www.ijecs.in
International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume 6 Issue 7 July 2017, Page No. 22112-22115
Index Copernicus value (2015): 58.10 DOI: 10.18535/ijecs/v6i7.34

Experimental Analysis of Long Term Evolution Using Vector Signal Transceiver (VST)

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Abstract: Long Term Evolution (LTE) has been introduced by 3rd Generation Partnership Project and dominates the 4th generation of mobile telecommunication network. LTE provides significantly increased peak data rates, with the potential for 100 Mbps downstream and 30 Mbps upstream, reduced latency, scalable bandwidth capacity, and backwards compatibility with existing GSM and UMTS technology. Future developments to could yield peak throughput on the order of 300 Mbps. In this article the performance of LTE system is experimentally evaluated based on VST 5644 using the modulation scheme like QPSK.

Keyword: - LTE, EVM, VST

1. INTRODUCTION

LTE Advanced offers considerably higher data rates than even the initial releases of LTE. While the spectrum usage efficiency has been improved, this alone cannot provide the required data rates that are being headlined for 4G LTE Advanced[1-4]. To achieve the very high data rates, it is necessary to increase the transmission bandwidths over those that can be supported by a single carrier or channel. Using LTE Advanced carrier aggregation, it is possible to utilize more than one carrier and in this way increase the overall transmission bandwidth.These channels or carriers may be in contiguous elements of the spectrum, or they may be in different bands. Spectrum availability is a key issue for 4G LTE. In many areas only small bands are available, often as small as 10 MHz[5-8]. As a result carrier aggregation over more than one band is contained within the specification, although it does present some technical challenges. Carrier aggregation is supported by both formats of LTE, namely the FDD and TDD variants. This ensures that both FDD LTE and TDD LTE are able to meet the high data throughput requirements placed upon them.

The LTE specs supplies downlink peak premiums with 300 Mbit/s, uplink peak premiums with 75 Mbit/s and QoS conditions enabling your transportation latency with substantially under 5 ms within the r / c entry network. LTE offers the ability to handle fast-moving phones in addition to can handle multi-cast in addition to sent out streams. LTE can handle scalable carrier bandwidths, through 1.4 MHz to 20 MHz in addition to can handle both rate of recurrence office duplexing (FDD) and time-division duplexing (TDD)[10-12]. The IP-based network architectural mastery, termed the Advanced Bundle Core (EPC) in addition to intended to bring back the GPRS Central Network, can handle easy handovers for speech in addition to details to cell systems using mature network technological innovation these kinds of as GSM, UMTS and CDMA2000. The simpler architectural mastery ends up with reduced doing work fees (for case, each E-UTRA cell will certainly help close to 4x the information in addition to speech capacity based on HSPA) [18].

Voice over LTE – VoLTE

The Voice over LTE, VoLTE scheme was devised as a result of operators seeking a standardised system for transferring traffic for voice over LTE.Originally LTE was seen as a completely IP cellular system just for carrying data, and operators would be able to carry voice either by reverting to 2G / 3G systems or by using VoIP in one form or another.When looking at the options for ways of carrying voice over the LTE system,[15-17] a number of possible solutions were investigated. A number of alliances were set up to promote different ways of providing the service[20]. A number of systems were proposed are outlined below:

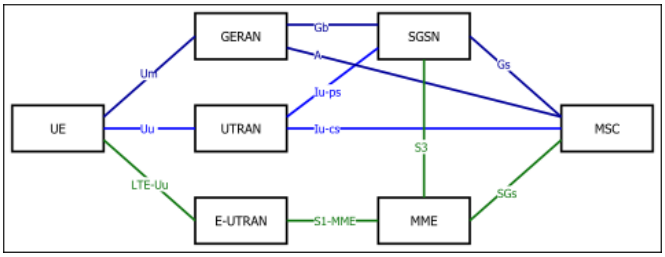

Figure 1: LTE CSFB to GSM/UMTS network interconnects

The LTE standard supports only packet switching with its all-IP network. Voice calls in GSM, UMTS and CDMA2000 are circuit switched, so with the adoption of LTE[14], carriers will have to re-engineer their voice call network. Three different approaches sprang up:

Circuit-switched fallback (CSFB)-In this approach, LTE just provides data services, and when a voice call is to be initiated or received, it will fall back to the circuit-switched domain. When using this solution, operators just need to

upgrade the MSC instead of deploying the IMS, and therefore, can provide services quickly. However, the disadvantage is longer call setup delay.

