ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

LONG TERM EVOLUTION OF RAPID DATA FOR MOBILE PHONES IN CASE OF ETHIOPIA

Aruna Rai Vadde*, Satyanarayana Gaddada, Harindra Reddy Vonteru

***** Department of Electrical & Computer Engineering, College of Engineering and Technology, Wollega University, Post Box No: 395, Nekemte, Ethiopia.

Department of Electrical & Computer Engineering, College of Engineering and Technology, Wollega University, Post Box No: 395, Nekemte, Ethiopia.

Department of Electrical & Computer Engineering, College of Engineering and Technology, Wollega University, Post Box No: 395, Nekemte, Ethiopia.

ABSTRACT

The vast majority of the nations on the planet are right now giving 2G or 3G versatile correspondence administrations with constrained scope of LTE administrations. Subsequently when a LTE administration client moves into or around such nations, the LTE terminal needs to meander or handover to 2G or 3G system for administration quality. For LTE terminals that can be joined with 3gpp Legacy, (for example, GSM, UMTS, and HSPA) and CDMA systems, it typically takes more than 2 minutes to choose one of a few applicant systems for wandering and 20 seconds to 2 minutes to handover to different systems before escaping from the LTE administration range, which is viewed as long by numerous LTE clients. This paper proposes a plan for quick meandering and handover that at the same time looks for various systems with a LTE terminal for both voice and information correspondence and the network selection time for roaming was reduced by 15% to 40% and the delay time for handover in LTE network was reduced by 90%.

KEYWORDS: LTE, GSM, UMTS, HSPA, 2G, 3G and CDMA

INTRODUCTION

The high-level LTE requirements for 3GPP radio-access technology include reduced latency, higher user data rates, improved system capacity and coverage and reduced costs for operators. Therefore, an evolution of the radio interface as well as the radio network architecture should be considered. It was also recommended that the Evolved UTRAN (E-UTRAN) should bring significant improvement so as to justify the standard- Imation effort and should avoid unnecessary options. The main advantages of LTE are high throughput, low latency, plug and play, FDD and TDD in the same platform, super- rior end-user experience and simple architecture resulting in low Operating Expenditures (OPEX). Furthermore, LTE also supports seamless connection to existing networks, such as GSM, CDMA and HSPA. The feasibility study on the UTRA and UTRAN Long Term Evolution was started in December 2004, with the objective being “to develop a framework for the evolution of the 3GPP radio-access technology towards a high-data-rate, low-latency and packet-optimized radio-access technology” [1, 2]. The study focused on supporting services provided from the PS-domain, concerning the radio interface physical layer for both downlink and uplink, the radio interface layers 2 and 3, the UTRAN architecture and RF issues. Furthermore, the Next Generation Mobile Networks (NGMN) initiative provided a set of recommend-dictions for the creation of networks suitable for the competitive delivery of mobile broadband services, with the goal of “to provide a coherent vision for technology evolutions beyond 3G for the competitive delivery of broadband wireless services” [1, 2]. The long-term objective of NGMN is to “establish clear performance targets, fundament- tall recommendations and deployment scenarios for a future wide area mobile broadband network” [1, 2].

The goals of LTE include improving spectral efficiency, lowering costs, improving services, making use of new spectrum and reframed spectrum opportunities and better integration with other open standards. The architecture that results from this work is called Evolved Packet System (EPS) and comprises Evolved UTRAN (E-UTRAN) on the access side and Evolved Packet Core (EPC) on the core side. EPC is also known as System Architecture

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

Evolution (SAE) and E-UTRAN is also known as LTE.Generally, LTE meets the key requirements of next generation networks, including downlink peak rates of at least 100 mbps, uplink peak rates of at least 50 mbps and Radio Access Network (RAN) round-trip times of less than 10 ms. Moreover, LTE supports flexible carrier bandwidths, from 1.4 MHz up to 20 MHz, as well as both Frequency Division Duplex (FDD) and Time Division Duplex (TDD).

