LTE And LTE-Advance Version 9 of the 3GPP for High Bit Rate Data Transmission For 4Generation of Mobile Networks

[1]Amin Aliabadi (s)
[2]Mahdieh Ramesh Khar(s)
[3]Amin heydari
*Corresponding Author E-mail: Communication.blogfa@gmail.com

Received: January 14, 2012 Revised: March 3, 2012 Accepted: March 10, 2012

ABSTRACT:
Due to the limitations of second generation mobile telecommunications system (GSM) in the message available bit rate of user, And limited mobile services as voice calls (The signal sent to the SMS service) And the demand for services such as Internet (Web Browsing), TV, send picture and video data as and etc… Operators at European, Japanese and American (in a single system called 3GPP) to send a data packet switch or IP3 (nor CS4) will attract. In this paper, given that growth in third generation mobile phones (UMTS99 techniques under R99 = WCDMA) has evolved , And also in the other versions of five papers (HSDPA), six (HSUPA & MBMS), seven (HSPA +) have been investigated. Many scientists believe that a review eight Version, four-generation mobile l (LTE) to increase the bit rate available to users of cellular mobile networks (under the same bandwidth), Increasing the bit rate available to users in the DL with the introduction of HSDPA in version 5 (2005), in the UL introduced the HSUPA version 6 (2007) and the release of seven and eight, with the introduction of HSPA + and LTE in both the UL and DL (2009) has begun, This evolution is likely to be completed in 2020. Few countries in the third generation now outdated and LTE is being used as experimental. Defects disappear in the course of 2014 will reach a more favorable situation. Proposal and agreement for the LTE radio technology that was used. For DL OFDMA and SC-FDMA is in the UL. In this article an overview of the techniques being considered for LTE Release 10 (aka LTE Advanced) is discussed. This includes bandwidth extension via carrier aggregation to support deployment bandwidths up to 100 MHz , downlink spatial multiplexing including single-cell multi-user multiple-input multiple-output transmission and coordinated multi point transmission, uplink spatial multiplexing including extension to four-layer MIMO, and heterogeneous networks with emphasis on Type 1 and Type 2 release.

KEYWORDS: *LTE ،OFDMA ،SC-FDMA ،LTE Protocols*

1. INTRODUCTION

Increase the bit rate available in the DL with the introduction of HSDPA users in version 5, and this increase in six versions (HSUPA) in the UL, version six (MBMS), seven copies (HSPA +) in both directions was introduced by 3GPP;In this article we introduce and examine copies of Eight (LTE) and the advantages and Considering the advantages and disadvantages of these models and techniques to achieve the long term evolution (LTE) can be expressed. For more general information about a closer look LTE inevitably have a previous version.

The sixth section introduces the fourth generation mobile radio technology to check the version of the airline (Air Interface), , The network architecture of LTE, multi-carrier signal transmission method (OFDMA) and single-carrier (SC-FDMA (, LTE physical layer and its protocols will , It is not unpleasant to the point that some believed were in the early emergence of LTE Competition between WiMAX and LTE on the verge of a hard and closely , But recent forecasts from the fact soon revealed that LTE and WiMAX have taken place since 2016 About this technology (WiMAX and its modems!) Will go along. [2].

2. LTE ARCHITECTURE

Schematic network architecture that has been agreed in 3GPP Figure 6-3 in more detail and is shown alongside the UMTS network The connection between the core and radio network is called the SI And standardization of this connection is the way User traffic and signaling traffic that is processed in separate elements in the core network makes The SI-MME connection control information and user data will pass information SI-U.

Possible action to implement the network core to an integrated or separate signaling and user segments are included. Handover for the connection between eNode b are called x2.Figer 1.