Simultaneous voice and LTE (SVLTE)

In this approach, the handset works simultaneously in the LTE and circuit switched modes, with the LTE mode providing data services and the circuit switched mode providing the voice service. This is a solution solely based on the handset, which does not have special requirements on the network and does not require the deployment of IMS either. The disadvantage of this solution is that the phone can become expensive with high power consumption.One additional approach which is not initiated by operators is the usage of over-the-top content (OTT) services, using applications like Skype and Google Talk to provide LTE voice service. Most major backers of LTE preferred and promoted VoLTE from the beginning. The lack of software support in initial LTE devices as well as core network devices however led to a number of carriers promoting VoLGA (Voice over LTE Generic Access) as an interim solution. The idea was to use the same principles as GAN (Generic Access Network, also known as UMA or Unlicensed Mobile Access), which defines the protocols through which a mobile handset can perform voice calls over a customer's private Internet connection, usually over wireless LAN. VoLGA however never gained much support, because VoLTE (IMS) promises much more flexible services, albeit at the cost of having to upgrade the entire voice call infrastructure. VoLTE will also require Single Radio Voice Call Continuity (SRVCC) in order to be able to smoothly perform a handover to a 3G network in case of poor LTE signal quality. While the industry has seemingly standardized on VoLTE for the future, the demand for voice calls today has led LTE carriers to introduce CSFB as a stopgap measure. When placing or receiving a voice call, LTE handsets will fall back to old 2G or 3G networks for the duration of the call.

Enhanced voice quality

To ensure compatibility, 3GPP demands at least AMR-NB codec (narrow band), but the recommended speech codec for VoLTE is Adaptive Multi-Rate Wideband, also known as HD Voice. This codec is mandated in 3GPP networks that support 16 kHz sampling. Fraunhofer IIS has proposed and demonstrated "Full-HD Voice", an implementation of the AAC-ELD (Advanced Audio Coding – Enhanced Low Delay) codec for LTE handsets. Where previous cell phone voice codecs only supported frequencies up to 3.5 kHz and upcoming wideband audio services branded as *HD Voice* up to 7 kHz, Full-HD Voice supports the entire bandwidth range from 20 Hz to 20 kHz. For end-to-end Full-HD Voice calls to succeed however, both the caller and recipient's handsets as well as networks have to support the feature. An additional requirement for VoLTE enabled networks is to have a means to handing back to circuit switched legacy networks in a seamless manner, while only having one transmitting radio in the handset to preserve battery life.

2. EXPERIMENTAL SET-UP BASED ON VST

Figure 3 shows the LTE Experimental setup based on VST for analyzing the performance of LTE signal at bandwidth of 5 MHz.

Figure 3:– VST based set-up for LTE

3. RESULT ANALYSIS

On the other hand, the theoretical PAPR of different modulated signals may be very different if it is measured directly over the modulated signal or it is measured after the ISI (inter-symbol interference) filters, whose roll-off factor increases the PAPR as much as the filter slope is approaching ideality. To directly mix PAPR figures taken before and after the ISI filter could produce misinterpretations. The error vector magnitude or EVM is a measure used to quantify the performance of a digital radio transmitter or receiver.