IMT-ADVANCED AND 4G

Today, wireless technologies and systems which are claimed to be "4G" represent a market positioning statement by different interest groups. Such claims must be substantiated by a set of technical rules in order to qualify as 4G. Currently, the ITU (International Telecommunications Union) has been working on a new international standard for 4G, called IMT-Advanced, which is regarded as an evolutionary version of IMT-2000, the international standard on 3G technologies and systems.With the rapid development of telecommunications technologies and services, the number of mobile subscribers worldwide has increased from 215 million in 1997 to 946 million (15.5% of global population) in 2001, as shown in Figure 1. It is predicted that by the year 2015 there will be 1700 million terrestrial mobile subscribers worldwide. A substantial portion of these additional subscribers is expected to be from outside the countries that already had substantial numbers of mobile users by the year 2000. Figure.1 shows the user trends of mobile and wire line telecommunications services and applications.

4G technologies can be thought of as an evolution of the 3G technologies which are specified by IMT-2000. The framework for the future development of IMT-2000 and IMT-Advanced and their relationship to each other are depicted in Figure 2. Systems beyond IMT-2000 will encompass the capabilities of previous systems. Other communication relationships will also emerge, in addition to person-to-person, machine-to-machine, machine-to-person and person-to-machine.

One of the unique features of 4G networks is that they will accommodate heterogeneous radio access systems, which will be connected via flexible core networks. Thus, an individual user can be connected via a variety of different access systems to the desired networks and services. The interworking between these different access systems in terms of horizontal and vertical handover and seamless service provision with service negotiation including mobility, security and QoS management will be a key requirement, which may be handled in the core network or by suitable servers accessed via the core network.

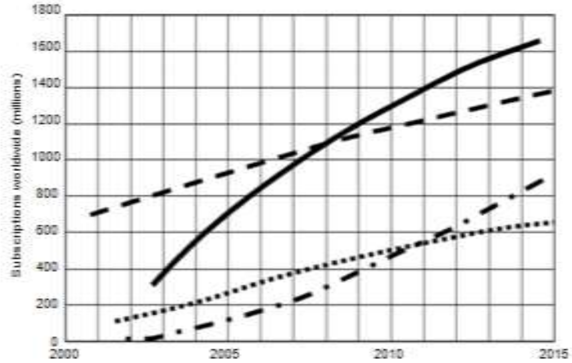

Figure 1 Global growth of mobile and wire line subscribers.

When discussing the time phases for IMT-advanced, it is important to specify the time at which the standards are completed, when spectrum must be available, and when deployment may start. Currently, IMT-Advanced is still at the call for proposal stage.

IMT-Advanced has been developed to provide true end-to-end IP services to mobile users at "anytime anywhere". Although the standardization process is still ongoing, the major design goals of 4G are quite certain, which are:

- ✓ 4G will be all IP networks, meaning that circuit switching will be eliminated in the next-generation cellular networks.
- ✓ 4G will have a very high data rate. It is expected that 4G networks will be capable of providing 100 mbps data rate under high mobility, which is much faster than 3G.
- ✓ 4G will provide Quality of Service (QoS) and security to the end users, which has been lacking in 3G.
- ✓ IP-based multimedia services such as Voice over IP (VoIP) and video streaming are expected to be the major traffic types in 4G. In this chapter, we will discuss three major contenders for 4G technologies: 3GPP Long Term Evolution (LTE), WiMax IEEE 802.16m and 3GPP2 Ultra Mobile Broadband (UMB).

LTE

LTE, which stands for 3rd Generation Partnership Project (3GPP) Long Term Evolution, is one of the next major steps in mobile radio communications designed to ensure competitiveness in a longer time

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

frame, i.e. for the next 10 years and beyond. The increasing usage of mobile data and newly emerged applications such as Multimedia Online Gaming (MMOG), mobile TV and streaming services has motivated the 3GPP to work on this standard. The aim of LTE is to improve the Universal Mobile Telecommunications System (UMTS) mobile phone standard and provide an enhanced user experience for next generation mobile broadband.

