to be a subset of the Home Subscriber Server (HSS) that supports the Packet Switched (PS) domain entities such as the Serving GPRS Support Node (SGSN), Mobile Management Entity (MME) and Gateway GPRS Support Node (GGSN). It also supports the Circuit Switched (CS) domain entities such as the Mobile Switching Centre (MSC). It is needed to enable subscriber access to services and to support roaming to legacy GSM/UMTS networks. See 3GPP TS23.002 Section 4.1.1.1.1.

HNBID Home eNodeB IDentifier. A free-text name to identify a Home NodeB or Home eNodeB, to aid the user in selecting the correct Closed Subscriber Group (CSG) cell when making a manual selection. See 3GPP TS22.011 Section 8.4.2 and 36.331 Section 6.3.1.

HO HandOver. HO is a procedure by which a mobile terminal changes serving cells (within the same frequency or on different frequencies or even on different Radio Access Technologies (RAT)). See 3GPP TS36.133.

H-PCRF Home Policy and Charging Rules Function. A functional element that encompasses policy and charging control decision functionalities in the Home Public Land Mobile Network (HPLMN) and in a Visited PLMN (VPLMN). H-PCRF includes functionality for both home-routed access and visited access (local breakout). See 3GPP TS23.203 Section 6.2.1.4.

HPLMN Home Public Land Mobile Network. A Public Land Mobile Network (PLMN) where the Mobile Country Code (MCC) and Mobile Network Code (MNC) of the PLMN identity are the same as the MCC and MNC of the International Mobile Subscriber Identity (IMSI) or the defined Equivalent HPLMN (EHPLMN). See 3GPP TS36.304 Section 3.1.

HRPD High Rate Packet Data. Also known as 1xEV-DO, HRPD is a packet data enhancement to the CDMA2000 Radio Access Technology (RAT). Inter-RAT handover performance requirements for an LTE UE to move to an HRPD cell are defined in 3GPP TS36.133.

HSDPA High-Speed Downlink Packet Access. A feature introduced in Release 5 of UMTS to improve downlink packet data transmission.

HSPA High-Speed Packet Access. The marketing term encompassing both HSDPA and HSUPA enhancements to Wideband Code Division Multiple Access, sometimes considered to be "3.5G".

HSPA+ High-Speed Packet Access Evolution. Corresponds to further enhancements to HSDPA and HSUPA beyond Release 7.

HSS Home Subscriber Server. The entity containing the subscription-related information to support the network entities handling calls/sessions. See 3GPP TS23.002 Section 4.1.1.1.

HSUPA High-Speed Uplink Packet Access. A feature introduced in Release 6 of UMTS to improve uplink packet data transmission.

HTTP Hyper Text Transfer Protocol. A client-server communication protocol developed for World Wide Web. See IETF RFC2616, www.ietf.org.

IANA Internet Assigned Number Authority. The body responsible for the global coordination of the Domain Name System (DNS) Root, Internet Protocol (IP) addressing, and other Internet protocol resources. See www.iana.org.

ICI Inter-Carrier Interference. The interference between symbols transmitted on different (usually adjacent) subcarriers in an Orthogonal Frequency Division Multiplexing (OFDM) signal. It arises from a loss of inter-subcarrier orthogonality, for example due to a lack of synchronization accuracy or a large channel delay spread (larger than the Cyclic Prefix (CP)).

ICIC Inter-Cell Interference Coordination. Techniques for the reduction of interference between cells, relying on exchange of information (for example on transmission resource scheduling) between different cells. ICIC techniques typically involve constraints on transmission resource allocations and/or power levels. In LTE ICIC may be static or semi-static, with different levels of associated communication required between eNodeBs.

ICS In-Channel Selectivity. A measure of a receiver's ability to receive a wanted signal at its assigned resource block locations in the presence of a co-channel interfering signal received at a larger power spectral density. Under this condition a throughput requirement has to be met for a specified reference measurement channel. See 3GPP TS36.141 Sections 7.4 and I.2.3, TS36.104 Section 7.4.1.

ICS Implementation Conformance Statement. A statement made by the supplier of an implementation or system claimed to conform to a given specification, stating which capabilities have been implemented. See 3GPP TS36.521-2.

ID IDentity.

IDFT Inverse Discrete Fourier Transform. An IDFT transforms a finite frequency-domain sequence into a finite time-domain sequence. It is the inverse of the Discrete Fourier Transform (DFT). An IDFT can be efficiently computed via an Inverse Fast Fourier Transform (IFFT).

IDNNS Intra-Domain Non-Access Stratum Node Selector. An information element provided in the Access Stratum (AS) part of the UTRAN Radio Resource Control (RRC) 'Initial Direct Transfer' message. It contains a routing parameter which can be used to route the establishment of a signalling connection to a Core Network (CN) node within a CN domain. See 3GPP TS25.331 Section 10.3.1.6 and TS23.236 Section 4.3.

IE Information Element. A parameter contained within a signalling message (e.g. Radio Resource Control (RRC)).

IETF Internet Engineering Task Force. A large open international community of network designers, operators, vendors and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet. See www.ietf.org.

IFDMA Interleaved Frequency Division Multiple Access. A particular case of Orthogonal Frequency Division Multiple Access (OFDMA) in which each user is assigned a set of non-contiguous subcarriers, typically equally-spaced and interleaved with the sets assigned to other users. This gives more frequency diversity than a set of contiguous subcarriers. In LTE it is used for the uplink Sounding Reference Signals (SRS). See 3GPP TS36.211 Section 5.5.3.2.

IFFT Inverse Fast Fourier Transform. The inverse of the Fast Fourier Transform (see FFT).

IM Implementation Margin. A margin taken into account in the performance requirements in order to allow for losses due to the non-idealities of practical implementations.

IMD InterModulation Distortion. Signal distortion which results when two or more signals are present at the input of a non-linear device such as an amplifier in a receiver. Intermodulation products generated from mixing with a tone outside the wanted band may fall into the wanted band and cannot be removed by filtering. For performance requirements which constrain the permissible IMD, see 3GPP TS36.101 Sections 6.7 and 7.8, TS36.521-1 Sections 6.7 and 7.8, TS36.104 Sections 6.7 and 7.8 and TS36.141 Sections 6.7, 7.8, I.1 and I.2.

IMEI International Mobile Equipment Identity. A unique number which is allocated to each individual mobile station. It is implemented by the mobile station manufacturer. See 3GPP TS 22.016.

IMEISVN International Mobile Equipment Identity Software Version number. This field allows the mobile equipment manufacturer to identify different software versions of a given mobile. The software version number is a separate field from the International Mobile Equipment Identity (IMEI), although it is associated with the IMEI. When the network requests the IMEI from the mobile subscriber, it may also request that the software version number is sent to the network. See 3GPP TS22.016.

IMS Internet Protocol Multimedia Subsystem. An architectural framework for delivering Internet Protocol (IP) multimedia services via UTRAN and E-UTRAN. See 3GPP TS23.228 and TS23.406.

IMSI International Mobile Subscriber Identity. A unique number associated with each mobile phone user. It is stored in the SIM inside the phone and is sent by the phone to the network. It is primarily intended for obtaining information on the use of the Public Land Mobile Network (PLMN) by subscribers. It is also used for other functions such as to compute the Paging Occasions (PO) in LTE. See 3GPP TS22.016 and TS23.003.

IMT International Mobile Telecommunications. The name given to families of standards defined by the International Telecommunication Union (ITU) to satisfy a certain set of requirements, for example in terms of data rate and mobility. Examples are IMT-2000, which encompasses third generation (3G) wireless communication systems, and IMT-Advanced which is designed to encompass the next major generation of systems.

IOV-UI Input Offset Value - Unconfirmed Information. Used in the GPRS ciphering process. It consists of a random 32-bit value generated by the Serving GPRS Support Node (SGSN). IOV-UI is intended for Unconfirmed Information frames, which carry information between Logical Link Control (LLC) entities of the GPRS mobile station to SGSN link. This parameter is involved in the E-UTRAN to GERAN inter- Radio Access Technology (inter-RAT) handover preparation phase. See 3GPP TS44.064 Sections 8.9.2 and 6.3.3, and TS23.401 Section 5.5.2.3.2.

IP Internet Protocol. A protocol which provides for transmitting blocks of data from sources to destinations over an interconnected system of networks (the internet). The sources and destinations are identified by fixed-length addresses. See IETF RFC791, www.ietf.org.

IP-CAN Internet Protocol Connectivity Access Network. The collection of network entities and interfaces that provides the underlying Internet Protocol (IP) transport connectivity between a UE and the IP Multimedia Subsystem (IMS)..

IQ In-phase - Quadrature phase. The in-phase signal and quadrature signal are the signals modulating the cosine and sine of the complex carrier-frequency waveform.

IR Incremental Redundancy. A type of Hybrid Automatic Repeat reQuest (HARQ) scheme where the code rate is progressively reduced by transmitting additional parity information with each retransmission. At each retransmission the receiver thus acquires extra information, and the probability of correct decoding increases. See 3GPP TS36.212 Section 5.1.4.

IRC Interference Rejection Combining. An IRC receiver calculates and applies a set of antenna weights in the receiver to maximize the Signal to Interference plus Noise Ratio (SINR) of the signal post-combining, taking into account the instantaneous direction of arrival of the wanted and interfering signals.

IRV Incremental Redundancy Version. A particular set of systematic and parity bits used for retransmission when an Incremental Redundancy (IR) Hybrid Automatic Repeat reQuest (HARQ) protocol is implemented. In LTE, circular buffer Rate Matching (RM) is used, which generates puncturing patterns for any arbitrary code rate. The IRV specifies a starting point in the circular buffer to start reading out the bits . See 3GPP TS36.212 Section 5.1.4.

ISD Inter-Site Distance. The distance between two eNodeBs in the network. Some indication of the effect of different values of ISD on the LTE system performance can be found in 3GPP TR36.942.

ISI Inter-Symbol Interference. A form of distortion of a signal in which one symbol interferes with subsequent symbols. ISI is usually caused by frequency selectivity in the propagation channel, giving rise to time-domain dispersion.

ISR Idle state Signalling Reduction. Provides a mechanism to limit signalling during inter- Radio Access Technology (inter-RAT) cell reselection in idle mode. In particular, it aims at reducing the frequency of Tracking Area Update (TAU) and Routing Area Update (RAU) procedures caused by UEs reselecting between E-UTRAN and GERAN/UTRAN. See 3GPP TS23.401 Annex J.

ITU International Telecommunication Union. The leading United Nations agency for information and communication technology issues, and the global focal point for governments and the private sector in developing networks and services. See www.itu.int.

ITU-R International Telecommunication Union Radiocommunication sector. The primary role of the Radiocommunication sector of the ITU is to manage the radio spectrum to ensure interference-free operation between different radio services such as fixed, mobile, broadcast, amateur, emergency and global positioning systems. This is effected through radio regulations and regional agreements, as well as the establishment of recommendations to assure the necessary performance and quality in operating radiocommunication systems. The ITU-R also seeks to conserve spectrum and ensure flexibility for future expansion and new technological developments. See www.itu.int/itu-r.

IXIT Implementation eXtra Information for Testing. A statement made by a supplier or implementer of an Implementation Under Test (IUT) which contains or references all of the information (in addition to that given in the Implementation Conformance Statement (ICS)) related to the IUT and its testing environment, which will enable the test laboratory to run an appropriate test suite against the IUT. An IXIT can take several forms: protocol IXIT, profile IXIT, profile specific IXIT, information object IXIT, and TMP implementation statement. See ISO/IEC 9646-1/X.290 Section 3.3.41.

KSI Key Set Identifier. An identifier used in the authentication process to enable communications with a mobile terminal to be ciphered without the continual need for reauthentication. See 3GPP TS33.401.

LA Location Area. An area in which a mobile station may move freely without updating the Visitor Location Register (VLR). A location area includes one or several GERAN/UTRAN/E-UTRAN cells.

LAC Location Area Code. The LAC is part of the Location Area Identity (LAI). The LAC identifies a Location Area (LA) within a Public Land Mobile Network (PLMN). It has a fixed length of 2 octets and is one of the parameters an LTE UE is requested to read when it detects UTRAN cells in the neighbourhood. See 3GPP TS23.003 Section 4.1.

LAI Location Area Identity. The LAI is composed of the Mobile Country Code (MCC), the Mobile Network Code (MNC) and the Location Area Code (LAC). See 3GPP TS23.003 Section 4.1.

LB Load Balancing. A function located in the eNodeB which handles uneven distribution of the traffic load over multiple cells. The purpose of LB is to influence the load distribution in such a manner that radio resources remain highly utilized and the Quality of Service (QoS) is maintained. LB may result in hand-over or cell reselection decisions. See 3GPP TS 36.300 Section 16.1.6.

LB Loop Back. A method for testing the data reception functionality of a device, whereby received data is directly retransmitted back to the tester for comparison with the original data. In LTE, LB operates at the level of the Packet Data Convergence Protocol (PDCP) Service Data Units (SDUs). See 3GPP TS36.509, Sections 5.

LBI Linked Evolved Packet System Bearer ID. The Evolved Packet System (EPS) Bearer Identity of the default bearer. See 3GPP TS23.401 Section 5.4.

LBRM Limited-Buffer Rate Matching. A technique used to execute Hybrid Automatic Repeat reQuest (HARQ) with reduced requirements for soft buffer sizes while maintaining the peak data rates. LBRM shortens the length of the virtual circular buffer of the code block segments for certain large sizes of Transport Block (TB), and therefore sets a lower bound on the code rate. It is applicable to UE categories 3, 4 and 5. See 3GPP TS36.212 Section 5.1.4.1.2 and TS36.306, Section 4.1.

LCG Logical Channel Group. A group of uplink logical channels for which a single joint buffer fill level is reported by the UE in Buffer Status Reports (BSR). The mapping of logical channels to LCGs is defined by the eNodeB. See 3GPP TS36.321 Section 6.1.3.1 and TS36.331 Section 6.3.2.

LCID Logical Channel ID. A 5-bit value included in the Medium Access Control (MAC) header to identify the logical channel of the corresponding MAC Service Data Unit (SDU) or the type of the corresponding MAC control element. There is one LCID field for each MAC SDU, MAC control element or padding included in a MAC Protocol Data Unit (PDU). See 3GPP TS 36.321, Section 6.2.1.

LDPC Low-Density Parity Check. LDPC codes are linear parity-check codes with a classical parity-check equation. The term ‘low-density’ refers to the fact that the parity-check matrix entries are mostly zeros (the density of ones is low). The parity-check matrix of an LDPC code can be represented graphically by a ‘Tanner graph’. In LTE, turbo codes were instead selected as the channel coding technique.

LI Length Indicator. A field in the Radio Link Control (RLC) header, indicating the length in bytes of a corresponding Data field element in a RLC data Protocol Data Unit (PDU). It is applicable to both RLC Unacknowledged Mode (UM) and RLC Acknowledged Mode (AM). See 3GPP TS36.322 Section 6.2.2.5.

LISN Line Impedance Stabilizing Network. A low-pass filter network designed to isolate equipment under test from an external power source. It is used for example in the conducted emission d.c. power input/output port test method. See 3GPP TS34.124 Section 8.3.

LLC Logical Link Control. This protocol provides a reliable logical link between a mobile station and its Serving GPRS Support Node (SGSN). The LLC layer is situated below the Subnetwork Dependent Convergence (SNDC) layer. See 3GPP TS23.060 Section 12.2.