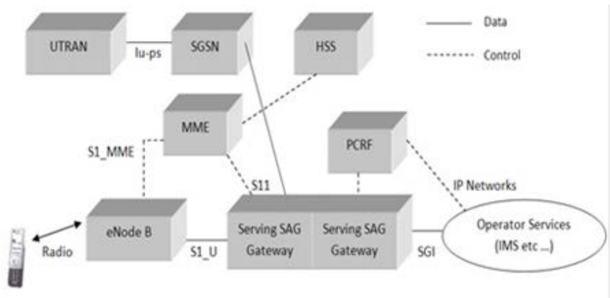

Fig. 1.LTE Architect Side of UMTS

3. LTE AIR_ INTERFACES

LTE provides a simplified architecture compared to UTRAN, because macro diversity gains are not relevant in EUTRAN, and hence a centralized radio controller is not needed. Thus all decisions related to communication over the air interface are taken at a transmitting or receiving network node, making ultimate adaptation both to traffic and channel conditions possible. Control plane communication is executed as the application protocol over the S1-interface between the serving eNode_B and the MME. User plane communication is executed as the transport protocol over the S1- interface between the eNode_B and the serving gateway In LTE, fast handovers are necessary because of the lack of macro diversity, which may cause the Signal to Interference plus noise ratio (SINR) suddenly decrease due to UE moving at high velocity. Therefore, an interface called X2 is defined between the eNode Bs. An application protocol may be run over the X2 for handover preparation and execution, and to control transfer of the user plane packet buffers between the eNode Bs at handover. Also Inter cell Interference Coordination may be performed over X2. The signaling solution between eNode Bs appears much lighter compared to the control and reconfiguration of the transport by a centralized node.

4. EUTRAN PROTOCOLS

In EUTRAN, security is also implemented in the PDCP layer, because it guarantees long sequence numbers for packets, which may be preserved during handovers as well. This ensures security and yet enables each packet processed individually.

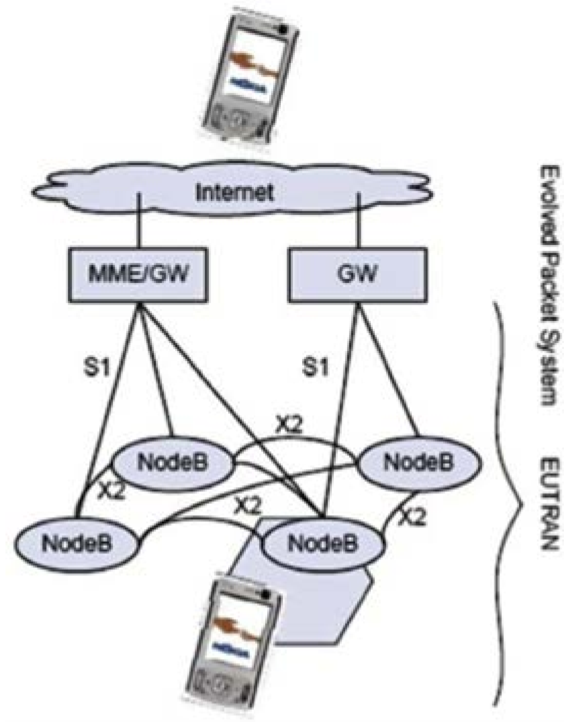

Fig.2.EUTRAN Architecture and Air Interfaces(Handover is doing by X2)

5. QOS (QUALITY OF FACTOR)

In EUTRAN architecture, QoS is provided by the Differentiated Services (DiffServ) mechanisms, PDP context procedures, transport tunneling and EPS bearer parameters. The default PDP context does not provide QoS differentiation. It offers a context port for Session Initiation, for TCP request/response messages, and possibly best effort services. Any number of secondary PDP contexts may be opened for defined QoS classes. EPS bearer parameters are defined in [1,8] and are shortly discussed below. QoS Class Identifier (QCI) is the primary parameter of EPS bearer quality. It controls bearer level packet forwarding treatment e.g. scheduling weights, admission thresholds, queue management thresholds, link layer protocol configuration that have been preconfigured by the operator, who owns the eNode_B. These QCI characteristics describe the packet forwarding treatment in terms of resource type i.e. guaranteed or non-guaranteed bit rate, priority, packet delay budget and packet error rate. In LTE, these values are valid to ensure that applications (services) mapped to a QCI get the same QoS through the entire delivery over the EPS, even in a multivendor deployment. Example services of different QCI values include conversational voice, conversational video, streaming, real-time gaming, IMS signaling , interactive gaming, interactive web browsing, as well as best effort traffic applications running on Transmission Control Protocol (TCP) like email, chat, ftp and rich media [12]. On the radio and S1-interfaces, each packet is indirectly associated with one QCI via the bearer identifier.

Allocation and Retention Priority (APR) takes an action only for the bearer establishment and modification, occasionally also for bearer dropping. Once successfully established, ARP has no impact on packet level forwarding (e.g. scheduling and rate control). Each EPS bearer may have additional parameters for the Guaranteed Bit Rate (GBR) and for the Maximum Bit Rate (MBR). All non-guaranteed bit rate services have instead the Aggregate Maximum Bit Rate (AMBR) parameter that applies to a group of EPS bearers that share the same PDN connection and which may share capacity dynamically.

