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Traffic Links Demonstration of Long Term Evolution Networks using NS-2 Modeler

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***Abstract*— Society of Third Generation Partnership Project (3GPP) is presently evolving Long Term Evolution Advanced (LTE-Advanced) as a development of the standard of LTE. This generation aims to produce specifications for a new radio-access technology geared to higher data rates, low latency and greater spectral efficiency. LTE-Advanced is an evolutionary step in the continuing development of LTE where the description in this article is based on LTE release 10 and thus provides a complete description of the LTE-Advanced radio access from the bottom up. This paper provides detailed interfacing parameters and factors which effect to implementing the traffics and links of transport layer for LTE-Advanced networks using the network simulator NS-2. Also it provides a deeper insight for the interface of protocol stacks, user plane, and control plane of protocol stack with the investigation to the links between the main parts LTE-Advanced system in terms of events, activities, organizations and other factors that have played an important role over transport layer.**

***Index Terms*— LTE, user plane, control plane, user stack, ns-2.**

I. INTRODUCTION

In September 2009 the partners of 3GPP have prepared the official suggestion to the proposed new ITU (International Telecommunication Union) systems, represented by LTE with Release 10 and beyond to be the appraised and the candidate toward IMT-Advanced (IMT: International Mobile Telecommunications). After attaining the requirements, the main object to bring LTE to the line call of IMT-Advanced is that IMT systems must be candidates for coming novel spectrum bands that are still to be acknowledged [6][7]. LTE-Advanced is applying various bands of spectrum which are already valid in LTE along with the future of bands of IMT-Advanced. More developments of the spectral efficacy in downlink and uplink are embattled, specifically if users serve at edge of cell. Also, LTE-Advanced aims quicker exchanging between the resource of radio states and between additional enhancements of the figures of latency. All at once, the bit cost must be decreased [8].

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IMT-Advanced represents the next generation in systems of wireless communications, which aim to accomplish other main advance of the current third generation systems, by reaching to uplink (UL) rate of 500 Mbps and to 1Gbps in downlink (DL)[9]. With LTE-Advanced starting, there are many key of requests and features that are up come to the light.

II. ARCHITECTURE OF LTE-ADVANCED NETWORKS

3GPP identified in Release 8 the requirements and features and requirements of the architecture of Evolved Packet Core (EPC) which that serving as a base for the next generation systems [12]. This identification specified two main work objects, called LTE and system Architecture Evolution (SAE) that leading to the description of the Evolved Packet Core (EPC), Evolved Universal Terrestrial Radio Access Network (E-UTRAN), and Evolved Universal Terrestrial Radio Access (E-UTRA). Fig. 1 illustrates the architecture of LTE-Advanced networks based on EPC and E-UTRAN. Each of these parts is correspond respectively to the network core, system air interface, and the radio access network. EPC is responsible to provide IP connection between an external packet data network by using E-UTRAN and the User Equipment (UE). In the environment of 4G systems, the radio access network and the air interface are actuality improved, while the architecture of core network (i.e., EPC) is not suffering large modifications from the previously systematized architecture of SAE.

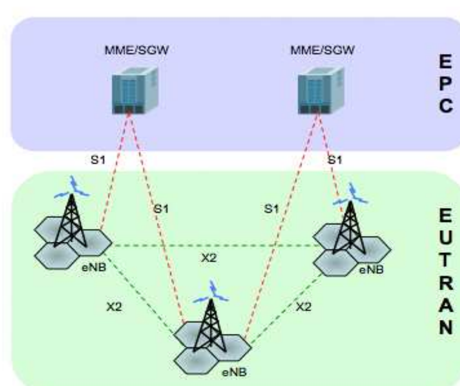

Fig.1. LTE-Advanced architecture

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The main part in the architecture of E-UTRAN is the improved Node B (eNB or eNodeB), that is provide the air interface between the control plane protocol terminations and the user plane towards the user equipment (UE). Both of the eNodeBs is a logical element that serving one or more E-UTRAN cells and the interfacing between the eNodeBs is termed the X2 interface. The interfaces of network are built on IP protocols. The eNodeBs are connected by an X2 interface and to the MME/GW (Mobility Management Entity/Gateway) object by an S1 interface.