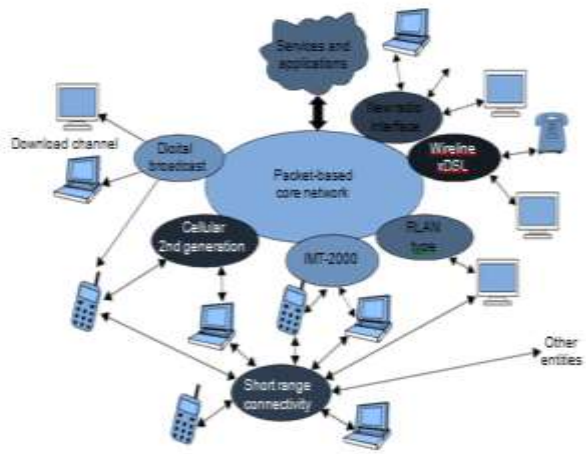

Figure 2 IMT-Advanced networks, including a variety of potential interworking access systems.

Network Architecture

The network architecture includes three functional entities: Mobile Station (MS), Access Service Network (ASN), and Connectivity Service Network (CSN).

An ASN is comprised of one or more Base Station(s) and one or more ASN Gateway(s), which may be shared by more than one CSN. The ANS provides radio access to an IEEE 802.16e/m MS. Specifically, the ASN provides the following functions [12]:

- ✓ IEEE 802.16e/m Layer-1 (L1)/Layer-2 (L2) connectivity among IEEE 802.16e/m MSs;
- ✓ Transfer of AAA (authentication, authorization and accounting) messages to IEEE
- ✓ 802.16e/m MS's Home Network Service Provider (H-NSP);
- ✓ Network discovery and selection of the MS's preferred NSP;
- ✓ Relay functionality for establishing Layer-3 (L3) connectivity with an MS;
- ✓ Radio resource management;
- ✓ ASN anchored mobility;
- ✓ CSN anchored mobility;
- ✓ Paging;
- ✓ ASN-CSN tunneling.

A CSN may be comprised of network elements such as routers, AAA proxy/servers, user data bases and Interworking gateway MSs. The CSN provides IP connectivity services to the IEEE 802.16e/m MS(s). Specifically, the CSN provides the following functions:

- ✓ MS IP address and endpoint parameter allocation for user sessions;
- ✓ AAA proxy or server;
- ✓ Policy and admission control based on user subscription profiles;
- ✓ ASN-CSN tunneling support;
- ✓ IEEE 802.16e/m subscriber billing and inter-operator settlement;
- ✓ Inter-CSN tunneling for roaming;
- ✓ Inter-ASN mobility.

An IEEE802.16m MS usually has four states:

- ✓ Initialization state, in which an MS decodes BCH information and selects one target BS;
- ✓ Access state, in which the MS performs network entry to the selected BS;
- ✓ Connected state, in which the MS maintains at least one connection as established during Access State, while MS and BS may establish additional transport connections, consisting of two modes; sleep mode and active mode.

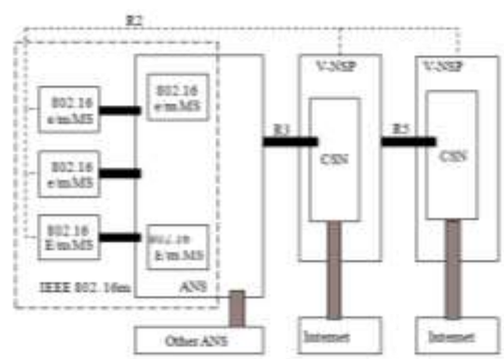

Figure 3 IEEE 802.16m overall network architecture

LTE Physical Layer

In the 30th conference of 3GPP in December 2005, TSG RAN decided to use downlink OFDMA and uplink SC-FDMA for the physical layer [4] which means that OFDMA won the LTE competition against CDMA. This outcome comes from, on the one hand, technological considerations and the adoption of OFDMA, SC-FDMA can reduce peak-to-average power ratio (PAPR) at the receiver's end, leading to a

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

smaller end user terminal with lower cost. On the other hand, it avoids the restrictions and monopolies of the core CDMA technology [5, 6]. The following are some of the key technologies used in LTE physical layer [7].