LLR Log-Likelihood Ratio. The ratio of the probabilities of two different hypotheses. An LLR can be computed for each information bit (as opposed to parity bits), where each hypothesis corresponds to one possible value of the information bit. The LLR gives information about the most likely value of the bit and about the reliability of that estimate.

LMMSE Linear Minimum Mean Squared Error. A linear filtering process based on a Minimum Mean Squared Error (MMSE) strategy (see MMSE).

LMS Least Mean Square. An iterative optimization technique aimed at incremental minimization of a mean square metric for parameter estimation. It is a stochastic way of implementing the steepest descent method.

LNA Low Noise Amplifier. A type of amplifier which aims to amplify the desired signal while adding as little noise as possible and without distorting the desired signal. In a receiver chain, the total receiver Noise Figure (NF) is dominated by the NF of the first stages (according to the Friis equation), so an LNA is usually placed as close to the antenna as possible in order to control the NF of the total receive chain.

LO Local Oscillator. An electronic device designed to generate a signal of a defined frequency locally within a receiver, as opposed to recovering the frequency from a received signal.

LOS Line-Of-Sight. A type of propagation where most of the signal energy travels directly in a straight line from the transmitter to the receiver, without reflections or scattering.

LR Location Registration. The process the UE undertakes to register its presence in a registration area when in Idle mode. As a result of LR, the Public Land Mobile Network (PLMN) selected by the UE becomes the Registered PLMN. This can be done regularly or when entering a new tracking area. See 3GPP TS36.304 Section 4.1.

LS Least Squares. A parameter estimation criterion which aims to minimize the energy of the difference between an observed signal and a reconstruction of the signal generated using the parameter(s).

LS Liaison Statement. A formal communication between Working Groups in 3GPP, or from 3GPP to other bodies.

LSB Least Significant Bit. The bit carrying the least weight in a binary word.

LSF Last Segment Flag. A 1-bit field in the header of a Radio Link Control (RLC) Protocol Data Unit (PDU), used when the PDU contains a retransmitted segment of a previously-transmitted Acknowledged Mode Data (AMD) PDU. It indicates whether or not the AMD PDU segment is the last segment of the original AMD PDU. See 3GPP TS36.322 Section 6.2.2.8.

LTE Long-Term Evolution. A radical step in the development of UMTS beyond the original 3rd generation Wideband Code Division Multiple Access (WCDMA) radio access technology. LTE comprises a new radio interface and radio access network architecture.

M1 User plane interface between Multimedia Broadcast and Multicast Service GateWay (MBMS GW) and eNodeB. See 3GPP TS36. 445 and TS36.446.

M2 Control plane interface between Multicell/Multicast Coordination Entity (MCE) and eNodeB. See 3GPP TS36. 443.

M3 Control plane interface between Evolved Packet Core (EPC) and E-UTRAN (Multimedia Broadcast and Multicast Service GateWay (MBMS GW) – Multi-Cell/Multicast Coordination Entity (MCE)). See 3GPP TS36.444.

MAC Medium Access Control. The protocol sublayer above the physical layer and below the Radio Link Control (RLC) layer in the LTE protocol stack. The connection to the physical layer below is through transport channels, and the connection to the RLC layer above is through logical channels. The MAC layer performs data transmission scheduling and multiplexing/demultiplexing between logical channels and transport channels. In the UE, it is also responsible for control of random access, timing advance and discontinuous reception. See 3GPP TS36.321.

MAC-I Message Authentication Code for Integrity. A field added by the Packet Data Convergence Protocol (PDCP) layer to each RRC message, for the purpose of integrity protection. This code is calculated based on the Access Stratum (AS) keys, the message itself, the radio bearer ID, the direction (i.e. uplink or downlink) and the COUNT value. See 3GPP TS36.323 Sections 5.7 and 6.3.4.

MAP Maximum A-posteriori Probability. A MAP estimator estimates the most likely transmitted sequence given an observed signal.

MBMS Multimedia Broadcast and Multicast Service. A service which aims to provide an efficient mode of delivery for both broadcast and multicast services over the core network. MBMS specifications for LTE are not included in the first release of LTE. Nevertheless the LTE Release 8 physical layer has already been designed to support MBMS. See 3GPP TS36.300.

MBMS GW Multimedia Broadcast and Multicast Service GateWay. The entity which receives user-plane Multimedia Broadcast and Multicast Service (MBMS) traffic from the Broadcast/Multicast Service Centre (BM-SC), and hosts the Packet Data Convergence Protocol (PDCP) layer of the user plane for header compression for MBMS data packets for both multi-cell and single-cell transmission. The MBMS GW forwards the user-plane traffic to the eNodeBs. See 3GPP TS36.300 Section 15.1.1.

MBR Maximum Bit Rate. The upper limit on the bit rate which can be expected from a Guaranteed Bit Rate (GBR) bearer. See 3GPP TS23.203.

MBSFN Multimedia Broadcast Single Frequency Network. A transmission mode which exploits the Orthogonal Frequency Division Multiplexed (OFDM) radio interface to send multicast or broadcast data as a multicell transmission over a synchronized single frequency network The transmissions from the multiple cells are sufficiently tightly synchronized for each to arrive at the UE within the OFDM Cyclic Prefix (CP) so as to avoid Inter-Symbol Interference (ISI). In effect, this makes the MBSFN transmission appear to a UE as a transmission from a single large cell, dramatically increasing the Signal-to-Interference Ratio (SIR) due to the absence of inter-cell interference. See 3GPP TS36.201 and TSs36.300.

MCC Mobile Country Code. The MCC identifies uniquely the country of domicile of a mobile subscriber. It consists of three digits. In LTE it is used in the construction of network entity related identities such as the E-UTRAN Cell Global Identifier (ECGI), the Global eNodeB Identifier and the Tracking Area Identity (TAI). See 3GPP TS23.003 Section 2.2 and TS36.300 Section 8.2.

MCCH Multicast Control CHannel. A downlink channel which is used to transmit control information related to the reception of Multimedia Broadcast and Multicast Services (MBMS). See 3GPP TS36.300 Section 15.3.5.

MCE Multi-Cell/Multicast Coordination Entity. This entity performs the management of both Multimedia Broadcast and Multicast Service (MBMS) content and resources. This includes allocating the time/frequency radio resources used by all eNodeBs in a Multimedia Broadcast Single Frequency Network (MBSFN) area for a given service, and deciding the radio configuration. See 3GPP TS36.300 Section 15.1.1.

MCH Multicast CHannel. The transport channel used to transport Multimedia Broadcast/Multicast Service (MBMS) data using Multimedia Broadcast Single Frequency Network (MBSFN) combining. See 3GPP TS36.300 Sections 5 and 15.

MCS Modulation and Coding Scheme. A term encompassing the modulation order and code rate of a transmission. The MCS therefore describes the information data rate of a transmission . See for example 3GPP TS36.213 Section 7.1.7.

ME Mobile Equipment. The physical mobile terminal. In the 3GPP specifications, an ME is technically defined as consisting of one or more 'Mobile Terminations' and one or more 'Terminal Equipments'. A Mobile Termination supports functions specific to the management of a Public Land Mobile Network (PLMN) interface, while a Terminal Equipment provides the functions necessary for the operation of the access protocols by the user. See 3GPP TR21.905.

MIB Master Information Block. A block of system information which includes a limited number of the most frequently transmitted parameters which are essential for a UE's initial access to the network – namely the downlink system bandwidth, an indicator of the resources allocated to HARQ acknowledgement signalling in the downlink, and the System Frame Number (SFN) . See 3GPP TS36.331 Section 6.2.2.

MIMO Multiple-Input Multiple-Output. A transmission scheme between a transmitter and a receiver both equipped with multiple anntennas.

MIP Mobile Internet Protocol. A communications protocol which allows users to move outside their home network while retaining their home Internet Protocol (IP) address. See IETF RFC3344, www.ietf.org.

MISO Multiple-Input Single-Output. A transmission scheme between a transmitter equipped with multiple antennas and a receiver equipped with a single antenna.

ML Maximum Likelihood. A form of an optimal estimator which, when applied to an observation, outputs the hypothesis that is most likely to have caused the current observation.

MLD Maximum Likelihood Detector. A sequence detector which uses the Maximum Likelihood (ML) principle to output the sequence most likely to have been transmitted given an observed received signal.

MM Mobility Management. The set of functions necessary to support mobile station mobility, including for example Non-Access Stratum (NAS) signalling and security, signalling between Core Network (CN) nodes for mobility between 3GPP access networks, Packet Data Network GateWay (P-GW) and Serving GateWay (S-GW) selection, Serving GPRS Support Node (SGSN) selection for handovers, and roaming and authentication. See 3GPP TS24.301 Section 5.

MME Mobility Management Entity. The control node which processes the signalling between the UE and the Core Network (CN) and provides Visitor Location Register (VLR) functionality for the Evolved Packet System (EPS). It supports functions related to bearer and connection management. See 3GPP TS23.002 Section 4.1.4.1, TS24.301, TS36.300 Section 19 and TS36.401.

MMEC Mobility Management Entity Code. Identifies a Mobility Management Entity (MME) within the scope of an MME Group within a Public Land Mobile Network (PLMN). See 3GPP TS24.301 Section 5.3 and TS23.003.

MMSE Minimum Mean Squared Error. An MMSE estimator is a filtering process applied to a signal, in which the filter coefficients are computed to minimize the Mean Squared Error (MSE) between the filtered version of the signal and a desired signal.

MNC Mobile Network Code. In conjunction with the Mobile Country Code (MCC), the MNC uniquely identifies a mobile network operator/carrier. In LTE it is used in the construction of network entity related identities such as the E-UTRAN Cell Global Identifier (ECGI), the Global eNodeB Identifier, and the Tracking Area Identity (TAI). See 3GPP TS23.003 Section 2.2 and TS36.300 Section 8.2.

MOCN Multi-Operator Core Network. A network in which multiple Core Network (CN) nodes are connected to the same eNodeB (or, in the case of UTRAN, to the same Radio Network Controller (RNC)) and the CN nodes are operated by different operators. See 3GPP TS23.251 Sections 4.1, 7.1.4 and 7.1.5.

MOP Maximum Output Power. The MOP of a UE is the minimum of the maximum allowed power configured by Radio Resource Control (RRC) signalling (see 3GPP TS36.331 Section 6.3.2) and the maximum UE power depending on the UE power class (see 3GPP TS36.101 Section 6.2).

MPR Maximum Power Reduction. The maximum allowed reduction in uplink transmit power to enable a UE to avoid non-linear transmission characteristics and hence to satisfy adjacent channel leakage requirements. The MPR is non-zero only for particular combinations of system bandwidth, transmit bandwidth configuration (resource blocks allocations) and modulation scheme which make it difficult to control sufficiently the adjacent channel leakage. See 3GPP TS36.101 Section 6.2.3.

MRC Maximum Ratio Combining. A technique for combining multiple components of a signal (e.g. received at different times or by different antennas), whereby the amplitude of each combining weight is proportional to the Signal-to-Noise Ratio (SNR) of the corresponding signal component and where the phases of the combining weights are set to compensate for the phase of the complex propagation channel coefficients.

MRP Mouth Reference Point. A point 25 mm in front of and on the axis of the lip position of a typical human mouth (or artificial mouth). See ITU-T Recommendation P.64 AMD 1.

MRRU Maximum Reconstructed Reception Unit. A parameter of the RObust Header Compression (ROHC) protocol, representing the size of the largest reconstructed unit in octets that the decompressor is expected to reassemble from segments. See IETF RFC3095, www.ietf.org.

MSAP Multicast channel Subframe Allocation Pattern. A pattern of subframes in which transmission resources are allocated for a specific Multicast CHannel (MCH). See 3GPP TS36.300 Section 15.3.3.

MSB Most Significant Bit. The bit carrying the highest weight in a binary word.

MSC Mobile Switching Centre. The MSC constitutes the interface between the radio system and the fixed networks. It performs all necessary functions in order to handle CS services to and from the mobile stations. See 3GPP TS23.002 Section 4.1.2.1.

MSD Maximum Sensitivity Degradation. A relaxation factor taken into account in the UE Reference Sensitivity (REFSENS) (in terms of the minimum received signal strength sufficient to satisfy a specified throughput requirement) for a particular transmission configuration. It is arises from the fact that the REFSENS requirements are more challenging in some bands and duplex spacings than others. See 3GPP TS36.101 Section 7.3.2.

MSE Mean Squared Error. The MSE is the second order moment of the difference between the estimate and the true value of the quantity being estimated. .

MSISDN Mobile Station International Subscriber Directory Number. The telephone number of a mobile user. The MSISDN is included in the Evolved Packet System (EPS) Bearer Context. See 3GPP TS 23.003 Section 3.3.

MTCH Multicast Traffic CHannel. A logical channel used to transmit user data for Multimedia Broadcast and Multicast Services (MBMS) in the downlink. See 3GPP TS36.300 Sections 6.1.2 and 6.1.3.

M-TMSI M Temporary Mobile Subscriber Identity. A temporary identity used to preserve subscriber confidentiality. It identifies a user between the UE and the Mobility Management Entity (MME). The relationship between M-TMSI and International Mobile Subscriber Identity (IMSI) is known only in the UE and in the MME. See 3GPP TS23.003 Section 2.1 and TS23.401 Section 5.3.10.3.

MTU Maximum Transfer Unit. The largest block of Internet Protocol (IP) data which may be transferred using a data link connection.

MU-MIMO Multi-User Multiple-Input Multiple-Output. MU-MIMO involves multiple UEs communicating simultaneously with a common base station using the same frequency and time-domain resources, being separated only in the spatial domain by means of multiple antennas at the base station. The downlink transmission mode 5 in LTE is designed to support MU-MIMO. See 3GPP TS 36.213 Section 7.1.5.

NACC Network Assisted Cell Change. It is a procedure for mobility from LTE to GERAN with network assistance. See 3GPP TS48.018, TR25.901 and TS36.413 Sections 9.2.3.23 and 9.2.3.24.

NACK Negative ACKnowledgment. A signal transmitted to indicate that one or more blocks of data have not been successfully received and decoded. Used in Hybrid Automatic Repeat reQuest (HARQ), as well as in Radio Link Control (RLC)-level ARQ.

NACS Non-Adjacent Channel Selectivity. A measure of a receiver's ability to receive a wanted signal at its assigned channel frequency in the presence of unwanted interfering signals falling into the receive band beyond the adjacent channel or into the first 15 MHz below or above the receive band. See 3GPP TS36.101 Section 7.6.1.

NAS Non-Access Stratum. Comprises the protocols which operate between UE and the Core Network (CN) – i.e. the protocols which are not specific to a particular Radio Access Technology (RAT). In the Evolved Packet System (EPS), the NAS protocols consist mainly of the protocols for mobility management and session management between the UE and the Mobility Management Entity (MME). See 3GPP TS 23.122.

NCC Network Colour Code. The most-significant 3 bits of a Base Station Identity Code (BSIC). The NCC is used to differentiate between mobile network operators utilizing the same frequencies, for example on an international border where more than one operator has been allocated the same carrier frequency. See 3GPP TS23.003 Sections 4.3.2 and A.3.

NCL Neighbour Cell List. A list of neighbour cells provided by the network to the UE to facilitate mobility. In LTE the UE has to be able to perform cell search without an explicit neighbour cell list being provided. For handover to UTRAN or GSM, a UE camped on an LTE cell will receive a UMTS neighbour cell list containing up to 32 primary scrambling codes per UMTS carrier and a GSM neighbour cell list with at least 32 GSM carrier numbers. See 3GPP TS36.133 and TS36.331.