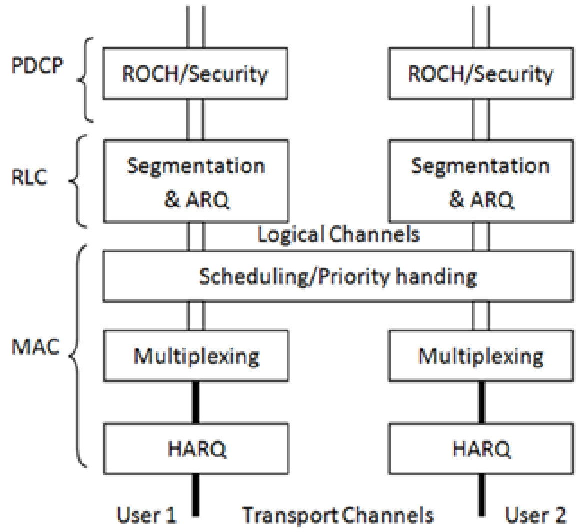

Fig. 3.The structure of Layer 2 processing in the User Equipment

6. PHYSICAL LAYER

In this section, we discuss the main principles of LTE physical layer design, which lead to new Radio Resource Management (RRM) opportunities that are significantly different from the ones applied in GSM and WCDMA/HSPA. LTE is primarily optimized for slow moving users in a wide coverage area. The leading principle is to solve inter symbol and in-cell interference problems that limit the high data rate coverage of the WCDMA/HSPA.

Downlink WCDMA/HSPA ideally provides orthogonal transmission of channelization codes. In practice, however, orthogonal is partially lost after multipath propagation. Uplink WCDMA/HSPA is designed to be in-cell non-orthogonal. LTE keeps in-cell orthogonal both for downlink and uplink even in a multipath propagation environment, because the channel dispersion is contained in the signal extension part of the received symbols. For this, the multiple access design is based on in-cell orthogonality and cyclic signal extensions, which enable frequency domain processing—in particular, frequency domain equalization is important for efficient and accurate computation. This design further enables the use of advanced multi antenna techniques because the spatial processing can be done in a frequency selective manner.

Reflecting the optimization criteria for slowly moving users, the multiple access scheme and the multi antenna techniques enable extensive use of instantaneous channel state information at the transmitter.Figer3.

7. FOR UPLINK: SC–FDMA TECHNOLOGY IN LTE

LTE uplink is designed to be in-cell orthogonal. This is contrary to the WCDMA/HSPA uplink, which is non-orthogonal and targets at randomizing the intra cell interference by long scrambling sequences. Non-orthogonal multiple access is in theory superior to orthogonal, if ideal multiuser detection is used. However, channel estimation imperfections limit the multiuser efficiency, especially at high load and high SNR, see e.g. [14]. 3GPP systems have been traditionally designed for full load, see e.g. evaluation principles in [4]. Accordingly, investing in multiuser detection would not pay off, when the target is high user data rates in a high load system. Also, we shall see in Section 6, comparing LTE uplink to a non orthogonal uplink with a conventional (RAKE) receiver, that the gains from reduced interference due to in-cell orthogonal are greatest for cell edge users.

Another important feature underlying the selection of the LTE uplink transmission technique is the need to sacrifice power and symbol resources for the channel estimation. Spreading the transmission over the whole bandwidth is not sensible for transmitters with limited power resources—the wider the bandwidth, the larger the overhead needed for the pilot signals. Together with the bandwidth flexibility target of LTE, these arguments lead to selecting Frequency Division Multiple Access (FDMA) as the basis for uplink user multiplexing. Figer4.

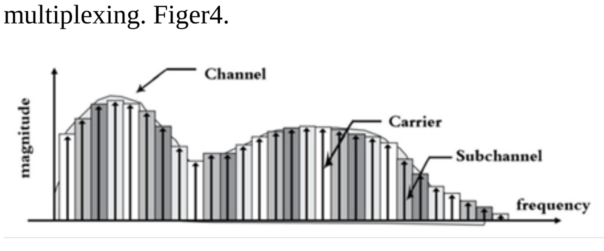

Fig.4.Linear model of the channel frequency response in a multi-carrier method

8. FOR DOWNLINK: OFDMA TECHNOLOGY IN LTE

LTE downlink modulation is based on multicarrier transmission of subcarrier signals, i.e. Orthogonal

Frequency Division Multiplexing (OFDM). As long as the channel delay spread remains within the CP, the subcarriers are orthogonal. In the transmitter, the subcarrier signals are generated in the frequency domain by an Inverse FFT. In the receiver, FFT is used, after discarding the CP, to recover the transmitted signals. In LTE, the data of different users is multiplexed in the frequency domain, and accordingly the downlink is characterized as Orthogonal Frequency Division Multiple Access (OFDMA).