LTE uses OFDM for the downlink, which meets the LTE requirement of 100 mbps data rate, the spectral efficiency and enables cost-efficient solutions for very wide carriers with high peak rates. OFDM is a well-established technology, widely used in standards such as IEEE 802.11a/b/g, 802.16, HIPERLAN-2, DVB and DAB. By configuring the quantities of sub-carriers, it can achieve flexible bandwidth configurations ranging from 1.25 Hz to 20 MHz In the time domain a radio frame is 10 ms long and consists of 10 Sub-frames of 1 ms each. Every sub-frame consists of two slots where each slot is 0.5 ms. the sub-carrier spacing in the frequency domain is 15 kHz. Twelve of these sub-carriers together (per slot) is called a resource block, so one resource block is 180 kHz. Six resource blocks fit in a carrier of 1.4 MHz, and 100 resource blocks fit in a carrier of 20 MHz. In addition, the Cyclic Prefix (CP) of 4.7 μs can ensure the handling of time delay while not increasing processing time. Another longer CP (16.7 μs) can be used to increase cell coverage or multi-cell broadcasting services. By using OFDM, a new dimension is added to Adaptive Modulation and Coding (AMC), i.e. the adaptive frequency variable, leading to more flexible and efficient resource scheduling. Inheriting from the HSDPA/HSUPA concept, LTE adopts link adaptation and fast re-transmission in order to increase gain, avoiding macro-diversity which requires the support of network architecture. The supported modulation formats on the downlink data channels are QPSK, 16QAM and 64QAM. For MIMO operation, a distinction is made between single user MIMO, for enhancing one user's data throughput, and multi-user MIMO for enhancing the cell throughput, usually with the antenna configuration of 2 × 2, namely, two transmitting antennae are set in the eNodeB, while two receiving antennae are set in UE. For higher speed downlink, four antennae are used in the eNodeB.

In the uplink, LTE uses a pre-coded version of OFDM called Single Carrier Frequency Division Multiple Access (SC-FDMA)[10,12]. This is to compensate for the drawback with normal OFDM, which has a very high Peak to Average Power Ratio (PAPR). High PAPR requires expensive and inefficient power amplifiers with high requirements of linearity, which increases the terminal cost and drains the battery very fast. SC-FDMA solves this problem by combining resource blocks in such a way that reduces the need for linearity, and so power consumption, in the power amplifier. A low PAPR also improves coverage and the cell edge performance. Within each TTI, the eNodeB allocates a unique frequency for transmitting data. Data for different users are separated from each other by using frequency space or time slot, ensuring the orthogonality among uplink carriers within the cell, avoiding frequency interference. Slow power control can resist the path loss and shading effect. Thanks to the orthogonality of uplink transmission, fast power control is no longer needed in order to deal with the near-far effect. In the meantime, with the help of CP, multi-path interference can be wiped out. The enhanced AMC mechanism applies to uplink as well. The supported modulation schemes on the uplink data channels are QPSK, 16QAM and 64QAM. If virtual MIMO/Spatial division multiple access (SDMA) is introduced the data rate in the uplink direction can be increased depending on the number of antennae at the base station. With this technology more than one mobile can reuse the same resources. Similarly, the uplink channel coding uses Turbo code. The basic MIMO configuration for uplink single user is also 2 × 2 . Two transmitting antennae are installed in the UE, and another two for receiving are installed in the eNodeB [8].

LTE Layer-II

The LTE layer-II is split into three sub-layers, i.e. Medium Access Control (MAC), Radio Link Control (RLC) and Packet Data Convergence Protocol (PDCP). The PDCP/RLC/MAC architecture for downlink and uplink are depicted in Figure 4.