NDI New Data Indicator. A 1-bit sequence number, which is toggled to indicate when the first transmission of a new packet occurs. See 3GPP TS36.321 Section 5.3.1 and TS36.212 Section 5.3.3.1.

NDS Network Domain Security. A security architecture for network domain Internet Protocol (IP) based control planes, which is applied to NDS/IP-networks (i.e. 3GPP and fixed broadband networks) to provide security in the Core Network (CN). See 3GPP TS33.210.

NF Noise Figure. The receiver noise figure is a measure of the degradation of the SINR caused by components in the RF signal chain, i.e. the ratio of actual output noise to that which would remain if the receiver itself did not introduce noise. This includes the antenna filter losses, the noise and the degradation of the signal introduced by the analogue part of the receiver and by the analogue to digital converter and any other noise sources.

NGMN Next Generation Mobile Networks. An alliance of network operators which aims to support the work in standardisation bodies by providing input regarding network operator requirements for next generation mobile systems. See www.ngmn.org.

NITZ Network Information and Time Zone. This feature provides the means for serving Public Land Mobile Networks (PLMN) to transfer current identity, time, daylight saving time and the local time zone to UEs, and for the UEs to store and use this information. See 3GPP TS22.042.

NLMS Normalized Least-Mean-Square. See Least-Mean-Square (LMS). In the normalized version, the step size used for incrementation is normalized with respect to the input signal's energy in order to improve stability of convergence.

NLOS Non-Line-Of-Sight. A type of propagation where the signal energy travels from the transmitter to the receiver via indirect paths with reflections and/or scattering, and no direct Line-of-Sight (LOS) path is present.

NNSF NAS Node Selection Function. This functionality is located in the eNodeB to determine and establish an association between a given UE and one of the Mobility Management Entity (MME) nodes that comprise the pool area to which the eNodeB belongs. It enables proper routing via the S1-MME interface. See 3GPP TS36.410 Section 5.7.2.

NRI Network Resource Identifier. A parameter used to identify the Core Network (CN) node assigned to serve a mobile station. See 3GPP TS23. 236 Section 4.3.

NSAPI Network layer Service Access Point Identifier. An identifier used in GPRS to identify a Packet Data Protocol (PDP) context (a unique data session) in the Mobile Station (MS) and in the Serving GPRS Support Node (SGSN). The NSAPI is assigned when the MS initiates the PDP Context Activation function. See 3GPP TS 23.060.

O&M Operation and Maintenance. Encompasses signalling to adapt, control and upgrade network nodes.

OAM Operation and Maintenance. Otherwise known as O&M.

OBW Occupied BandWidth. Defined as the bandwidth containing 99% of the total integrated mean power of the transmitted spectrum on the assigned channel. The occupied bandwidth for all transmission bandwidth configurations (Resource Block allocations) is less than the channel bandwidth. See 3GPP TS36.101 Section 6.6.1.

OCNG Orthogonal Frequency Division Multiple Access Channel Noise Generator. A noise source that models a full cell load across the system bandwidth for testing scenarios, without having all resources allocated to a single UE. This enables a flat transmitted power spectral density to be achieved from the serving cell in the test setup, as well as modelling interference that may arise due to imperfections or from neighbouring cells. See 3GPP TS36.133 Annex A.3.2.

OD Optionally present, Discontinue. In relation to an Information Element (IE) in a signalling message (e.g. Radio Resource Control (RRC)), OD signifies that inclusion of the IE is optional, and that if the IE is absent the receiver should discontinue use of any existing value of that IE. See 3GPP TS36.331 Section 6.1.

ODB Operator Determined Barring. This allows the network operator or service provider to regulate access by the subscribers to services, by the barring of certain categories of outgoing or incoming calls or of roaming. See 3GPP TS22.041 and TS23.015.

OFCS Offline Charging System. A process whereby charging information for network resource usage is collected concurrently with that resource usage. The charging information is then passed through a chain of logical charging functions. Offline charging is a mechanism where charging information does not affect, in real-time, the service rendered. See 3GPP TS32.240 Section 4.1.1.

OFDM Orthogonal Frequency Division Multiplexing. A signal transmission scheme using multiple subcarriers closely-spaced in the frequency domain such that adjacent subcarriers are orthogonal to each other; such schemes enable the symbol length to be increased compared to a single-carrier transmission and are therefore typically tolerant of multipath propagation. It is the radio access technology used for the LTE downlink. See 3GPP TS36.201 Section 4.2 and TS36.211 Section 6.12.

OFDMA Orthogonal Frequency Division Multiple Access. A multiple access scheme relying on the use of Orthogonal Frequency Division Multiplexing (OFDM) where individual subcarriers (or groups of subcarriers) are assigned to distinct users, based on scheduling decisions. See 3GPP TS36.201 Section 4.2.

OI Overload Indicator . An indicator sent on the X2 interface between eNodeBs to indicate physical layer measurements of the average uplink interference plus thermal noise for each Resource Block (RB).The OI can take three values, expressing low, medium, and high levels. It cannot be updated more often than every 20 ms. See 3GPP TS 36.423 Section 9.2.17.

OMC Operation and Maintenance Centre. A central facility to provide fast and efficient administration and maintenance for a mobile network.

ON Optionally present, No action. In relation to an Information Element (IE) in a signalling message (e.g. Radio Resource Control (RRC)), ON signifies that inclusion of the IE is optional, and that if the IE is absent the receiver should continue to use the existing value where applicable. See 3GPP TS36.331 Section 6.1.

OOB Out Of Band. Refers to emissions on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions. See 3GPP TS36.101, Sections 6.6.2 and 7.6.2.

OP Optionally Present. In relation to an Information Element (IE) in a signalling message (e.g. RRC), OP signifies that inclusion of the IE is optional, and that the relevant specification should specify the required behaviour in the event of the IE not being present in the message. See 3GPP TS36.331 Section 6.1.

P Polling bit. The P field in the header of a Radio Link Control Acknowledged Mode Protocol Data Unit (RLC AM PDU) indicates whether or not the transmitting side of the AM RLC entity requests a STATUS report from its peer AM RLC entity. P is set to 1 if a STATUS report is requested, and 0 otherwise. See 3GPP TS36.322, Section 6.2.2.11.

P/S Parallel-to-Serial. The conversion of a parallel set of sequences of symbols to a single serial sequence, usually by mapping a symbol (or group of symbols) from each of the parallel sequences in turn to the serial sequence.

PA Power Amplifier. An electronic device which amplifies a low-power radio-frequency signal. It is typically used to drive the antenna of a transmitter.

PAPR Peak-to-Average Power Ratio. The ratio between the average transmit power of a signal and the maximum instantaneous transmit power. It is sometimes used as an indication of the extent of the linear region of operation that is required for the Power Amplifier (PA); however, the Cubic Metric (CM) of the signal is a more reliable predictor of the required PA characteristics.

PB Pass Band. The range of signal frequencies intended to be passed without significant attenuation (e.g. not greater than 3 dB) from the input to the output of a filter.

PBCH Physical Broadcast CHannel. The LTE physical channel which carries the Master Information Block (MIB), consisting of a limited number of the most frequently transmitted parameters essential for initial access to the cell. The PBCH is designed for early detection by the UE, and cell-wide coverage. See 3GPP TS36.212 Section 5.3.1 and TS36.211 Section 6.6.

PBR Prioritized Bit-Rate. The data rate provided to one logical channel before allocating any transmission resource to a lower-priority logical channel. Prioritarization is designed to control how the UE divides the granted uplink resources between the different radio bearers. See 3GPP TS36.321 Section 5.4.3.

PC Power Control. PC refers to the process of setting the transmission power, by either open-loop or closed-loop means. It can be used to counteract propagation effects such as path-loss, shadowing or fast fading, or to control interference to neighbouring cells. See 3GPP TS36.213 Section 5.

PCC Policy Control and Charging. This encompasses flow based charging, including charging control and online credit control and policy control (e.g. gating control, Quality of Service (QoS) control, QoS signalling). See 3GPP TS23.203.

PCCC Parallel Concatenated Convolutional Code. A method to create turbo codes, where the constituent convolutional codes are parallely concatenated through an interleaver. In LTE the turbo code is constructed by two 8-state constituent encoders and one turbo code internal interleaver. The code rate of the turbo encoder is 1/3. See 3GPP TS36.212, Section 5.1.3.2.1.

PCCH Paging Control CHannel. A downlink logical channel which is used to notify UEs of an incoming call or a change of system information. See 3GPP TS36.322 Section 4.2.1.1.1 and TS36.321, Section 4.5.2.

PCEF Policy and Charging Enforcement Function. This encompasses Service Data Flow (SDF) detection, policy enforcement and flow-based charging functionalities. See 3GPP TS23.203 Section 6.2.2.

PCFICH Physical Control Format Indicator CHannel. A downlink physical channel which carries a Control Format Indicator (CFI) which indicates the number of OFDM symbols (i.e. normally 1, 2 or 3) used for transmission of downlink control channel information in each subframe. See 3GPP TS36.211, Section 6.7.

PCG Project Coordination Group. The group responsible for the overall time-frame and management of the technical work in 3GPP to ensure that the 3GPP specifications are produced in a timely manner as required by the market.

PCH Paging CHannel. A downlink transport channel used to transport paging information to UEs. This channel is also used to inform UEs about updates of the system information. See 3GPP TS36.321 Sections 4 and 5.5.

PCI (or PCID) Physical Cell Identifier. The identity of an LTE cell. It is included in the LTE X2 setup procedure. The eNodeB can choose the PCI within a list of possible identity values. In LTE there are 504 unique physical layer cell identities, grouped into 168 groups of three identities. The Primary Synchronization Sequence (PSS) and Secondary Synchronization Sequence (SSS) in a given cell are used to indicate the PCI to the UE. See 3GPP TS36.300, Section 22.3.

PCO Protocol Configuration Options. Used to transfer parameters between the UE and the Packet Data Network Gateway (P-GW). They are sent transparently through the Mobility Management Entity (MME) and the Serving GW (S-GW). The PCO may include the address allocation preference indicating that the UE prefers to obtain an IPv4 address only after the default bearer activation. See 3GPP TS23.401 Section 5.3.2.

PCRF Policy Control and Charging Rules Function. This encompasses policy control decision and flow-based charging control functionalities. See 3GPP TS23.203 Section 6.2.1.

PDB Packet Delay Budget. An upper bound on packet delay which needs to be satisfied when the UE has sufficient radio channel quality. The PDB is made up of a delay in the network between a Packet Data Network GateWay (P-GW) and an eNodeB and a delay in the radio interface itself. See 3GPP TS 23.203 Section 6.1.7.2

PDCCH Physical Downlink Control CHannel. A downlink control channel used to support efficient data transmission in LTE. A PDCCH carries a message known as Downlink Control Information (DCI), which includes transmission resource assignments and other control information for a UE or group of UEs. Many PDCCHs can be transmitted in a subframe. See 3GPP TS36.212 Section 5.3.3 and TS36.211 Section 6.8.

PDCP Packet Data Convergence Protocol. The top sublayer of the LTE user plane layer 2 protocol stack, above the Radio Link Control (RLC) layer. The PDCP layer processes Radio Resource Control (RRC) messages in the control plane and Internet Protocol (IP) packets in the user plane. Depending on the radio bearer, the main functions of the PDCP layer are header compression, security (integrity protection and ciphering), and support for reordering and retransmission during handover. See 3GPP TS36.323.

PDN Packet Data Network. The network through which a UE obtains a packet data connection to the internet. See 3GPP TS29.274.

PDP Power Delay Profile. The typical averaged distribution of power of a channel impulse response across the different path delays.

PDP Packet Data Protocol. A network protocol (such as Internet Protocol (IP)) which handles packet routing and transfer functionality. See 3GPP TS23.060, Section 9.

PDSCH Physical Downlink Shared CHannel. The main downlink data-bearing channel in LTE. It is used for all user data, as well as for broadcast system information which is not carried on the Physical Broadcast CHannel (PBCH), and for paging messages. See 3GPP TS36.213 Section 7, TS36.212 Section 5.3.2 and TS36.211 Section 6.4.

PDU Protocol Data Unit. At the transmitting side, a PDU of a layer is the output of that layer to the layer below. Each layer receives a Service Data Unit (SDU) from the layer above. At the receiving side, a layer receives its PDUs from the layer below.

PF Paging Frame. A radio frame, known to the UE, in which E-UTRAN can page the UE. One paging frame may contain one or multiple subframe(s) in which a paging message may be transmitted, each such subframe being known as a Paging Occasion (PO). See TS 3GPP36.304 Section 7.1.

PF Packet Flow. A specific user data flow carried through the Policy and Charging Enforcement Function (PCEF). A packet flow can be an Internet Protocol (IP) flow. See 3GPP TS23.203 Section 6.2.2.

PFI Packet Flow Identifier. A PFI may be associated with a Packet Data Protocol (PDP) context. Four PFIs are specified: one for best-effort services, one for SMS, one for message tunnelling and one for signalling. Others may be dynamically assigned. See 3GPP TS24.008 Section 10.5.6.11 and TS23.060 Section 12.6.3.5..

PFS Proportional Fair Scheduling. A proportional fair scheduler allocates transmission resources to different users according to a metric which is proportional to their current instantaneous transmission capacity (taking into account radio channel conditions and typically also availability of data to transmit) but inversely proportional to their average throughput over a past time window – in other words, the instantaneous user throughput at time 't' normalized by the time-averaged user throughput up to time 't'. The normalization imposes a measure of fairness.

P-GW Packet Data Network GateWay. The gateway which terminates the interface towards the Packet Data Network (PDN). If a UE is accessing multiple PDNs, there may be more than one P-GW for that UE. See 3GPP TS23.002 Section 4.1.4.2.2.

PH Power Headroom. The difference between the nominal UE maximum transmit power and the estimated power for Physical Uplink Shared CHannel (PUSCH) transmission in the current subframe, expressed in dB. This information can be reported to the eNodeB in configurable Power Headroom Reports (PHR). See 3GPP TS36.133 Section 9.1.8, TS36.213 Section 5.1.1.2 and TS36.321 Section 5.4.6.

PHICH Physical Hybrid ARQ Indicator CHannel. A downlink physical channel which carries the Hybrid ARQ (HARQ) ACK/NACK information indicating whether the eNodeB has correctly received a transmission on the Physical Uplink Shared CHannel (PUSCH). Multiple PHICHs (for different UEs) are mapped to the same set of downlink resource elements. These constitute a PHICH group, where different PHICHs within the same PHICH group are separated through different complex orthogonal Walsh sequences. See 3GPP TS36.211 Section 6.9 and TS36.212 Section 5.3.5.

PHR Power Headroom Report. The index reported by the UE to indicate the estimated power headroom. The power headroom reporting range is from -23 to +40 dB. The eNodeB can use the power headroom reports to determine how much more uplink bandwidth per subframe a UE is capable of using. See 3GPP TS36.133 Section 9.1.8, TS36.213 Section 5.1.1.2 and TS36.321 Section 5.4.6.

PHY Physical Layer. The lowest layer in the LTE user plane and control plane protocol stacks. It defines the means of transmittting raw bits rather than logical data packets over a physical link. See 3GPP TS36.201, TS36.211, TS36.212, TS36.213 and TS36.214.

PICS Protocol Implementation Conformance Statement. An Implementation Conformance Statement (ICS) for an implementation or system claimed to conform to a given protocol specification. See 3GPP TS36.521-2.

PIXIT Protocol Implementation eXtra Information for Testing. A statement made by a supplier or implementer of an Implementation Under Test (IUT) which contains or references all of the information (in addition to that given in the Protocol Implementation Conformance Statements (PICS)) related to the IUT and its testing environment. See 3GPP TS36.521-2.