The multi-carrier OFDMA method is in fact one of the posts. However OFDMA Subcarrier have special properties Them from straightforward case mentioned in the previous section, to put together a narrowband signal And their integration in the frequency domain requires placing the protective bond between them is Makes. These are properties. There are a lot of overlap with the carrier frequency, due to being orthogonal to each other in the frequency domain, Guard band between them there was no need to put And hence frequency performance to reach the maximum possible. Figer5.

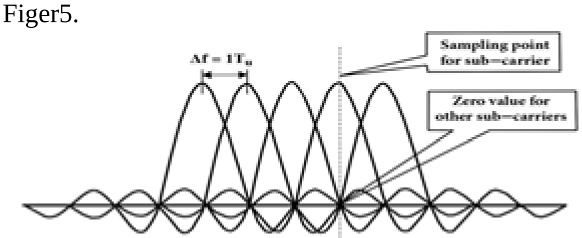

Fig.5.Following distance carrier and compress them together in the frequency domain for OFDMA

Possible to implement digital signal processing circuits, transmitter receptor from circuit OFDMA using DSP.A negative aspect of this method is also a multi-carrier OFDM is that, Rapid changes in the transmitter output power is momentarily Leading to reduced transmitter power amplifier efficiency and increasing costs are making it Terms of trade may be too expensive for the user terminal The goals in designing LTE terminals is consistent with reasonable cost.

The use of OFDM in the UL was not possible And use of broadband signal with a single carrier method. single carrier, multiple carriers in the UL has been replaced.

9. MODULATION AND CHANNEL CODING (AMC)

The set of modulation alphabets used is a system design choice due the requirements posed on the implementation of the transmitter– receiver chain. The dynamic range, sensitivity and decoding complexity are key issues as well as requirements for the linearity, Error Vector Magnitude (EVM) and noise figure of the receiver.

In LTE, QPSK, 16QAM and 64QAM modulations may be used both in downlink and uplink. For amplitude modulated multicarrier symbols, the peak power varies depending on the instantenous choices of modulated symbols. In the eNod_B transmitter, where the linear range of the amplifier can be large, the power limiter cuts the highest power peaks to the wideband noise. The p reliability of the highest power peaks is fairly small due to a large number of modulated subcarriers, thus the power-density of the in band noise remains small, and 64QAM transmissions may be possible. In the UE transmitter, the linear region of the power amplifier sets constraints for the choice of modulation. In practice, uplink transmissions at least up to 16QAM are feasible. The benefits of 64QAM transmission are disputable, because its coverage-area probability remains small in mobile reception. For short range communications, it however may provide gain codes. Convolutional codes provide higher coding gain for small information blocks, e.g. in control signaling, whereas Turbo code [18] is best for larger information blocks of high data rates. Low Density Parity Codes (LDPC) were studied as an alternative for LTE, but were not selected due to their rate matching properties [19].

10. POWER CONTROL IN LTE

LTE power control applies to a burst transmission per sub frame. As several UEs are multiplexed to the same physical downlink shared channel, there may be a UE specific power offset between the allocation and the reference symbols. In LTE uplink, the shared data channel transmit power of a UE is:

$$P = \min\{P_{\max}, 10.\log M + P_0 + \alpha_{PL} PL + \Delta_{TF} \big| + f\} \qquad (1)$$

where P0 is the nominal power, M the allocated bandwidth, and DTF the power headroom for the transport format used. Path loss is fractionally compensated up to the factor a PL, and finally a short term power adjustment f may be used, which may be an absolute or an accumulated relative update. The cell-specific and UE-specific control parameters may be defined by higher layer (RRC) signaling. The short term adjustment f may be given inside the signaling entry per allocation in the downlink shared control channel. The transmit power of the control channel is set in reference to the nominal power and relative to at least the path loss and control channel signaling format. The transmit power of the sounding reference symbols is controlled relative to at least the cell specific shared data channel power reference, bandwidth and fractional path loss .Fig 6.

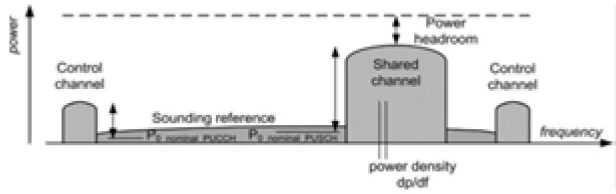

Fig. 6.Power Control in LTE uplink.