The Service Access Points (SAP) between the physical layer and the MAC sub-layer provide the transport channels. The SAPs between the MAC sub-layer and the RLC sub-layer provide the logical channels, and the SAPs between the RLC sub-layer and the PDCP sub-layer provide the radio bearers. Several logical channels can be multiplexed onto the same transport channel. The multiplexing of radio bearers with the same QoS onto the same priority queue is FFS. In the uplink, only one transport block is generated per Transmission Time Interval (TTI) in the case of non-MIMO. In the downlink, the number of transport blocks is FFS[13,14].

The MAC sub-layer provides the following services and functions: multiplexing or demultiplexing of RLC PDUs belonging to one or different radio bearers into/from trans- port blocks (TB) delivered to and from the physical layer on transport channels,

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

mapping between logical channels and transport channels, traffic volume measurement reporting, error correction through HARQ, priority handling between logical channels of one UE, priority handling between UEs by means of dynamic scheduling, transport format selection, mapping of Access Classes to Access Service Classes (FFS for RACH), padding (FFS) and in-sequence delivery of RLC PDUs if RLC cannot handle the out of sequence delivery caused by HARQ (FFS).

For the RLC sub-layer, the main services and functions are to transfer of upper layer PDUs supporting AM, UM or TM data transfer (FFS), error correction through ARQ, seg- mutation according to the size of the TB, re-segmentation when necessary, concatenation of SDUs for the same radio bearer is FFS, in-sequence delivery of upper layer PDUs, duplicate detection, protocol error detection and recovery, flow control, SDU discard (FFS) and reset, etc[15].

The main services and functions of the PDCP sub-layer include: header compression and decompression, transfer of user data, ciphering of user plane data and control plane data (NAS Signaling), integrity protection of control plane data (NAS signaling) and integrity protection of user plane data are FFS.

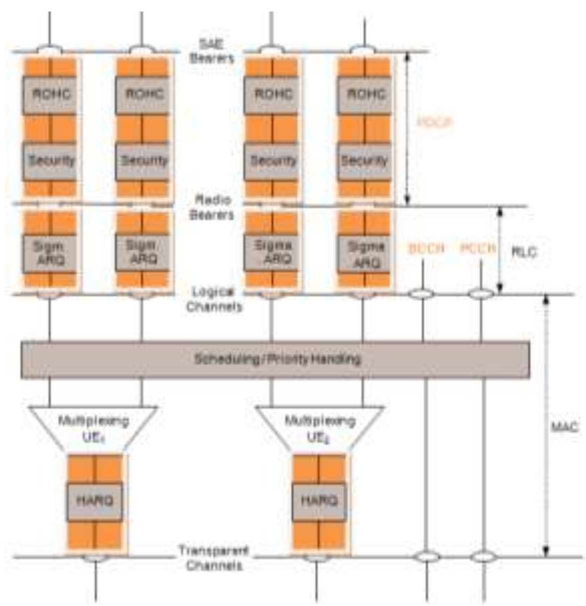

Figure 4 Layer-II Structures

ADVANTAGES

- ✓ Peak download rates up to 299.6 mbps and upload rates up to 75.4 mbps
- ✓ Improved support for mobility, exemplified by support for terminals moving at up to 350 km/h or 500 km/h depending on the frequency band.
- ✓ Increased spectrum flexibility: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz and 20 MHz wide cells are standardized.
- ✓ Supports at least 200 active data clients in every 5 MHz cell.
- ✓ Support for cell sizes from 10 meters radius (femto and pico cells) up to 100 km radius microcells. In the lower frequency bands to be used in rural areas, 5 km is the optimal cell size, 30 km having reasonable performance, and up to 100 km cell sizes supported with acceptable performance. In city and urban areas, higher frequency bands (such as 2.6 GHz in EU) are used to support high speed mobile broadband. In this case, cell sizes may be 1 km or even less
- ✓ Users can start a call or transfer of data in an area using an LTE standard, and, should coverage be unavailable, continue the operation without any action on their part using GSM/GPRS or W-CDMA-based UMTS or even 3GPP networks such as CDMA one or CDMA2000)