PL Path-Loss. The attenuation of an electromagnetic wave as it propagates through free space. In LTE each UE measures the path-loss based on the serving cell's Reference Signals (RSs) by averaging measurements of the downlink Reference Signal Received Power (RSRP). This is used to determine the uplink transmission power needed to compensate for some or all of the path-loss.

PLL Phase-Locked Loop. A control system which aims to fix the frequency of an oscillator to that of a received signal, by lowering or raising the frequency of the oscillator until it is matched to the reference signal in both frequency and phase. PLLs are typically used to lock a UE to the downlink carrier frequency received from the eNodeB.

PLMN Public Land Mobile Network. Typically the mobile network run by one network operator in one country. See 3GPP TS23.002 Section 3.1.

PLR Packet Loss Rate. The ratio between the number of packets which have not been correctly received and the total number of transmitted packets.

P-MCCH Primary Multicast Control CHannel (MCCH). A downlink channel which is used to transmit control information related to the reception of Multimedia Broadcast and Multicast Services (MBMS). It may be able to point to optional additional Secondary-MCCH(s). The details will be finalized in a later release of LTE. See 3GPP TS 36.300, Section 15.3.5.

PMCH Physical Multicast CHannel. The downlink physical channel which carries data originating from higher protocol layers for Multimedia Broadcast and Multicast Services (MBMS) using single-frequency network operation (MBSFN). See 3GPP TS36.211 Sections 6.3.2, 6.5 and 6.9.3, and TS36.300 Section 5.

PMI Precoding Matrix Indicator. A signal fed back by the UE to support Multiple-Input Multiple-Output (MIMO) operation. It corresponds to the index of the precoder (within a codebook shared by the UE and eNodeB) that maximizes the aggregate number of data bits which could be received across all downlink spatial transmission layers. See 3GPP TS36.213 Section 7.2.4.

PMIP Proxy Mobile Internet Protocol. A network-based mobility management mechanism. It is an amendment to Mobile IPv6 which allows mobility control to be moved from the mobile node to a proxy in the network. LTE supports PMIP over the S2, S5 and S8 interfaces. See 3GPP TS23.402.

PN Pseudo-Noise. A signal whose correlation characteristics are similar to noise. PN sequences typically consist of a deterministic sequence of pulses that repeats itself after a long period.

PO Paging Occasion. A subframe within a Paging Frame (PF) in which E-UTRAN can page a UE. The E-UTRAN configures which of the radio frames and subframes are used for paging, following a default or UE-specific paging cycle. In a PO configured for a UE, the UE will monitor the Physical Downlink Control CHannel (PDCCH) for any transmissions of the Paging- Radio Network Temporary Identifier (P-RNTI). See 3GPP TS36.304 Section 7.1.

PPF Paging Proceed Flag. A flag managed by the Mobility Management Entity (MME) in LTE; if set, it indicates that the UE was known to be within the coverage area within a previous time period, and the MME may initiate paging to the UE in the event of downlink data arrival. The PPF is typically cleared if the MME believes the UE to have gone out of coverage, in which case downlink data will be rejected. See 3GPP TS23.401 Section 4.3.5.2.

PPP Point-to-Point Protocol. A data link protocol used to establish a direct connection between two networking nodes. It can provide connection authentication, as well as offering transmission encryption and compression. See IETF RFC1661 and RFC2153, www.ietf.org.

PRACH Physical Random Access CHannel. A physical channel used to carry the Random Access Channel (RACH). It consists of a preamble signature, which is either randomly selected or pre-assigned. By partitioning the signatures into two groups, the PRACH can carry one bit of higher layer information indicating the amount of resource needed for the next uplink message. See 3GPP TS36.211, section 5.7.

PRB Physical Resource Block. A unit of transmission resource consisting of 12 subcarriers in the frequency domain and 1 timeslot (0.5 ms) in the time domain. See 3GPP TS36.211, Sections 5.2.3 and 6.2.3.

P-RNTI Paging-Radio Network Temporary Identifier. A fixed identifier used on the Physical Downlink Control CHannel (PDCCH) to indicate paging messages on the Physical Downlink Shared CHannel (PDSCH). It is transmitted as a scrambling code applied to the Cyclic Redundancy Check (CRC) of the PDCCH transmission. See 3GPP TS36.321 Section 7.1.

PS Packet Switched. In PS communication each data packet is labelled with the destination address and routed over a shared transmission resource. In contrast with Circuit Switching (CS) where dedicated transmission resources are reserved between network nodes to deliver a reliable transmission rate and delay, in a PS connection the transmission rate and delay may vary depending on the traffic load and the medium capacity, with packets being buffered if necessary.

PSAP Public Safety Answering Point. An agency (typically in the United States of America) which receives emergency calls from the public for assistance from police, fire or ambulance services. It may also provide public warnings of emergencies which can be broadcast over the cellular network.

PSD Power Spectral Density. PSD is a positive real function describing how the power of a signal is distributed with frequency. It provides the amount of energy per unit of frequency (dBm/Hz), and can be computed as the Fourier transform of the autocorrelation process.

PSS Primary Synchronization Signal. A sequence transmitted by every LTE cell every 5 ms. It allows the UE to obtain slot synchronization and part of the physical layer cell IDentifier (cell ID). Three different sequences exist with a one-to-one mapping to three different cell IDs within each of 168 groups of cell IDs. The PSS is based on Zadoff-Chu (ZC) sequences. See 3GPP TS36.211 Section 6.11.1.

PSS_RA Primary Synchronization Signal to Reference Signal Energy Per Resource Element ratio. The ratio of the transmitted energy per resource element between the Primary Synchronization Signal (PSS) and the downlink RS, used in defining performance requirements. See 3GPP TS36.101 Annex C.

PTI Procedure Transaction IDentity. An identity which is dynamically allocated by the UE for the UE-requested bearer resource activation, modification and deactivation procedures. The PTI is released when the procedure is completed. See 3GPP TS29.274 section 8.40 and TS24.301 Sections 6.4–6.6.

P-TMSI Packet Temporary Mobile Subscriber Identity (TMSI). A P-TMSI identifies a UE within a given Routing Area (RA) on a temporary basis and is used by the network to page the specified UE. See 3GPP TS23.003 Sections 2.7 and 2.8.2.

PUCCH Physical Uplink Control CHannel. The LTE uplink physical channel carrying uplink control information including Channel Quality Indicators (CQI), Hybrid Automatic Retransmission reQuest (HARQ) ACKnowledgment/Negative ACKnowledgment (ACK/NACK) and uplink scheduling requests. See 3GPP TS36.211 Section 5.4.

PUSCH Physical Uplink Shared CHannel. The LTE uplink physical channel carrying scheduled data traffic, and control signalling if some is required to be transmitted in the same subframe. See 3GPP TS36.211 Section 5.3.

PWS Public Warning System. A PWS provides the ability to broadcast warnings to alert the public to major emergencies, such as natural and other disasters. Such a system may also broadcast information allowing emergency services to request public assistance, for example when life is in danger. See 3GPP TS22.268.

QAM Quadrature Amplitude Modulation. QAM involves modulating the amplitude of two separate carrier waves, exactly 90 degrees out of phase with each other (sine and cosine). These are therefore called quadrature carriers, from which the scheme derives its name. M-QAM conveys information by means of M different combinations of amplitudes of the two carriers ($\sqrt{M}$ possible amplitudes on each carrier), and hence $\log_2(M)$ information bits are conveyed per QAM symbol. In LTE M=16 or 64 for both uplink and downlink (although M=64 is optional for the uplink). See 3GPP TS36.211 Sections 5.3.2 and 6.3.2.

QCI Quality of Service (QoS) Class Identifier. A parameter of the QoS profile of an Evolved Packet System (EPS) bearer. It is a scalar which refers to access node-specific parameters that control bearer-level packet forwarding treatment (e.g. scheduling weights, admission thresholds, queue management thresholds, link layer protocol configuration). See 3GPP TS23.401 Section 4.7.3 and TS23.203 Annex J.

QoS Quality of Service. A descriptor of the level of performance provided in transmission of data. Typical QoS metrics include bit rate, delay, bit/block error rate, maximum blocking probability and outage probability. QoS guarantees are especially important for real-time streaming applications, such as Voice over Internet Protocol (VoIP), since these are often delay-sensitive.

QPP Quadratic Permutation Polynomial. QPPs are used to define the turbo coding interleavers in LTE. For an information block size K, a QPP interleaver is defined by the following polynomial: $\pi(i) = (f_1 i + f_2 i^2) \bmod K$, where i is the output index($0 \leq i \leq K-1$), $\pi(i)$ is the input index and f_1 and f_2 are the coefficients that define the permutation, with f_1 being relatively prime to the block size K and all prime factors of K also being factors of f_2. 188 such interleaver polynomials are defined for LTE. See 3GPP TS36.212 Section 5.1.3.2.3.

QPSK Quadrature Phase Shift Keying. QPSK is a modulation scheme in which information is conveyed through phase variations of a carrier, while keeping a constant amplitude and frequency. The four phases are $0, \pi/2, \pi, 3\pi/2$, enabling $\log_2(4) = 2$ information bits to be conveyed per QPSK symbol. See 3GPP TS36.211 Sections 5.3.2 and 6.3.2.

R Reserved. A bit field, usually in a message header, which is reserved for possible use in a later version of the specifications.

r.m.s root mean square. A statistical measure of the magnitude of a series of values. It is the square root of the mean of the squares of the values.

RA Random Access. A procedure by which a UE can access the network, generally by random selection of a transmission resource rather than by specific assignment. The random access procedure in LTE is used when a UE is not allocated with uplink radio resources but has data to transmit, or when the UE is not time-synchronized in the uplink direction. See 3GPP TS36.321, Section 5.1 and TS36.213 Section 6.

RA Resource Allocation. RA is part of the radio resource management functionality and is performed by the eNodeB. It comprises allocation and de-allocation of transmission resources for both user and control plane packets, including the selection of radio bearers whose packets are to be scheduled and determining power levels and specific resource blocks to be used. It typically takes into account the Quality of Service (QoS) requirements, any channel quality information, buffer status reports and/or restrictions related to inter-cell interference coordination considerations. See 3GPP TS36.213, Sections 7.1.6 and 8.1.

RA Routing Area. An area in which a mobile station, in certain operation modes, may move freely without updating the Serving GPRS Support Node (SGSN). An RA includes one or several GSM/EDGE Radio Access Network (GERAN) or UTRAN cells. An RA is always contained within a location area.

RAB Radio Access Bearer. A service provided by the Access Stratum (AS) to the Non-Access Stratum (NAS) for the transfer of user data between the UE and the Core Network (CN).

RAC Radio Admission Control. The RAC function is located in the eNodeB and controls admission or rejection of new radio bearer establishment requests. The goal of RAC is to maximize radio resource utilization while ensuring that the required Quality of Service (QoS) is achieved for sessions which are already established. RAC can take into account the overall resource situation in E-UTRAN, the QoS requirements, the priority levels, the provided QoS of in-progress sessions and the QoS requirements of new radio bearer requests. See 3GPP TS36.300, Section 16.1.2.

RAC Routing Area Code. The RAC is part of the Routing Area Identity (RAI). The RAC identifies a routing area within a location area. It has a fixed length of 1 octet. See 3GPP TS23.003 Section 4.2.

RACH Random Access CHannel. A transport channel used for access to the network when the UE does not have accurate uplink timing synchronization, or when the UE does not have any allocated uplink transmission resource. The RACH is normally contention-based, which may result in collisions between UEs. See 3GPP TS36.321.

RAI Routing Area Identity. Used for paging and registration purposes. It is composed of the Location Area Identity (LAI) and the Routing Area Code (RAC). See 3GPP TS23.003 Section 4.2.

RAN Radio Access Network. A RAN consists of the ground-based infrastructure required for delivery of communication between UEs and the Core Network (CN). In LTE, the RAN consists of one or more base stations (i.e. eNodeBs). Examples of other RANs are UMTS, TD-SCDMA, GSM, CDMA2000 and WiMAX.

RAPID Random Access Preamble IDentifier. A field of the Medium Access Control (MAC) header for the Random Access Response (RAR). The RAPID field identifies the transmitted random access preamble to which the RAR corresponds. See 3GPP TS36.321 Section 6.2.2.

RAR Random Access Response. The message sent by the eNodeB in response to a random access preamble. The RAR is sent by the eNodeB on the Physical Downlink Shared CHannel (PDSCH), and addressed with the Random Access Radio Network Temporary Identifier (RA-RNTI), which identifies the time-frequency slot in which the preamble was detected. The RAR conveys the identity of the detected preamble, a timing alignment instruction to synchronize subsequent uplink transmissions from the UE, an initial uplink resource grant for transmission of the next uplink message, and an assignment of a Cell-RNTI (C-RNTI). The RAR message can also include a 'backoff indicator' which the eNodeB can set to instruct the UE to back off for a period of time before retrying a random access attempt. See 3GPP TS36.321 Sections 5.1.4 and 6.1.5.

RA-RNTI Random Access Radio Network Temporary Identifier. The RA-RNTI is used to identify a message sent on the Physical Downlink Control CHannel (PDCCH) as a Random Access Response (RAR). It also indicates the time-frequency slot of the preamble to which the RAR corresponds. See 3GPP TS36.312 Section 5.1.4 and TS36.401, Section 6.2.8.1.

RAT Radio Access Technology. The RAT is the type of radio technology used in a Radio Access Network (RAN) to access the Core Network (CN), e.g. UMTS, GSM, CDMA2000, WiMAX.

RAU Routing Area Update. A RAU is triggered when a UE crosses a routing area boundary from one routing area to another. A RAU can also be performed periodically, with the time interval being set by the network.

RB Resource Block. A unit of transmission resource consisting of 12 subcarriers in the frequency domain and 1 timeslot (0.5 ms) in the time domain. See 3GPP TS36.211, Sections 5.2.3 and 6.2.3.

RB Radio Bearer. A service provided by the Layer 2 for the transfer of data between a UE and the E-UTRAN.

RBC Radio Bearer Control. A function located in the eNodeB for the management (i.e. setting up, maintenance and release) of radio bearers. The setting up of a radio bearer for a service is based on the overall resource situation in E-UTRAN, and the Quality of Service (QoS) requirements of current sessions and the new service. RBC handles the maintenance of established radio bearers when the radio resource situation changes, for example due to mobility. RBC is involved in the release of radio resources associated with radio bearers, for example at session termination or handover. See 3GPP TS36.300, Section 16.1.1.

RBG Resource Block Group. A RBG consists of 1, 2, 3 or 4 Physical Resource Blocks (PRB), depending on the system bandwidth, which are consecutive in the frequency domain and are in the same timeslot. The grouping of PRBs in this way enables the signalling overhead to be reduced for downlink transmission resource allocation. See 3GPP TS36.213 Section 7.1.6.1.

RBG Radio Bearer Group. A RBG corresponds to a group of logical channels for the purposes of uplink buffer status reporting. By grouping logical channels in this way the signalling overhead for informing the eNodeB of arrival of high-priority data in the UE's buffer is reduced. See 3GPP TS36.300 Section 11.3 and TS36.321 Section 6.1.3.1.

RE Resource Element. The RE is the smallest unit of transmission resource in LTE, in both uplink and downlink. An RE consists of 1 subcarrier in the frequency domain for a duration of 1, Orthogonal Frequency Division Multiplexing (OFDM) or Single Carrier- Frequency Division Multiplexing(SC-FDM), symbol in the time domain. See 3GPP TS36.211 Sections 5.2 and 6.2.

