International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2018 IJSRCSEIT | Volume 3 | Issue 3 | ISSN : 2456-3307

Survey on LTE Network Architecture and its Security Aspects

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ABSTRACT

Mobile technology has emerged the needs for wireless communication over various generations of wireless technologies with upcoming demands of new wireless multimedia applications. During the past few years, evolution and development of mobile technologies has improved over 4 to 5 generations (0G to 4G) for facilitating the needs of booming number of mobile data users. Recent research on wireless communication technology concentrates on improvement and advancement of 4G-LTE technology and 5G. This review article focuses on a comprehensive overview on 4G-LTE network architecture and security concerns relevant to it.

Keywords: LTE, SAE, 4G, UE, PDN, EPS, UTRAN, E-UTRAN.

I. INTRODUCTION

4G LTE architecture is basically an extension of 3G technology. LTE technology provides mobility to users along with data rates at higher speed and high capacity applications based on IP.

LTE technology focuses on providing uninterrupted internet connectivity between user equipment (UE) and the packet data network (PDN) to users' data. Compared to previous cellular networks designed for circuit switched model, Long Term Evolution (LTE) has been designed for working on packet-switched services.[1]

The term "LTE" encircles the evolution of the Universal Mobile Telecommunications System (UMTS) radio access over the Evolved UTRAN (E-UTRAN), it is followed by an evolution of the System Architecture Evolution (SAE), which includes the Evolved Packet Core (EPC) network. LTE and SAE combined together makes the Evolved Packet System (EPS).[2]

IP traffic from a PDN gateway to the UE is routed with help of EPS which uses the concepts of EPS bearers. EPS bearer is a flow of an IP data packets with a defined quality of service (QoS) between the PDN gateway and the UE. The E-UTRAN and EPC together set up and release bearers as required by applications.

II. LTE ARCHITECTURE

4G being the fourth generation of mobile communication it is an improved technology providing, broadband, voice to video multimedia application, and better security. 4G LTE network is operating on TCP/IP architecture where only packet switched communication is feasible for improved performance. Moreover, all network signalling and controlling protocols are based on IP.[3]

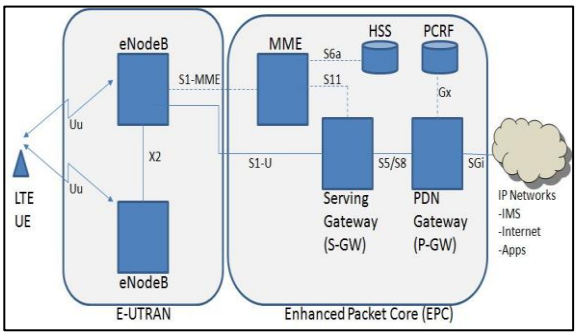

Figure 1. Typical LTE Architecture

LTE network consists of user equipment (UE), E-UTRAN, evolved packet core (EPC), and IP based networks such as internet and many more.

User Equipment (UE) that is considered as a 4G enabled mobile handset is connected to the network of eNodeB which is a part of E-UTRAN. The eNodeB network is responsible for establishing radio communication link with user equipment (UE) and also with EPC.0 EPC consists of MME (Mobile Management Entity), HSS (Home Subscriber Service), S-GW, PDN and PCRF. [4]

The function of MME is same as VLR in GSM architecture which is to perform control operations. MME is responsible for determining the location of ideal UEs and signalling of UEs. It also performs the operation of selection of S-GW for UE based on its location and based on the network topology available.

The HSS is similar to HLR (Home Location Register) of GSM architecture and it stores information like subscription, services provided to UE and other mobility data. It is also responsible of storing UE's MME address and is responsible for authentication.

The main function of S-GW is to route data between eNobeB and PDN gateway. S-GW also reroutes the data to a new eNobeB when handover takes place.

PDN is used to connect cellular network with external data network like Internet. The communication between service providers internal network with external IP network is handled by PDN. Other functions of PDN are billing information, charging information, filtering of packet and it also allocates IP to UE.

PCRF (Policy and Charging Rule Function) is a software which handles information regarding charging policy for data packets and also manages data sessions for UE. PCRF is also responsible for policy enforcement.

III. LTE SECURITY ARCHITECTURE

Security plays an important role in LTE architecture. The level of security measures provided in LTE security ensures the privacy of users and allows the users to be fearless about day to day attacks of hacker's. For this purpose network should be organised and secure from vulnerable attacks.[5]

Several key elements has to be kept in mind in order to design a secure LTE architecture. LTE security must ensure to provide same level of security that is provided in 3G and GSM architecture. However, the security aspects given in LTE architecture should not affect the current utilisation of USIM in 3G services.

For ensuring the above security necessity to be followed, further security parameters must be added into the system from evolved core network to user equipment (UE). Following changes are necessary to be implemented in LTE architecture for providing required level of security.

The LTE security architecture has been defined by 3rd Generation Partnership Project (3GPP) which covers security features, mechanisms and procedures for each section of EPS. In, this section we primarily discuss the LTE security features based on 3GPP. Figure 2 demonstrates the 3GPP security architecture. Based on the security aspects 3 GPP is divided into 5 main domains:

(1) Network access security: It ensures that mobile users have secure access to network services and

mobile network is secured against attacks via the (radio) access link. (2) Network domain security: It is the group of security features that protects against the attacks in the wire line networks and enable notes to exchange signal data in a safe way. (3) User domain security: Security feature set providing authentication between the ME and the USIM before being accessed by the USIM. (4) Application domain security: Securely exchange messages are enabled the applications in the UE and service provider domain by specific security features.

(5) Non 3GPP domain security: The set of features that enables the UEs to securely access to the EPC via non-3GPP access networks and provide security protection on the (radio) access link.

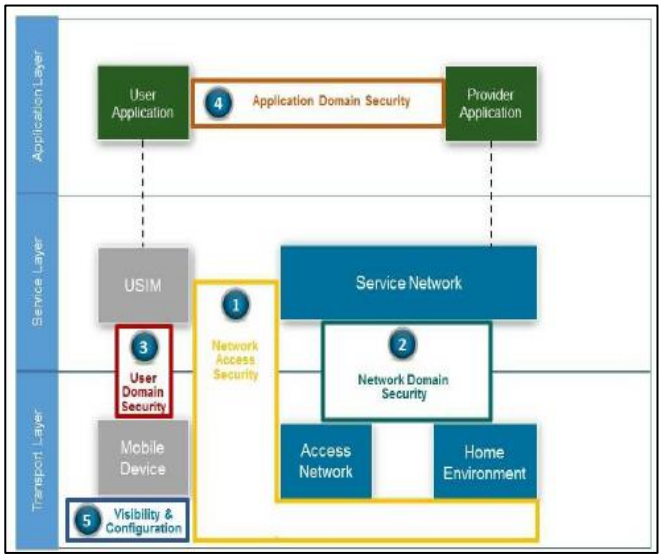

Figure 2. LTE security architecture

IV. CONCLUSION

With the development of 4G networks, the user requirements for mobile communication rates have reached at its pinnacle. The research field concentrates on evolution Version (LTE) of 4G network. At present, the experimental network for LTE standard has been built around the world; however, there are many problems to be solved for business application. In this paper, the 3GPP LTE network security problems are studied, the paper provides a tutorial overview of the proposed security mechanism in 3GPP LTE. It first gives a brief overview of the LTE security mechanisms, and then puts forward security architecture for LTE.

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