DISADVANTAGES

- ✓ VOICE CALLS: The LTE standard only supports packet switching with its all-IP network. Voice calls in GSM, UMTS and CDMA2000 are circuit switched, so with the adoption of LTE, carriers will have to re-engineer their voice call network.
- ✓ FREQUWNCY BAND: The LTE standard can be used with many different frequency bands. In North America, 700/ 800 and 1700/ 1900 MHz are planned to be used; 800, 1800, 2600 MHz in Europe; 1800 and 2600 MHz in Asia; and 1800 MHz in Australia. As a result, phones from one country may not work in other countries. Users will need a multi-band capable phone for roaming internationally.
- ✓ LTE has adopted multiple-input multiple-output (MIMO) technology. As a result, cell base stations may need additional transmit and receive antennae. Mobile phones may have one transmit antenna and up to two receive antennae. Service providers may have to upgrade base stations, and consumers will need to buy new phones to utilize these upgraded networks.

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

CONCLUSION

LTE (Long Term Evolution) is a standard for wireless communication of high-speed data for mobile phones and data terminals which is marketed as 4G LTE. It is based on the GSM/EDGE and UMTS/HSPA network a technology, increasing the capacity and speed using new modulation techniques.LTE uses radio waves to allow more data to be transferred over the same bandwidth used by 3G equipment. As a result, service providers should be able to get more data transfer out of their existing cells and possibly lower the cost to run their networks.

REFERENCES

1. “3GPP TD RP-040461: Proposed Study Ite on Evolved UTRA and UTRAN”.
2. “3GPP, TR25.896, Feasibility Study for Enhanced Uplink for UTRA FDD”.
3. “3GPP TR 25.913, Requirements for evolvedUniversal Terrestrial Radio Access (UTRA) and Universal Terrestrial Radio Access Network (UTRAN)”.
4. “3GPP TR 25.814, Physical Layer Aspects for Evolved Universal Terrestrial Radio Acces (UTRA)”, 2006.
5. “3GPP R1-061118, E-UTRA physical layer framework for evaluation, Vodafone, Cingular, DoCoMo, Orange, Telecom Italia, T-Mobile, Ericsson, Qualcomm, Motorola, Nokia, Nortel, Samsung, Siemens”.
6. “3GPP RP-060169, Concept evaluation for evolved UTRA/UTRAN, Cingular Wireless, CMCC, NTT DoCoMo, O2, Orange, Telecom Italia, Telephonic, T-Mobile, Vodafone”.
7. “3GPP, TR25.848, Physical Layer Aspects of UTRA High Speed Downlink Packet Access”.
8. “3GPP, TR 25.942 V3.3.0 (2002-06), RF System Scenarios, June 2002”.
9. H. E. et al , “Technical Solutions for the 3G Long-Term Evolution[J]”, IEEE Commun. Mag.., pp. 38 – 45, Mar. 2006.
10. “ETSI TR 101 112 (V3.1.0): Universal Mobile Telecommunications System (UMTS); Selection procedures for the choice of radio transmission technologies of the UMTS (UMTS 30.03 version 3.1.0)”.
11. “3GPP, TR 23.882, 3GPP System Architecture Evolution”.
12. the Draft IEEE 802.16m System Description Document (SDD), IEEE 802.16 Broadband Wireless AccessesWorking Group, Jul. 2008.
13. IEEE Std. 802.16-2004: IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Fixed Broadband Wireless Access Systems, Jun. 2004.
14. IEEE std. 802.16e-2005: IEEE Standard for Local and metropolitan area networks Part 16: Air Inter- face for Fixed and Mobile Broadband Wireless Access Systems, Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands, and IEEE Std.802.16-2004/Cor1-2005, Corrigendum 1, Dec. 2005.
15. IEEE STD 802.16j-2008: Draft Amendment to IEEE Standard for Local and Metropolitan Area Networks – Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems – Multichip Relay Specification, Jun. 2008