REFSENS REFerence SENSitivity power level. It is the minimum mean received signal strength applied to both antenna ports at which there is sufficient SINR for a given modulation scheme to meet 95% of the maximum throughput of a reference measurement channel. It is given by REFSENS $= kTB +$ NF $+$ SINR $+$ IM $- 3$ (dBm), where kTB is the thermal noise level in dBm in the bandwidth B, NF is the prescribed maximum noise figure for the receiver, SINR is the requirement for the chosen Modulation and Coding Scheme (MCS), IM is an implementation margin and the -3 dB represents the diversity gain. See 3GPP TS36.101, Section 7.3.

REG Resource Element Group. A group of four Resource Elements (REs). These groups are used to structure the mapping of the downlink physical control channels (Physical Downlink Control CHannel (PDCCH), Physical Control Format Indicator CHannel (PCFICH) and Physical Hybrid ARQ Indicator CHannel (PHICH)) to resource elements in the first Orthogonal Frequency Domain Multiplexing (OFDM) symbols of each subframe. See 3GPP TS36.211 Section 6.2.4.

RET Remote Electrical Tilting. A mechanism for changing electrically the overall tilt of a base station antenna by increasing the lengths of different antenna elements inside the antenna casing. This can be used to improve the overall coverage and bandwidth distribution of cells, in particular where manual adjustment of the tilt of an antenna is expensive or impractical. RET allows network operators to respond to changing capacity requirements. For background for UTRAN, see 3GPP TR25.802 and TS25.460, TS25.461, TS25.462, TS25.463 and TS25.466.

RF Radio Frequency. Refers to signal oscillation frequencies such that if the signal is input to an antenna an electromagnetic field is generated suitable for wireless communication. These frequencies cover a significant part of the electromagnetic radiation spectrum, ranging from a few kilohertz to hundreds of gigahertz. See 3GPP TR36.942 for some discussion of related issues.

RF Resegmentation Flag. A field in a Radio Link Control (RLC) header indicating whether the RLC Protocol Data Unit (PDU) is an Acknowledged Mode Data (AMD) PDU or an Unacknowledged Mode Data (UMD) PDU segment. If the RLC PDU is an AMD PDU segment, the RF field is set to 1, otherwise it is set to 0. See 3GPP TS36.322 Section 6.2.2.10.

RFC Request for Comments. A type of memorandum that captures much of the output of the Internet Engineering Task Force (IETF). These memoranda describe techniques and protocols related to the functioning of the internet and internet-connected systems.

RFSP Radio Access Technology / Frequency Selection Priority. An index provided by the Mobility Management Entity (MME) to an eNodeB across the S1 interface to support radio resource management in E-UTRAN. The RFSP index is mapped by the eNodeB to a locally defined configuration in order to apply specific Radio Resource Management (RRM) strategies. The RFSP index is UE-specific and applies to all the radio bearers for that UE. See 3GPP TS23.401 Section 4.3.6.

RI Rank Indicator. A RI is signalled to the eNodeB by UEs configured for Physical Downlink Shared CHannel (PDSCH) transmission modes 3 (open-loop spatial multiplexing) and 4 (closed-loop spatial multiplexing). It corresponds to the number of useful transmission layers for spatial multiplexing (based on the UE's estimate of the downlink channel), enabling the eNodeB to adapt the PDSCH transmissions accordingly. See 3GPP TS36.213 Section 7.2.

RIM Radio Access Network Information Management. The RIM provides a generic method for the exchange of information between applications belonging to the Radio Access Network (RAN) nodes. The RAN information is transferred via the Mobility Management Entity (MME) and Serving GPRS Support Node (SGSN) node(s). The RAN information is included in a RIM container which is not interpreted by the Core Network (CN) nodes, such that the RAN information is transparent to the CN. See 3GPP TS36.300, Section 19.2.1.13.

RIV Resource Indication Value. A field in Physical Downlink Control CHannel (PDCCH) messages indicating contiguous Physical Resource Block (PRB) allocations to a UE; this includes all uplink resource grants, and some downlink resource assignments. The RIV indicates the starting resource block of the contiguous allocation and the length of the contiguous allocation of resource blocks. See 3GPP TS36.213 Sections 7.1.6.3 and 8.1.

RL Radio Link. A logical communication link between a UE and an eNodeB, carrying one or several radio bearers.

RLC Radio Link Control. The RLC layer is located between the Packet Data Convergence Protocol (PDCP) layer and the Medium Access Control (MAC) layer in the LTE user plane protocol stack. The main functions of the RLC layer are segmentation and reassembly of upper layer packets in order to adapt them to the size which can actually be transmitted over the radio interface. For radio bearers which need error-free transmission, the RLC layer also performs retransmission to recover from packet losses. Additionally, the RLC layer performs reordering to compensate for out-of-order reception due to Hybrid Automatic Repeat reQuest (HARQ) operation in the MAC layer. There is one RLC entity per radio bearer. See 3GPP TS36.322.

RLF Radio Link Failure. An RLF occurs when a UE is considered to have lost synchronization with the downlink from the eNodeB, typically due to degradation of the air interface arising from unfavourable signal propagation conditions, i.e. when the received power level is lower than a predefined threshold, Q_{out}. After radio link failure detection and the expiration of a timer (T310), the UE enters IDLE mode. See 3GPP TS36.300 Section 10.1.6, TS36.213 Section 4.2.1 and TS36.331 Section 5.3.11.

RLP Radio Link Protocol. RLP covers the Layer 2 functionality of the ISO OSI Reference Model, between the UE and the interworking function located at the nearest Mobile Switching Centre (MSC). It is designed to support circuit switched data transmission within a Public Land Mobile Network (PLMN). See 3GPP TS24.022.

RLS Recursive Least Squares. A technique used to find the coefficients of adaptive filters by recursively computing the smallest values of the squares of the error signal. This can be contrasted with Minimum Mean Squared Error (MMSE) filters, which aim to minimize the mean squared error. While MMSE filters depend on the statistics of the signal, RLS filters are dependent on the signals themselves.

RM Rate Matching. The RM process adapts the code rate of the LTE data transmissions such that the number of information and parity bits to be transmitted matches the resource allocation. Based on the 1/3 mother code rate of the turbo coder, the LTE RM uses a circular buffer to either repeat bits to decrease the code rate or puncture bits to increase the code rate. See 3GPP TS36.212 Section 5.1.4.

RMC Reference Measurement Channel. RMCs provide defined sets of parameters for transmitted channels to enable radio receiver performance to be analyzed in a consistent way. See 3GPP TS36.101 Annex A.

RNC Radio Network Controller. The equipment in the UTRAN RNS in charge of controlling the use and the integrity of the radio resources.

RNL Radio Network Layer. The RNL encompasses the radio network control plane and the radio network user plane. It handles all Radio Access Bearer-related functions.

RNS Radio Network Subsystem. Either a full UTRAN network or only the access part of a UTRAN, offering the allocation and release of specific radio resources to establish means of connection in between a UE and the UTRAN. An RNS comprises a Radio Network Controller (RNC) and one or more NodeBs.

RNTI Radio Network Temporary Identifier. RNTIs are used to identify UEs within E-UTRAN, in particular in signalling messages between the UE and E-UTRAN. Several types of RNTI exist, including Cell-RNTI (C-RNTI), Paging-RNTI (P-RNTI), Random Access-RNTI (RA-RNTI) and System Information-RNTI (SI-RNTI). See 3GPP TS36.321 Section 7.1.

RNTP Relative Narrowband Transmit Power. RNTP indicates, per Physical Resource Block (PRB), whether or not the cell intends to keep the downlink transmit power in the PRB below a certain threshold. The value of this threshold, and the period for which the RNTP indicator is valid in the future, are configurable. This enables the neighbouring eNodeBs to take into account the expected level of interference in each RB when scheduling UEs in their own cells. See 3GPP TS36.213 Section 5.2.1.

ROHC RObust Header Compression. A standardized method to compress the Internet Protocol (IP), User Datagram Protocol (UDP), Real-time Transport Protocol (RTP) and Transmission Control Protocol (TCP) headers of internet packets. ROHC header compression operates by allowing both the sender and the receiver to store the static parts of the header (e.g. the IP addresses of the sender/receiver), and to update these only when they change. Dynamic parts (such as the timestamp in the RTP header) are compressed by transmitting only the difference from a reference maintained in both the transmitter and the receiver. See www.ietf.org.

RoT Rise over Thermal. RoT is defined as the ratio between the total power received at a base station and the thermal noise at the base station. It provides a measure of the uplink load level in a cell.

RPF RePetition Factor. A parameter defining the degree of repetition of time-domain samples of a Single Carrier Frequency Division Multiple Access (SC-FDMA) signal used in the LTE uplink. An RPF = n means that the time-domain samples are repeated $n - 1$ times (i.e. transmitted n times), resulting in the signal occupying one subcarrier every n subcarriers in the frequency domain. This can be used to generate Interleaved Frequency Division Multiple Access (IFDMA) signals from different UEs. In LTE, this is applied to transmission of the Sounding Reference Signals (SRS) in the uplink, with RPF = 2 allowing SRS from two UEs to be interleaved across a given bandwidth while retaining frequency-domain orthogonality.

R-PLMN Registered Public Land Mobile Network. The PLMN on which the UE has performed a successful location registration.

RRC Radio Resource Control. The RRC protocol handles the Layer 3 control plane signalling by which the E-UTRAN controls the UE behaviour. The RRC protocol supports the transfer of both common and dedicated Non-Access Stratum information. It covers a number of functional areas including System Information (SI) broadcasting, connection control including handover within LTE, network-controlled inter-Radio Access Technology (RAT) mobility and measurement configuration and reporting. See 3GPP TS36.300 Section 7 and TS36.331.

RRC Root Raised Cosine. A filter shape, frequently used for pulse-shaping because of its ability to minimize Inter-Symbol Interference (ISI) when used at both the transmitter and receiver – the two filters together having a Raised Cosine response. The frequency response of an RRC filter is a piecewise function equal to unity in the centre frequencies and approaching zero following the square-root of a raised cosine curve. The sharpness of the frequency-domain roll-off can be traded off against the amplitude of time-domain ripple in the filter impulse response by varying the 'roll-off factor', typically referred to as α. For $\alpha = 0$ the frequency response of the filter becomes a rectangular function, and for $\alpha = 1$ it is a pure root raised cosine.

RRM Radio Resource Management. RRM consists of the system-level control mechanisms used to manage radio resources in the air interface. The objective of RRM is to maximize the system spectral efficiency and to support mobility for the users. RRM therefore involves strategies and algorithms for resource allocation, Modulation and Coding Scheme (MCS), transmission power selection, and mobility. See 3GPP TS36.133.

RS Reference Signal. A signal, known to the receiver, that is inserted into a transmitted signal in order to facilitate channel estimation for coherent demodulation and measurements. In the LTE downlink, Cell-specific RSs are provided which are available to all UEs in a cell; UE-specific RSs may be embedded in the data for specific UEs, and Multimedia Broadcast Single Frequency Network (MBSFN) -specific RSs are provided in case of MBSFN operation. These RSs occupy specified Resource Elements (REs) within an Orthogonal Frequency Division Multiplexed (OFDM) symbol. In the LTE uplink, Demodulation RSs (DM-RS) and Sounding RSs (SRS) are provided for channel estimation for demodulation and channel sounding respectively. See 3GPP TS36.211 Sections 5.5 and 6.10.

RSCP Received Signal Code Power. A measurement used for mobility to UTRA. It is the received power on the Primary Common PIlot CHannel (P-CPICH for UMTS Frequency Division Duplex (FDD)), or the Primary Common Control Physical CHannel (for UMTS Time Division Duplex (TDD)) after despreading. See 3GPP TS36.214 Section 5.1.4.

RSRP Reference Signal Received Power. An LTE measurement which provides a cell-specific signal strength metric. This measurement is mainly used to rank different LTE cells according to their signal strength as an input for handover and cell reselection decisions. The RSRP of a cell is defined as the linear average over the power contributions (in Watts) of the Resource Elements (REs) which carry cell-specific RS within the considered measurement bandwidth. Normally the RSs transmitted on the first eNodeB antenna port are used for RSRP determination, but the RS on the second antenna port can also be used if the UE can determine that they are being transmitted. If the UE is equipped with multiple antennas, the reported RSRP value is not permitted to be lower than the RSRP computed on the individual branches. See 3GPP TS36.214 Section 5.1.1.

RSRQ Reference Signal Received Quality. RSRQ is an LTE measurement which provides a cell-specific signal quality metric. Similarly to Reference Signal Received Power (RSRP), this measurement is mainly used to rank different LTE cells according to their signal quality as an input for handover and cell reselection decisions, for example in scenarios for which RSRP measurements do not provide sufficient information to perform reliable mobility decisions. The RSRQ is defined as the ratio $N \cdot \text{RSRP}/(\text{LTE carrier RSSI})$, where N is the number of Resource Blocks (RBs) of the LTE carrier Received Signal Strength Indicator (RSSI) measurement bandwidth. While RSRP is an indicator of the wanted signal strength, RSRQ additionally takes the interference level into account due to the inclusion of RSSI. RSRQ therefore enables the combined effect of signal strength and interference to be reported in an efficient way. If the UE is equipped with multiple antennas, the reported RSRQ value is not permitted to be lower than the RSRQ computed on the individual branches. See 3GPP TS36.214 Section 5.1.2.

RSSI Received Signal Strength Indicator. A measurement defined as the total received wideband power observed by a UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference and thermal noise within the measurement bandwidth. For LTE it is not reported as an independent measurement, but is an input to the derivation of RSRQ. For RSSI in UTRA and GSM, see 3GPP TS36.214 Sections 5.1.5, 5.1.7 and 5.1.8.

RTCP Real-time Transport Control Protocol. RTCP provides control signalling functionality to support data packets transmitted by Real-time Transport Protocol (RTP). Its primary function is to monitor transmission statistics to provide Quality of Service (QoS) feedback for the RTP data. See IETF RFC3550, www.ietf.org.

RTD Round-Trip Delay. RTD usually refers to twice the one-way propagation delay for a radio signal between a source node and a destination node. In some instances it may also include a processing time at the destination node, for the response signal to be generated.

RTP Real-time Transport Protocol. RTP is a communication protocol which provides end-to-end network transport functions suitable for applications transmitting real-time data, such as audio and video over multicast or unicast networks. See IETF RFC3550, www.ietf.org.

RTT Round-Trip Time. RTT usually refers to the time between retransmissions in a Hybrid Automatic Repeat reQuest (HARQ) protocol. It therefore consists of the total time required for a packet to travel from a source node to a destination node, for decoding and ACKnowledgement/Negative ACKnowledgment (ACK/NACK) generation at the destination, for transmission of a response back to the source, and for processing at the source to formulate the retransmission.

RV Redundancy Version. An RV is a particular set of systematic and parity bits transmitted from a channel-coded data packet. In Incremental Redundancy (IR) schemes, successive retransmissions of the packet use different RVs. In LTE, each RV is defined by a particular starting point in the rate matching circular buffer filled from the output of the turbo coder. The RV of each retransmission must be known by the receiver (either by explicit signalling or specified rules) in order to enable correct combining with other transmissions of the same packet. See 3GPP TS36.212 Section 5.1.4.1.2.

Rx Receive.

RxD Receive Diversity. The use of two or more physically separate antennas for reception.

S/P Serial-to-Parallel. The conversion of a serial sequence of symbols into a parallel set of sequences, usually by mapping each symbol (or group of symbols) of the serial sequence to a different one of the parallel sequences in turn.