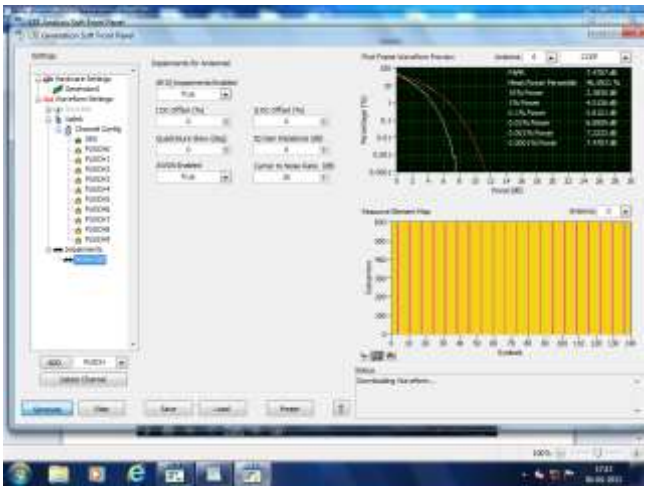

Figure 4: Parametric consideration of LTE signal using VST

A signal sent by an ideal transmitter or received by a receiver would have all constellation points precisely at the ideal locations, however various imperfections in the implementation (such as carrier leakage, low image rejection ratio, phase noise etc.) cause the actual constellation points to deviate from the ideal locations. Informally, EVM is a measure of how far the points are from the ideal locations. Noise, distortion, spurious signals, and phase noise all degrade EVM, and therefore EVM

provides a comprehensive measure of the quality of the radio receiver or transmitter for use in digital communications. Transmitter EVM can be measured by specialized equipment, which demodulates the received signal in a similar way to how a real radio demodulator does it. One of the stages in a typical phase-shift keying demodulation process produces a stream of I-Q points which can be used as a reasonably reliable estimate for the ideal transmitted signal in EVM calculation. Figure 5 Error Vector Magnitude and scatter plot for QPSK..The PAPR value achived is 7.0536dB wchich clearly dictates the acceptable link performance.

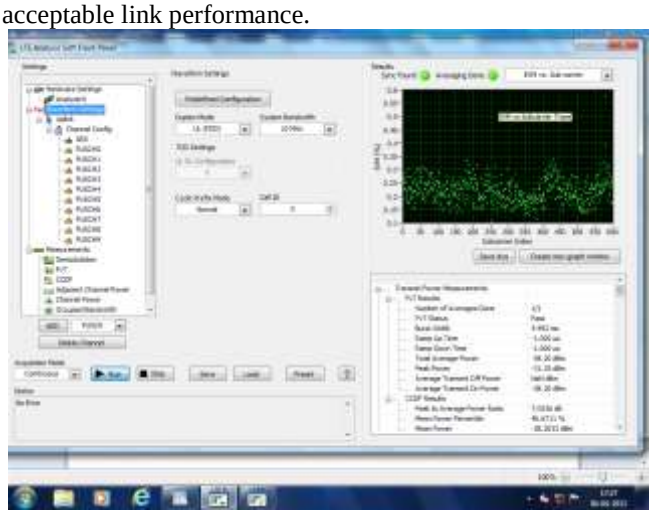

Figure 5: Error Vector Magnitude and scatter plot for QPSK

4. CONCLUSION

Long Term Evolution (LTE) is the recent cellular wireless communication systems standardized by the third Generation Partnership Project (3GPP). These standards promise to achieve the higher data rates on the mobile devices and are shown to be spectrally efficient. Physical layer coding is considered as a promising technology to improve the throughput performance of wireless cellular networks. The advent of high speed transmission in wireless communications renewed interest for M-ary modulation systems, mainly because of their ability to send more bits per transmitted symbol..In this paper, we analyze the Performance of LTE Link using QPSK based on VST.

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ACKNOWLEDGEMENT

The authors would like to express their gratitude to the Department of Electronics & Communication Engineering, of Amritsar College of Engineering & Technology, Amritsar, Punjab (UGC Autonomous college, NBA and NAAC accredited) for their whole hearted support and encouragement in carrying out successfully this project and for carrying out this research work in the Centre of Excellence-Research and Development Laboratory (ECE) which is being empowered by world class Sophisticated hardware like PXIe 1062Q, VST 5644 R and USRP 2920 and LabVIEW 2012 version software from National instruments, USA.

DOI: 10.18535/ijecs/v6i7.34

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