10. Conclusion

The LTE process led to rapid research and innovation for the EUTRA technology to radically bring the 3G networks to a new 4G performance era. The technical targets set in [3] required an iterative development process, where simultaneous innovations in the design of the physical layer, radio protocols, resource management algorithms and network architectures support each other. Hence, increasing the cell edge throughput and spectral efficiency had to happen yet reducing the air interface latency, which requires advanced receiver algorithms and efficient signaling protocols. Despite of the high performance at highly aggressive scheduling events, the UE is able to activate its over saving modes for the moments of low activity. This shows as increased battery activity times and yet provide fast transitions to the active state of communications, because the IP connectivity is maintained to the serving gateway on the ‘‘always-on” EPS bearer. The cost factors, flexibility and reliability of the network are improved due to the server based distributed architecture and due to the lack of centralized control in the radio access network several field trials are on-going or planned by the mobile network operators with the mobile device vendors. Targets for launching commercial operations in the near future have been published, and the first openings are expected to begin in year 2010. After the first launches, LTE deployments are expected to increase rapidly, because the network upgrades suit to the existing 3G sites. Also in regions, where 3G is not widely spread, LTE technology is expected to offer the next major upgrade. Hence, LTE will clearly be the future technology for the wide area mobile data coverage in dense traffic areas globally In longer term, local access is expected to gain more momentum, because the forecasted increase of traffic volumes cannot fully be satisfied by wide area deployments with large cell ranges. This observation motivates new local area studies e.g. by scaling the LTE technology for small cells and to implement local networking for low cost of operation.

LTE reaches the targets set for IMT-Advanced [10] in wide area evaluation scenarios. New releases of LTE [11], including technology components such as uplink MIMO and carrier aggregation, will improve LTE performance in local area scenarios, and factually realize a G bit/s peak rate, often seen as a rate characteristic of 4G systems.

REFERENCES

[1] A. Aliabadi, Design,optimization and power control of Cellular Mobile communication (HSDPA,HSUPA,HSPA+ and LTE) , Iranian Scientific Publishers of Javdan Kherad, Tehran (2012), ISBN 9789646030749,Feb 2012.

[2] E. Dahlman, S. Parkvall, J. Sköld, P. Beming, 3G Evolution: HSPA and LTE for Mobile Broadband, second ed., Academic Press, 2008. 448 pages.

[3] RD Pascoe, TN Eichorn, What is communication-based train control IEEE Veh. Technol.Mag. 4(4), 16–21 (2009).

[4] UIC, LTE/SAE, The future railway mobile radio system? Long-term visions on railway mobile radio technologies. 4 (2009).

[5] GP White, YV Zakharov, Data communications to trains from high-altitude platforms.IEEE Trans. Veh. Technol. 56(4), 2253–2266 (2007).

[6] F Abrishamkar, J Irvine, Comparison of current solutions for the provision of voice services to passengers on high speed trains, in Proc IEEE 52nd Veh Technol Conf(VTC’00Fall), vol. 5 (Boston, MA, Boston, MA, 2000), pp. 2068–2075.

[7] LH Lu, XM Fang, M Cheng, CZ Yang, WT Luo, C Di, Positioning and relay assisted robust handover scheme for high speed railway, in Proc IEEE 73rd Veh Technol Conf (VTC’11 Spring), vol. 1 (,Budapest, Hungary, 2011), pp. 1–5.

[8] R Knopp, P Humblet, Information capacity and power control in single cell multiuser communications, in Proc IEEE Int Computer Conf (ICC’95), vol. 1 (, Seattle, WA, 1995), pp.331–335.

[9] P Viswanath, DNC Tse, R Laroia, Opportunistic beamforming using dumb antennas. IEEE Trans. Inf. Theory 48, 2002, pp. 1277–1294.

[10] E Dahlman, H Ekstrom, A Furuskar, Y Jading, J Karlsson, M Lundevall, S Parkvall, The 3G long-term evolution radio interface concepts and performance evaluation, in IEEE 63rd Veh Technol Conf(VTC’06), vol. 1 (, Melbourne, Australia, 2006), pp. 137–141.

[11] G Gaire, S Shamai, On the achievable throughput of a multiantenna Gaussian broadcast channel. IEEE Trans. Inf. Theory 49(7), 1691–1706 (2003).

[12] P Viswanath, D Tse, Sum capacity of the vector Gaussian broadcast channel and uplink downlink duality. IEEE Trans. Inf. Theory 49(8), 1912–1921 (2003).