S1 The interface between an eNodeB and the Core Network (CN). See 3GPP TS36.300 Section 19 and TS36.410 to TS36.414.

S1-AP S1 Application Protocol. The radio network layer signalling protocol of the S1 interface. See 3GPP TS36.413.

S1-U S1-User plane. Provides non-guaranteed delivery of user plane Protocol Data Units (PDU) between the eNodeB and the Serving-GateWay (S-GW). It is built on Internet Protocol (IP) transport, and GPRS Tunnelling Protocol-User Plane (GTP-U) is used on top of User Data Protocol (UDP) / Internet Protocol (IP) to carry the user plane PDUs between the eNodeB and the S-GW. It supports inter-eNodeB path switching during handover. See 3GPP TS36.300 Section 19.1 and TS36.414.

S5 The interface between a Serving-GateWay (S-GW) and a Packet Data Network GateWay (P-GW) within the same Public Land Mobile Network (PLMN).

S8 The interface between a Serving-GateWay (S-GW) and a Packet Data Network GateWay (P-GW) in different Public Land Mobile Networks (PLMN).

SABM Set Asynchronous Balanced Mode. A message in the High-Level Data Link Control (HDLC) protocol, used to initiate Asynchronous Balanced Mode (ABM).

SAE System Architecture Evolution. The part of the Evolved Packet System (EPS) which involves the non-radio aspects. It includes the Evolved Packet Core (EPC) network, and accompanies LTE.

SAP Service Access Point. A point at which a higher layer application may access the services of a lower protocol layer. See 3GPP TS23.110.

SAPI Service Access Point Identifier. An address field identifying a destination Service Access Point (SAP). See 3GPP TS23.110 Section 6.1.3.

SAW Stop-And-Wait. A simple Automatic Repeat reQuest (ARQ) technique, in which, upon transmission of a transport block, the transmitter stops and awaits feedback from the receiver before making any further transmissions. If an ACKnowledgment (ACK) does not reach the transmitter before a certain time has elapsed, or if a NegativeACK (NACK) is received, the transmitter retransmits the same transport block. Such a simple SAW operation cannot on its own utilize the transmission resources during the period between the first transmission and the retransmission. Therefore multiple SAW processes can be interlaced in time so that all the transmission resources can be used by one of the processes. Each SAW process is responsible for a separate SAW operation and manages a separate buffer.

SC-FDMA Single-Carrier Frequency Division Multiple Access. SC-FDMA, like Orthogonal Frequency Division Multiplexing (OFDM), divides the transmission bandwidth into multiple parallel subcarriers, with the orthogonality between the subcarriers being maintained in frequency-selective channels by the use of a Cyclic Prefix (CP). The use of a CP prevents Inter-Symbol Interference (ISI) between SC-FDMA information blocks. However, unlike OFDM, in SC-FDMA the signal modulated onto a given subcarrier is a linear combination (typically via a DFT precoding operation) of all the data symbols transmitted at the same time instant. Thus in each symbol period, all the transmitted subcarriers of an SC-FDMA signal carry a component of each modulated data symbol. This gives SC-FDMA its single-carrier property, which results in the lower Cubic Metric (CM) and Peak to Average Power Ratio (PAPR) than pure multicarrier transmission schemes such as OFDM. See 3GPP TS36.211 Section 5.6.

SCH Synchronization CHannel. A downlink channel in Wideband Code Division Multiple Access (WCDMA) (consisting of primary and secondary SCHs) allowing UEs to identify and synchronize to a cell. See 3GPP TS25.211 Section 5.3.3.5.

SCM Spatial Channel Model. A geometry-based stochastic channel model for Multiple-Input Multiple-Output (MIMO) systems developed jointly by 3GPP and 3GPP2. See 3GPP TR25.996.

SCME Spatial Channel Model - Extension. SCME is an extension to the 3GPP/3GPP2 SCM, developed in the IST-WINNER project. The extension was designed to increase the channel model bandwidth from 5MHz to 100MHz, while remaining simple and backward-compatible with the original SCM. See www.ist-winner.org.

SCTP Stream Control Transmission Protocol. A reliable transport layer protocol, defined by the Internet Engineering Task Force (IETF), operating on top of a connectionless packet network such as Internet Protocol (IP). It was originally designed for transporting signalling messages for the Public Switched Telephone Network (PSTN) over IP networks. It ensures reliable, non-duplicated message delivery. In addition it can handle multiple streams and is tolerant of network-level faults through support of multi-homing. The design of SCTP also includes congestion avoidance and resistance to flooding and masquerade attacks. See IETF RFC4960, www.ietf.org.

SDF Service Data Flow. An aggregate set of packet flows that matches a set of filters (based on packet headers such as source and destination Internet Protocol (IP) addresses) in a Policy and Charging Control rule. See 3GPP TS23.203.

SDMA Spatial Division Multiple Access. A type of Multiple-Input Multiple-Output (MIMO) technology by which parallel streams are transmitted, with each stream being addressed to a different user. Each user is enabled to decode its own stream by virtue of its antenna(s) being spatially separated from those of other users, together with spatial decorrelation of the transmitting antennas.

SDO Standards Development Organisation. An organisation whose primary activities are developing, managing and promulgating standards. 3GPP is a partnership of six regional SDOs, namely the Association of Radio Industries and Businesses (ARIB), Alliance for Telecommunications Industry Solutions (ATIS), China Communications Standards Association (CCSA), European Telecommunications Standards Institute (ETSI), Telecommunication Technology Association (TTA) and Telecommunication Technology Committee (TTC).

SDU Service Data Unit. At the transmitting side, an SDU is a unit data which a certain protocol layer receives from a higher layer, for which the layer in question provides a transport service. The SDU of layer n is a Packet Data Unit (PDU) of layer $n + 1$. At the receiving side, the process is reversed: each layer passes SDUs up to the layer above, where they are received as PDUs.

SEM Spectrum Emission Mask. A mask defined for out-of-channel emissions of a transmitter relative to the in-channel power. See 3GPP TS36.101 Section 6.6.2.1.

SFBC Space-Frequency Block Code. A frequency-domain version of the well-known Space-Time Block Codes (STBCs), also known as Alamouti codes. This family of codes is designed so that the transmitted diversity streams are orthogonal and achieve the optimal Signal to Noise Ratio (SNR) with a linear receiver. Such orthogonal codes only exist for the case of two transmit antennas. Generalizations are possible for higher dimensions.

SFDR Spurious-Free Dynamic Range. The input power range in which the received signal can be detected in the presence of noise, and amplified, without being exposed to InterModulation Distortion (IMD) from the non-linear amplification of interfering signals.

SFN System Frame Number. SFN identifies the 10 ms radio frames of a cell of an eNodeB. See 3GPP TS36.331 Section 6.2.2.7.

SGSN Serving GPRS Support Node. The interface between the radio system and the fixed network for Packet Switched (PS) services, performing all necessary functions in order to handle packet transmission to and from the mobile stations. For each mobile station, the SGSN stores subscription and location information, including the cell or the Routing Area (RA) where the mobile station is registered. See 3GPP TS23.002 Sections 4.1.3.1 and 4.1.4.3.

S-GW Serving GateWay. The gateway which terminates the interface towards E-UTRAN. For each UE associated with the Evolved Packet System (EPS), at a given point in time, there is a single S-GW. See 3GPP TS23.002 Section 4.1.4.2.1.

SI Study Item. A formal task in 3GPP addressing a specific topic, not intended to produce changes to normative specifications. A Technical Report may be produced to document the findings.

SI System Information. SI consists of cell- and network-specific parameters which are broadcast to allow UEs to connect successfully to the network. SIs is structured into System Information Blocks (SIB), each of which contains a set of functionally-related parameters. See 3GPP TS36.331 Sections 5.2, 6.2.2.7 and 6.3.1.

SIB System Information Block. The System Information (SI) is broadcast in SIBs, each of which contains a set of functionally-related parameters. In LTE, the SIB types include: the Master Information Block (MIB), which contains a limited number of the most frequently transmitted parameters which are essential for a UE's initial access to the network; SIB1, which contains parameters needed to determine if a cell is suitable for cell selection, as well as information about the time domain scheduling of the other SIBs; SIB2, which includes common and shared channel information; SIB3 - SIB8, which include parameters used to control intra-frequency, inter-frequency and inter-Radio Access Technology (RAT) cell reselection. See 3GPP TS36.331 Sections 6.2.2.7 and 6.3.1.

SIC Successive Interference Cancellation. A decoding technique where multiple data streams which are individually channel-coded and are received simultaneously, are processed one by one, from the strongest to the weakest stream. The process is handled in a serial manner in contrast to Parallel Interference Cancellation (PIC) where the streams are simultaneously processed at each stage. In SIC, the processing sequence typically consists of detection, decoding, remodulating, re-encoding and subtraction from the total received signal.

SIM Subscriber Identity Module. The entity that contains the International Mobile Subscriber Identity (IMSI) which uniquely identifies a subscriber. Without a valid IMSI, GSM service is not accessible. The main function of the SIM is to provide a means to authenticate the user, but it may also store other subscriber-related information or applications such as text messages and phone book contacts. The equivalent of a SIM in UMTS and LTE is a Universal Subscriber Identity Module (USIM). See 3GPP TS42.017.

SIMO Single-Input Multiple-Output. A transmission scheme between a transmitter equipped with a single antenna and a receiver equipped with multiple antennas.

SINR Signal to Interference plus Noise Ratio. The ratio of the average received modulated carrier power to the sum of the average co-channel interference power (i.e. signals other than the wanted signal) and the noise power from other sources (typically thermal noise, modelled as Additive White Gaussian Noise (AWGN)), which are simultaneously-received.

SIP Session Initiation Protocol. SIP is an Internet Engineering Task Force (IETF) application-layer signalling protocol. It is used for setting up, modifying, and terminating sessions with one or more participants consisting of one or several media streams. These sessions include two-way voice or video call, collaborative multi-media conference session, streaming multimedia distribution, instant messaging and online games. It allows parameters (e.g. addresses or ports, inviting more participants, adding or deleting media streams) to be changed in mid-session. See IETF RFC3261, www.ietf.org.

SIR Signal to Interference Ratio. The ratio of the average received modulated carrier power to the average simultaneously-received co-channel interference power (i.e. signals other than the wanted signal). The SIR is also known as the Carrier to Interference Ratio (CIR).

SI-RNTI System Information Radio Network Temporary Identifier (RNTI). A fixed identifier used on the Physical Downlink Control CHannel (PDCCH) to indicate broadcast System Information Blocks (SIBs) transmitted on the Physical Downlink Shared CHannel (PDSCH). The SI-RNTI is known a priori to all UEs and thus allows SIBs to be distinguished from UEs' data transmitted on the same channel. It is transmitted as a scrambling code applied to the Cyclic Redundancy Check (CRC) of the PDCCH transmission. See 3GPP TS36.321 Section 7.1.

SISO Single-Input Single-Output. A transmission scheme between a transmitter equipped with a single antenna and a receiver equipped with a single antenna.

SISO Soft-Input Soft-Output. A term applied to a Forward Error Correction (FEC) decoder, which processes soft (i.e. non-binary) input values to produce new soft output values (typically A-Posteriori Probabilities (APP)). A SISO decoder can be used to decode convolutional codes as well as turbo codes; in the latter case, two SISO decoders operate in parallel, each refining the outputs of the other and producing new extrinsic information to pass back to the other for the next iteration.

SMC Security Mode Command. The SMC procedure consists of a round-trip of messages between an eNodeB and a UE. It allows an active UE and a serving eNodeB to agree upon algorithms for Radio Resource Control (RRC) ciphering integrity protection, user-plane ciphering, Non-Access Stratum (NAS) ciphering integrity protection, and Key Derivation for the Evolved Packet System (EPS). See 3GPP TS33.401, Section 7.2.4.

S-MCCH Secondary Multicast Control CHannel. A channel discussed for the implementation of Multimedia Broadcast and Multicast Service (MBMS) in a future release of LTE. It would be responsible for signalling MBMS control information for a Multimedia Broadcast Single Frequency Network (MBSFN) area. See 3GPP TS36.300 Section 15.3.5.

SMS Short Message Service. SMS (also commonly referred to as "text messaging") is a communications protocol allowing the interchange of short text messages of up to 160 characters between mobile devices. SMS is similar to paging, except that it is a store-and-forward system and therefore does not require the mobile phone to be active and within range. Messages are sent to a Short Message Service Centre (SMSC), stored and delivered to the mobile when it is connected to the network.

SN Sequence Number. A label attached to a packet to indicate the order in which the packet was transmitted with respect to other packets. As an example, SNs are used in the headers of Radio Link Control (RLC) Protocol Data Units (PDUs) to enable reordering in the receiver. The SN is incremented by one for each PDU. In the case of an Acknowledged Mode Data (AMD) PDU segment, the SN indicates the sequence number of the original AMD PDU of which the AMD PDU segment is a part. See 3GPP TS36.322 Section 6.2.2.3.

SND Sequence Number Down. A GPRS Tunnelling Protocol (GTP) sequence number of the next downlink N- Protocol Data Unit (PDU) to be sent to the mobile station. See 3GPP TS29.060 Section 7.7.29.

SNDCP SubNetwork Dependent Convergence Protocol. The SNDCP provides services to the higher layers which may include multiplexing of Packet Data Protocols (PDPs), compression/decompression of user data, compression/decompression of protocol control information, segmentation of network Protocol Data Units (PDUs) into Logical Link Control (LLC) PDUs, and re-assembly of LLC PDUs into network PDUs. See 3GPP TS44.065.

SNOW 3G A stream-cipher algorithm available in UMTS and LTE. See ETSI TC SAGE Specification ‘Specification of the 3GPP Confidentiality and Integrity Algorithms UEA2 and UIA2; Document 1: UEA2 and UIA2 specifications’, available from portal.etsi.org and subject to licensing conditions.

SN-PDU SubNetwork Dependent Convergence Protocol Protocol Data Unit. A Protocol Data Unit (PDU) processed by the SubNetwork Dependent Convergence Protocol (SNDPC). See 3GPP TS44.065.

SNR Signal-to-Noise Ratio. The ratio of the average received modulated carrier power to the noise power (typically thermal noise modelled as Additive White Gaussian Noise (AWGN)).

SNU Sequence Number Up. A GPRS Tunnelling Protocol (GTP) sequence number of the next uplink N- Protocol Data Unit (PDU) to be sent to the Gateway GPRS Support Node (GGSN). See 3GPP TS29.060 Section 7.7.29.

SO Segmentation Offset. A 15-bit field in the header of an Acknowledged Mode Data (AMD) Protocol Data Unit (PDU) segment indicating the starting position of the segment within the original AMD PDU. See 3GPP TS36.322 Section 6.2.2.7.

SON Self-Optimizing/Organizing Network. A feature of LTE which is designed to support self-configuration for newly-added cells and self-optimization for existing ones (with minimal human involvement). Measurements (e.g. of radio channel reception levels and traffic loads) can be collected and processed to support these functions, for example to provide the targeted service availability and quality as efficiently as possible and to resolve capacity/coverage gaps in case of cell failure. See 3GPP TR36.902.

SPID Subscriber Profile IDentity for Radio Access Technology / Frequency Selection Priority. A parameter received by the eNodeB via the S1 interface which refers to user information (e.g. mobility profile, service usage profile). SPID is used to define camp priorities in Idle mode and to control inter- Radio Access Technology (inter-RAT) / inter-frequency handover in Connected mode. See 3GPP TS36.300 Section 16.1.8.

SPL Sound Pressure Level. A measure of the amplitude of a sound wave, measured in dBPa. Used in tests for audio noise arising from electromagnetic interference. See 3GPP TS36.124 Annex A.

SPS Semi-Persistent Scheduling. SPS enables radio resources to be semi-statically configured and allocated to a UE for a longer time period than one subframe, avoiding the need for specific downlink assignment messages or uplink grant messages over the Physical Downlink Control CHannel (PDCCH) for each subframe. SPS is useful for services where the timing and amount of radio resources needed are predictable, such as Voice over Internet Protocol (VoIP), thus reducing considerably the overhead of the PDCCH compared to dynamic scheduling. See 3GPP TS36.321 Section 5.10.

SPS-C-RNTI Semi-Persistent Scheduling Cell- Radio Network Temporary Identifier. An identifier of the scheduling messages transmitted on the Physical Downlink Control CHannel (PDCCH) for semi-persistently scheduled Physical Downlink Shared CHannel (PDSCH) data transmissions. It allows the UE to differentiate these messages from those used for dynamic scheduling messages identified by Cell- Radio Network Temporary Identifier (C-RNTI). It is transmitted as a scrambling code applied to the Cyclic Redundancy Check (CRC) of the PDCCH transmission. See 3GPP TS36.321 Section 7.1.

SR Scheduling Request. An SR is employed by the UE to request allocation of uplink resources when having data ready for transmission but no resource grant for use of the Physical Uplink Shared CHannel (PUSCH). It is transmitted on the Physical Uplink Control CHannel (PUCCH). See 3GPP TS36.312 Section 5.4.4.

SRB Signalling Radio Bearer. A radio bearer carrying Radio Resource Control (RRC) signalling messages. See 3GPP TS36.331 Section 4.2.2.

SRS Sounding Reference Signals. Reference signals transmitted in the LTE Up-Link (UL) to enable the eNodeB to perform channel sounding, for example to support frequency-domain scheduling. See 3GPP TS36.211 Section 5.5.3.

SRVCC Single Radio Voice Call Continuity (VCC). SRVCC refers to continuity between Internet Protocol (IP) Multimedia Subsystem (IMS)-over-Packet Switched (PS) access and Circuit Switched (CS) calls that are anchored in IMS when the UE is capable of transmitting/receiving on only one of those access networks at a given time. See 3GPP TS23.216.

SS System Simulator. A simulator used for conformance testing of UEs. It models at least one eNodeB and often some interference sources, enabling the UE's performance to be evaluated. See 3GPP TS36.508.

SSC Secondary Synchronization Code. The code transmitted on the WCDMA Secondary Synchronization Channel (S-SCH). See 3GPP TS25.211 Section 5.3.3.5.

SSS Secondary Synchronization Signal. The SSS is used by the UE to detect the LTE frame timing and to obtain the physical layer cell identity group. It is transmitted twice in each 10 ms frame. The SSS sequences are based on maximum length sequences, known as M-sequences. Each SSS sequence is constructed by interleaving, in the frequency-domain, two length-31 Binary Phase Shift Keying (BPSK)-modulated sequences. These two codes are two different cyclic shifts of a single length-31 M-sequence. The cyclic shift indices of the M-sequences are derived from a function of the physical layer cell identity group. The two codes are alternated between the first and second SSS transmissions in each radio frame. This enables the UE to determine the 10 ms radio frame timing from a single observation of a SSS. See 3GPP TS36.211 Section 6.11.1.

SSS_RA Secondary Synchronization Signal - to - Reference Signal Energy Per Resource Element ratio. The transmitted energy ratio (per resource element) between the Secondary Synchronization Signal (SSS) and the downlink Reference Signal (RS), used in defining performance requirements. See 3GPP TS36.101 Annex C.

STBC Space-Time Block Code. A transmit diversity technique involving the transmission of multiple copies of a data stream using multiple antennas and multiple symbol periods, in order to improve the reliability of the received data. The best-known STBC technique is the Alamouti scheme, whereby the transmitted diversity streams are designed to be orthogonal and achieve the optimal Signal to Noise Ratio (SNR) with a linear receiver. Such orthogonal codes only exist for the case of two transmit antennas. Generalizations are possible for higher dimensions.

S-TMSI System Architecture Evolution - Temporary Mobile Subscriber Identity. The S-TMSI is a unique identifier assigned to the UE by the Mobility Management Entity (MME) in order to identify the UE context while supporting subscriber identity confidentiality. See 3GPP TS23.003 Section 2.9.

STTD Space-Time Transmit Diversity. The name given to a transmit diversity scheme used in WCDMA. It uses two transmit antennas, with the same data being transmitted from both NodeB antennas, using a space-time block code to ensure orthogonality of the signals from the two transmit antennas. See 3GPP TS25.211 Section 5.3.1.1.1.

SU-MIMO Single-User Multiple-Input Multiple-Output. In relation to the LTE downlink, SU-MIMO refers to the use of multiple transmit and receive antennas to transmit possibly multiple independent data streams simultaneously to a single UE using the same resource blocks. It corresponds to Physical Downlink Shared CHannel (PDSCH) transmission modes 3 and 4. See 3GPP TS36.213 Sections 7.1.3 and 7.1.4.

SVD Singular-Value Decomposition. A factorization of a rectangular matrix (real or complex). The SVD of an $m \times n$ matrix $\mathbf{M}$ is obtained as $\mathbf{M} = \mathbf{U}\mathbf{\Sigma}\mathbf{V}^{\mathrm{H}}$, where $\mathbf{U}$ and $\mathbf{V}$ are $m \times m$ and $n \times n$ unitary matrices and the matrix $\mathbf{\Sigma}$ is an $m \times n$ diagonal matrix with non-negative real numbers on the diagonal. The diagonal entries of $\mathbf{\Sigma}$ are the singular values of $\mathbf{M}$. The columns of $\mathbf{U}$ and $\mathbf{V}$ are, respectively, left- and right-singular vectors for the corresponding singular values. SVD can for example be used to construct the optimal transmit and receive beamforming matrices in Multiple-Input Multiple-Output (MIMO) applications.

SVN Software Version Number.

TA Tracking Area. A TA includes one or several E-UTRAN cells. The network allocates a list with one or more TAs to the UE. In certain operation modes, the UE may move freely in all TAs of the list without updating the Mobility Management Entity (MME).

TA Timing Advance. A mechanism by which the uplink transmission timing is set earlier than the downlink timing as received at the UE, in order to compensate for propagation delay. The timing advance procedure in LTE is divided into Initial Timing Advance and Timing Advance Updates. The Initial TA is used after the UE first synchronizes its receiver to the downlink transmissions of the eNodeB and is set by means of the random access procedure: the eNodeB can estimate the uplink timing from the random access preamble and sends timing advance command within the Random Access Response (RAR) message. The TA Updates are needed from time to time to update the uplink transmission timing to counteract changes in the arrival time at the eNodeB; it is performed by a closed-loop mechanism whereby the eNodeB measures the received uplink timing and issues timing advance update commands to the UE by means of Medium Access Control (MAC) control elements. See 3GPP TS36.321 Section 5.2 and TS36.213 Section 4.2.3.

TA Time Alignment. The main role of time alignment is to counteract differing propagation delays between different UEs for uplink transmissions and have all UEs symbols time-aligned at the eNodeB is order to preserve the intra-cell orthogonality. This is achieved by applying a timing advance at the UE transmitter, relative to the received downlink timing. See 3GPP TS36.321 Section 5.2 and TS36.213 Section 4.2.3.

TAC Tracking Area Code. The TAC is part of the Tracking Area Identity (TAI). It is a 16-bit integer. See 3GPP TS23.003 Section 19.4.2.3.

TAD Traffic Aggregate Description. The TAD consists of a description of the packet filter(s) for the traffic flow aggregate (where a traffic flow aggregate consists of data traffic for a particular destination).

TAI Tracking Area Identity. This is the identity used to identify tracking areas. It is composed of a Tracking Area Code (TAC), a Mobile Network Code (MNC) and a Mobile Country Code (MCC). See 3GPP TS23.003 Section 19.4.2.3.

TAT Timing Advance Timer. A timer whose duration is configured by the eNodeB, which is restarted each time a timing advance command is received. As long as the timer is running, the UE can consider that its uplink is synchronized and can transmit directly using the Physical Uplink Control CHannel (PUCCH) or Physical Uplink Shared CHannel (PUSCH). If the timer expires, the UE must use the Random Access CHannel (RACH) to reacquire uplink synchronization before any other uplink transmissions can be made. See 3GPP TS36.321 Section 5.2.

TAU Tracking Area Update. The procedure by which the UE updates the network as to its new location, either periodically or whenever it moves out of its current Tracking Area (TA). See 3GPP TS23.401 Section 4.3.5.2.

TB Transport Block. A Medium Access Control (MAC) Protocol Data Unit (PDU) delivered to the physical layer. Each TB is individually protected by a Cyclic Redundancy Check (CRC) and encoded as a single codeword for transmission.

TBD To Be Determined. A term used to indicate that an item needs to be decided in the future.

TBF Temporary Block Flow. A physical connection used by two GPRS radio resource entities to support the unidirectional transfer of upper layer Packet Data Units (PDUs) on packet data physical channels. See 3GPP TS44.060 Section 5.2.1.

TBS Transport Block Size. The number of bits in a Transport Block (TB). See 3GPP TS36.213 Sections 7.1.7.2 and 8.6.2.

TC Test Case. A set of conditions and procedures under which a tester will determine whether certain specification requirements are met.

TCH Traffic CHannel. A channel carrying data traffic.

TCP Transmission Control Protocol. TCP is a reliable host-to-host protocol used in packet-switched communication networks together with the Internet Protocol (IP). While IP handles the actual transmission of the packets, TCP takes care of the control of the packets, requesting retransmission of lost ones and rearranging out-of-order packets. It also helps minimize network congestion. See IETF RFC4614, www.ietf.org.

TDD Time Division Duplex. A mode of bidirectional communication in which transmissions in each direction take place on the same carrier frequency but in different time slots.

TDL Tapped Delay Line. A model in which a signal is delayed in multiple successive stages, with outputs being taken at one or more points between the stages. Such models are frequently used to emulate the different delays of a multipath propagation channel. Similar structures are used in linear equalizer receivers, where the outputs from each tap are individually weighted and then combined.

TDM Time Division Multiplexing. A method of multiplexing different data signals, whereby the channel is divided into multiple time slots and the different signals are mapped to different time slots.

TDMA Time Division Multiple Access. An access scheme allowing multiple users to share the same frequency channel by dividing the channel into different time slots. Each user is allocated a different time slot.

TD-SCDMA Time Division Synchronous Code Division Multiple Access. A 3G mobile telecommunications standard, based on the 1.28 Mcps Time Division Duplex (TDD) mode of UMTS. TD-SCDMA is termed "synchronous" as the uplink signals are synchronized at the base station receiver by means of regular timing adjustments.

TE Terminal Equipment. Equipment that provides the functions necessary for the operation of access protocols by a user. See ITU-T I.112, www.itu.int/itu-t.

TEID Tunnelling End IDentity. Uniquely identifies a tunnel endpoint in a receiving GPRS Tunnelling Protocol (GTP)-User-plane or GTP-Control plane entity. See 3GPP TS29.281 Section 4.2.1.

TF Transport Format. A term typically used to describe the modulation and coding scheme applied for the transmission of a transport block.

TFT Traffic Flow Template. TFTs are used to discriminate between different user payloads. They use Internet Protocol (IP) header information such as source and destination IP addresses and Transmission Control Protocol (TCP) port numbers to filter packets such as Voice over Internet Protocol (VoIP) from web browsing traffic so that each can be sent down the respective bearers with appropriate Quality of Service (QoS). See 3GPP TS23.060 Section 15.3.

TGRP Transmission Gap Repetition Period. LTE can provide regularly-spaced transmission gaps to enable a UE to identify and measure inter-frequency and/or inter- Radio Access Technology (inter-RAT) cells. During these gaps the UE does not transmit any data and is not expected to tune its receiver to the E-UTRAN serving carrier frequency. The TGRP is the time between the start of one transmission gap and the start of the next. See 3GPP TS36.133 Section 8.1.2.

TH Temperature High. Denotes the upper temperature at which extreme-condition conformance testing is carried out for a UE, namely $+55°$C (See also Temperature Low (TL)). See 3GPP TS36.508 Section 4.1.1.

TI Transaction Identifier. The UE dynamically allocates a TI for UE-requested Packet Data Protocol (PDP) context activation. TIs for network-requested PDP context activation are dynamically allocated by the network. A corresponding allocation is also needed for Evolved Packet System (EPS) Bearers in order to successfully transfer Bearers to GERAN/UTRAN. See 3GPP TS23.401 Section 5.2.1.

TIN Temporary Identifier used in Next update. A parameter which identifies the UE identity that the UE is to indicate in the next Routing Area Update (RAU) Request or Tracking Area Update (TAU) Request message. The TIN also identifies the status of Idle state Signalling Reduction (ISR) activation in the UE. See 3GPP TS23.401 Section 4.3.5.6.

TL Temperature Low. Denotes the lower temperature at which extreme-condition conformance testing is carried out for a UE, namely $-10°$C (See also Temperature High (TH)). See 3GPP TS36.508 Section 4.1.1.

TLLI Temporary Logical Link Identity. Used for addressing resources allocated for GPRS services at Radio Link Control (RLC)/Medium Access Control (MAC) layer communication between the mobile station and the Serving GPRS Support Node (SGSN). Three types of TLLI exist: Local TLLI (for normal use), Foreign TLLI (for use when crossing a Routing Area boundary) and Random TLLI (used for initial access). See 3GPP TS23.060.

TM Transparent Mode. One of three Radio Link Control (RLC) data transmission modes (the other two being Acknowledged Mode (AM) and Unacknowledged Mode (UM)). The TM RLC entity is transparent to the Protocol Data Units (PDU) that pass through it – no functions are performed and no RLC overhead is added; thus an RLC Service Data Unit (SDU) is directly mapped to an RLC PDU and vice versa. The use of TM RLC is very restricted: only Radio Resource Control (RRC) messages which do not need RLC configuration can utilize the TM RLC, such as broadcast system information messages and paging messages. TM RLC is not used for user plane data transmission in LTE. See 3GPP TS36.322.

TMA Tower Mounted Amplifier. A Low-Noise Amplifier (LNA) mounted as close as possible to the antenna in the base station. A TMA can enable the base station noise figure to be reduced and therefore improve the overall efficiency of the uplink transmission. See 3GPP TR25.818 and TS25.466 Section 6.8.

TMD Transparent Mode Data. The type of Protocol Data Unit (PDU) used in Radio Link Control (RLC) Transparent Mode (TM). It consists only of a data field and does not have any RLC headers. Since no segmentation or concatenation is performed, an RLC Service Data Unit (SDU) is directly mapped to a TMD PDU. See 3GPP TS36.322 Section 9.2.1.2.

TNL Transport Network Layer. The TNL establishes physical and logical connections between the Radio Access Network (RAN) and the Core Network (CN). It comprises the transport network control plane and the transport network user plane.

TPC Transmitter Power Control. The process of setting the transmission power, by either open-loop or closed-loop means. It can be used to counteract propagation effects such as path-loss, shadowing or fast fading, or to control interference to neighbouring cells. See 3GPP TS36.213 Section 5.

TPC-PUCCH-RNTI The Radio Network Temporary Identifier (RNTI) used for sending Transmitter Power Control (TPC) commands applicable to the Physical Uplink Control CHannel (PUCCH). See 3GPP TS36.321 Section 7.1.

TPC-PUSCH-RNTI The Radio Network Temporary Identifier (RNTI) used for sending Transmitter Power Control (TPC) commands applicable to the Physical Uplink Shared CHannel (PUSCH). See 3GPP TS36.321 Section 7.1.

TPD Total Power De-rating. TPD is the total amount by which the power amplifier needs to be operated below its rated maximum output power in order to meet a given Adjacent Channel Leakage Ratio (ACLR) requirement. TPD is composed of an element corresponding to the occupied bandwidth (as a proportion of the channel bandwidth) and an element corresponding to the waveform of the transmitted signal.

TPMI Transmitted Precoding Matrix Indicator. An indicator transmitted on the Physical Downlink Control CHannel (PDCCH) to inform the UE as to which codebook (precoding matrix) index is used for transmission to that UE on the Physical Downlink Shared CHannel (PDSCH). It enables the UE to form the correct phase reference for demodulating the PDSCH data, based on the correct linear combination of the common reference signals. See 3GPP TS36.212 Section 5.3.3.1.

TR Technical Report. A 3GPP output document containing mainly informative elements approved by a Technical Specification Group (TSG).

TrCH Transport CHannel. A set of Transport Channels are offered by physical layer that can be used by the Medium Access Control (MAC) sublayer. A TrCH is used to transmit one data flow with a given Quality of Service (QoS) over the radio interface. A number of TrCHs can be active at the same time and multiplexed at the physical layer. The transport channels are configured at call setup by the network.

TS Technical Specification. A 3GPP output document containing normative provisions approved by a Technical Specification Group (TSG).

TSG Technical Specification Group. 3GPP is divided into four TSGs: TSG Service and System Aspects (SA), TSG Core network and Terminals (CT), TSG Radio Access Network (RAN) and TSG GSM EDGE Radio Access Network (GERAN). Each TSG is comprised of a number of Working Groups (WGs) with responsibility for a specific aspect of the specifications.

TSTD Time-Switched Transmit Diversity. TSTD is a multiple antenna transmission technique where a signal is transmitted from only a subset (usually one) of the available antennas at any time. The selected subset changes periodically such that a block of data is transmitted from different antennas at different times. It is used in the LTE uplink. See 3GPP TS36.213 Section 8.7.

TT Test Tolerance. The amount by which a core specification performance requirement is relaxed to take into account factors such as measurement uncertainty. The TT is the difference between the core specification value and the test limit. See 3GPP TS36.521 Annex F.3.

TTA Telecommunications Technology Association. The Korean Standards Development Organization (SDO) in 3GPP. See www.tta.or.kr.

TTC Telecommunication Technology Committee. One of the Japanese Standards Development Organisations (SDOs) in 3GPP (the other being ARIB). See www.ttc.or.jp.

TTI Transmission Time Interval. The minimum time between Medium Access Control (MAC) Protocol Data Units (PDUs) being passed down to the physical layer. It is usually also the time over which data blocks are encoded for physical transmission. It is a multiple of the radio subframe length.

TU Typical Urban. Usually refers to a propagation model originally developed for GSM, representing deployment in an urban area. See www.etsi.org.

Tx Transmit.

TxD Transmit Diversity. The use of two or more physically separate antennas for transmission. A variety of TxD schemes are possible, such as the Space Frequency Block Code (SFBC)/ Frequency Switched Transmit Diversity (FSTD) schemes used in the LTE downlink, or Time Switched Transmit Diversity (TSTD) used in the LTE uplink. See 3GPP TS36.211 Section 6.3.4.3 and TS36.213 Section 8.7 respectively.

UARFCN UTRA Absolute Radio Frequency Channel Number. See ARFCN.

UCI Uplink Control Information. The term used to describe the control signalling (e.g. ACKnowledgement (ACK) / Negative ACK (NACK) and Channel Quality Indicator (CQI)) transmitted from the UE to the eNodeB. This information is usually transmitted using the Physical Uplink Control CHannel (PUCCH). See 3GPP TS36.212 Sections 5.2.3 and 5.2.4.

UDP User Datagram Protocol. A transport layer protocol used along with the Internet Protocol (IP). UDP is not designed to support reliable transfer, and therefore packets may arrive out of order, be duplicated, or be lost without notice. UDP assumes that error checking and correction is either not necessary or performed in the application. UDP does not use handshaking between sending and receiving transport-layer entities prior to sending a packet and is therefore said to be connectionless. The simplicity of UDP keeps the overhead from using the protocol low. Common applications that use UDP include time-sensitive applications (where loss of packets is preferable to delayed packets) and broadcasting (where feedback is not supported). See IETF RFC768, www.ietf.org.

UE User Equipment. The mobile unit which allows a user to access network services, connecting to the UTRAN or E-UTRAN via the radio interface. A UE can be subdivided into a Universal Integrated Circuit Card (UICC) and a Mobile Equipment (ME). See 3GPP TS21.905 Section 3.

UEA2 A new ciphering algorithm to be deployed in UMTS Release 7 as an insurance policy against the original UMTS Kasumi-based ciphering scheme being cracked in the future. See ETSI TC SAGE Specification 'Specification of the 3GPP Confidentiality and Integrity Algorithms UEA2 and UIA2; Document 1: UEA2 and UIA2 specifications', available from portal.etsi.org and subject to licensing conditions.

UE-AMBR UE Aggregate Maximum Bit-Rate. The Aggregate Maximum Bit-Rate (AMBR) for a specific UE.

UEUT User Equipment Under Test. A UE undergoing conformance testing. See 3GPP TS36.521-2.

UICC Universal Integrated Circuit Card. A physically-secure removable smart card used in mobile terminals, holding the Subscriber Identity Module (SIM) for GSM and the Universal SIM (USIM) for UMTS. See 3GPP TS31.101.

UL UpLink. The radio link in the direction from the mobile to the base station.

UL-SCH UpLink Shared Channel. A transport channel used for the uplink user data and control messages. See 3GPP TS36.321.

UM Unacknowledged Mode. One of three Radio Link Control (RLC) modes (the other two being Acknowledged Mode (AM) and Transparent Mode (TM)). It provides a unidirectional data transfer service and is used when retransmission is not necessary, for example for delay-sensitive and error-tolerant real-time applications, especially Voice over Internet Protocol (VoIP), and other delay sensitive streaming services. Point-to-multipoint services such as Multimedia Broadcast and Multicast Service (MBMS) also use UM RLC. See 3GPP TS36.322.

UMD Unacknowledged Mode Data. The type of Protocol Data Unit (PDU) used to carry user-plane data in Radio Link Control (RLC) Unacknowledged Mode (UM). The PDU header includes a sequence number to support reordering and duplicate-detection. See 3GPP TS36.322.

UMTS Universal Mobile Telecommunications System. A third-generation radio access technology standardized by 3GPP. It uses Wideband Code Division Multiple Access (WCDMA) as the underlying air interface.

UP Unitary Precoding. A beamforming method to support multi-layer transmission in Multiple-Input Multiple-Output (MIMO) radio systems, where the beamforming matrix is unitary. An N $\times$ N matrix $\mathbf{G}$ is unitary if $\mathbf{G}^{\mathrm{H}}\mathbf{G} = \mathbf{G}\mathbf{G}^{\mathrm{H}} = \mathbf{I}_{\mathrm{N}}$ where $\mathbf{I}_{\mathrm{N}}$ is the N $\times$ N identity matrix.

UPE User Plane Entity. The entity managing protocols on the user plane. The main functions of the UPE include terminating, for idle state UEs, the downlink data path and triggering/initiating paging when downlink data arrive for the UE. It also stores and manages UE contexts and performs replication of the user traffic in case of interception.

U-plane User plane. The user plane is the protocol stack carrying user data, as opposed to control signalling which is carried by the control plane. See 3GPP TS36.300 Section 4.3.1.

UpPTS Uplink Pilot TimeSlot. A special uplink timeslot occurring in the second (and in some configurations the 7^{th}) subframes of each radio frame when LTE is operated in Time Division Duplex (TDD). It has a length of 1 or 2 Single Carrier Frequency Division Multiple Access (SC-FDMA) symbols and is used only for transmission of a shortened Random Access CHannel (RACH) preamble or Sounding Reference Signal (SRS). The name UpPTS is derived from Time Division-Synchronous Code Division Multiple Access (TD-SCDMA). See 3GPP TS36.211 Section 4.2.

URRP-MME UE Reachability Request Parameter for the Mobility Management Entity (MME). A temporary parameter stored in the Home Subscriber Server (HSS) and MME, indicating that the HSS has requested the MME to provide notification of UE activity (for example the next Non-Access Stratum (NAS) activity by the UE). See 3GPP TS23.401.

USIM Universal Subscriber Identity Module. The USIM is one component which can run on a Universal Integrated Circuit Card (UICC) smart card. It is the UMTS and LTE equivalent of the Subscriber Identity Module (SIM) used in GSM. The USIM stores the security key identifying a mobile service subscriber, enabling the subscriber to access the service. It can also store information such as text messages and phone book contacts.

UTRA Universal Terrestrial Radio Access. The radio access solution for UMTS.

UTRAN Universal Terrestrial Radio Access Network. UTRAN consists of Radio Network Controllers (RNCs) and NodeBs of a UMTS network. It allows connectivity between the UE and the core network.

Uu The radio interface between the eNodeB and the User Equipment (or, in the case of UMTS, between the NodeB and the UE).

VCB Virtual Circular Buffer. The Circular Buffer (CB) used for rate matching in LTE. It is 'virtual' in the sense that it does not require the implementation of any actual physical buffer; for any combination of Transport Block Sizes (TBS) and Redundancy Versions (RVs), the desired output bits for transmission can be obtained directly from the output of the turbo encoder using simple addressing based on sub-block permutation. See 3GPP TS36.212 Section 5.1.4.1.2.

VCC Voice Call Continuity. A feature which allows a UE to move between different access technologies (in particular between the circuit-switched and packet-switched domains) while maintaining a voice call, in order to give a seamless user experience. See 3GPP TR23.806 and TS24.206.

VCO Voltage-Controlled Oscillator. An oscillator whose frequency is determined by the level of a control voltage input.

VH Higher extreme Voltage. The UE-manufacturer-declared supply voltage level (from a battery or mains) up to which a UE has to fulfil all the LTE specification requirements. If the supply voltage exceeds this value, the UE must take measures to ensure that it does not make ineffective use of the radio spectrum. See 3GPP TS36.101 Annex E.2.

VL Lower extreme Voltage. The UE-manufacturer-declared supply voltage level (from a battery or mains) below which a UE has to fulfil all the LTE specification requirements. If the supply voltage falls below this value, the UE must take measures to ensure that it does not make ineffective use of the radio spectrum. See 3GPP TS36.101 Annex E.2.

VLR Visitor Location Register. A database which stores information about all the mobiles that are currently under the jurisdiction of a Mobile Switching Centre (MSC) that it serves. See 3GPP TS23.002 Section 4.1.1.2.

VoIP Voice over Internet Protocol. The transmission of packetized voice communications using IP. VoIP is a thus a packet-switched technology.

V-PCRF Visited Policy Control and Charging Rules Function. The Policy Control and Charging Rules Function (PCRF) which resides within the Visited Public Land Mobile Network (VPLMN).

VPLMN Visited Public Land Mobile Network. A Public Land Mobile Network (PLMN) on which the mobile subscriber has roamed when leaving their Home PLMN (HPLMN).

VRB Virtual Resource Block. A logical unit of transmission resource in the LTE downlink, associated with the same dimensions and number of Resource Elements (REs) as a Physical Resource Block (RB). VRBs are mapped to PRBs in pairs. Two types of VRB exist: localized VRBs and distributed VRBs. A pair of localized VRBs is mapped to a pair of PRBs which occupy the same 12 subcarriers in the same subframe. A pair of distributed VRBs is mapped to a pair of PRBs such that one of the PRBs occupies one set of 12 subcarriers in the first slot of a subframe and the other PRB occupies a different set of 12 subcarriers in the second slot of the same subframe. Distributed VRBs are used for frequency diverse scheduling while localized VRBs may be used for frequency selective scheduling. See 3GPP TS36.211 Section 6.2.3.

X2 The interface used to interconnect eNodeBs. See 3GPP TS36.300 Section 20 and TS36.420 to TS36.424.

X2-C X2 Control plane. The signalling interface between eNodeBs. See 3GPP TS36.422.

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xCH_RA xCHannel to Reference Signal Energy Per Resource Element ratio. The transmitted energy ratio (per Resource Element (RE)) between an arbitrary downlink channel 'xCH' and the downlink Reference Signal (RS), in all transmitted Orthogonal Frequency Division Multiplexed (OFDM) symbols not containing RS. Used in defining performance requirements. See 3GPP TS36.101 Annex C.

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xCH_RB xCHannel to Reference Signal Energy Per Resource Element ratio. The transmitted energy ratio (per Resource Element (RE)) between an arbitrary downlink channel 'xCH' and the downlink Reference Signal (RS), in all transmitted Orthogonal Frequency Division Multiplexing (OFDM) symbols containing RS. Used in defining performance requirements. See 3GPP TS36.101 Annex C.

XID eXchange IDentification. An identifier that is exchanged between nodes to negotiate parameters of the Radio Link Protocol (RLP) layer 2 Relay function. See 3GPP TS24.022 Section 5.2.2.6.

X-MAC X Message Authentication Code. An X-MAC is calculated by the receiver of a Packet Data Convergence Protocol (PDCP) Protocol Data Unit (PDU) during the process of integrity verification for Signalling Radio Bearers (SRBs). If the calculated X-MAC value corresponds to the Message Authentication Code for Integrity (MAC-I), integrity protection has been verified successfully. See 3GPP TS36.323 Section 5.7.

ZC Zadoff-Chu. Non-binary unit-amplitude sequences, which satisfy a Constant Amplitude Zero Autocorrelation (CAZAC) property. They are also known as Generalized Chirp-Like (GCL) sequences.

ZCZ Zero Correlation Zone. A zone where the correlation between a Zadoff-Chu (ZC) sequence and a cyclicly-shifted replica of the same sequence is equal to zero. This zone maintains orthogonality between the two sequences provided that the misalignment between them is smaller than the shift.

ZF Zero-Forcing. A filter design in which the coefficients are selected in order to eliminate (i.e. force to zero) unwanted signal components. Examples are zero-forcing equalizers and zero-forcing transmit precoders, which can be applied in the receiver and transmitter respectively. Zero-forcing equalizers are defined for the Error Vector Magnitude (EVM) measurement procedure for LTE. See 3GPP TS36.101 Annex F.

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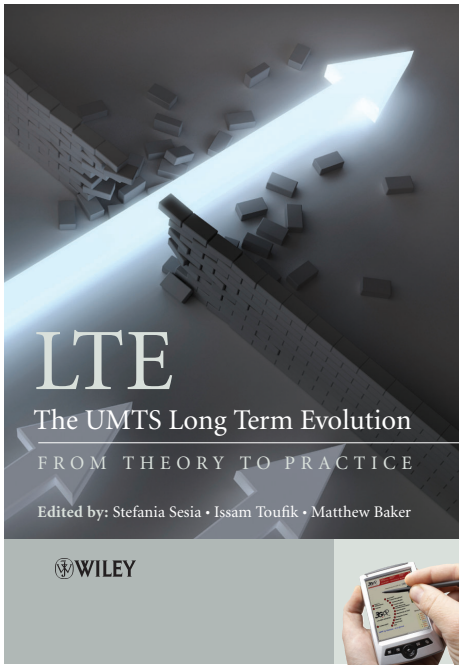

ISBN 978-0-470-69716-0
Available from www.wiley.com