The interface S1 is support a many relationship between eNodeBs and MME/GW [13]. The two entities of the logical gateway are termed Serving Gateway (S-GW) and the other is Packet Data Network Gateway (P-GW). The Serving Gateway (S-GW) is act as limited anchor for the mobility service to receiving and forwarding packet rates from and to the eNodeB to serve the UE, while the P-GW is interface with the exterior Packet Data Networks (PDNs) for example the IMS (Internet multimedia server) and the Internet. P-GW provides other IP functions such as packet filtering, routing, policy statement, and address allocation. The MME is an entity to provide signaling only and later the user packets of the IP do not pass over the MME. The main benefit of separating the network entities is for indicating if the capacity of network for traffic and signaling can independently grow. Actually, the core tasks of MME are to idle mode the reachability of UE together with controlling the retransmission of paging, roaming, authorization, P-GW/S-GW selection, tracking area list management, bearer management including dedicated bearer establishment, authentication, security negotiations and signaling of NAS[14]. The eNodeB is implementing the functions of eNodeB along with protocols usually applied in Radio Network Controller (RNC).

The eNodeB functions are ciphering, packet reliable delivery, and header compression. But in controlling side, eNodeB is incorporating functions such as:

- Radio resource management (radio bearer control, radio admission and connection mobility control, dynamic scheduling).
- Routing user plane data towards SAE Gateway.

Several benefits by using one node in the network accessing are to reducing the latency and the RNC processing distribution load in to many eNodeBs.

III. User Plane and Control Plane Protocols

The stack of user plane protocol is shown in Fig. 2. Form the Fig. 3, the Radio Link Control (RLC) and the Packet Data Convergence Protocol (PDCP) layers usually concluded in RNC on the network side are now concluded in eNodeB. The control plane protocol stack demonstrates in Fig. 3, where the Radio Resource Control (RRC) functional conventionally applied in RNC is integrated in to eNodeB [15].

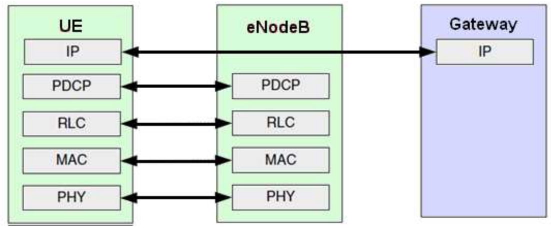

Fig. 2. User plane protocol

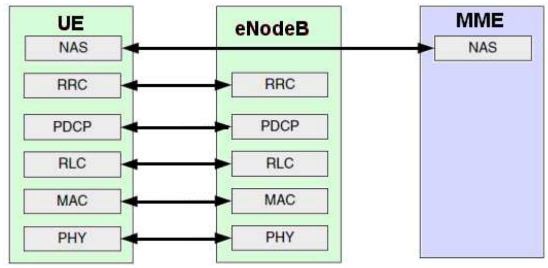

Fig. 3. Control plane protocol architecture

The layers of Medium Access Control (MAC) and Radio Link Control (RLC) are implementing similar roles to user plane. The RRC functions are include paging, system information broadcast, radio bearer control, connection management for RRC, measurement reporting to UE, and mobility functions. In the MME network side, the Non-Access Stratum (NAS) protocol is terminated while on the terminal side, the UE executes functions such as Evolved Packet System (EPS), authentication, security control, and bearer management.

IV. Interface Protocol Stacks

In Fig. 4 and Fig. 5, the interface protocol stacks S1 and X2 are presented where the protocols that used are similar in the two interfaces. The interface between S-GW and eNodeB are interconnected by S1 user plane interface (S1-U). This interfacing is used GPRS Tunneling Protocol-User Data Tunneling (GTP-U) over UDP/IP transport. Also it is provide a nonguaranteed delivery to the user plane PDUs between S-GW and eNodeB [13krr]. GTP-U is a comparatively simple IP and is based on tunneling protocol that allows a lot of tunnels between end points sets. In details, the S1 interfacing is separating the EPC and the E-UTRAN. It is splitting in to two interfaces; the first is S1-U that is transfers traffic data among S-GW and the eNodeB, and the second is S1-MME that is a signaling the interface between the MME and eNodeB.

X2 is the interfacing between the eNodeBs and also involving two interfaces; the first is X2-C which is the control plane interface between eNodeBs, and X2-U is the user plane interface between eNodeBs. It is supposed that always there is an X2 interface between eNodeBs which is to provide communicating between each other [4].

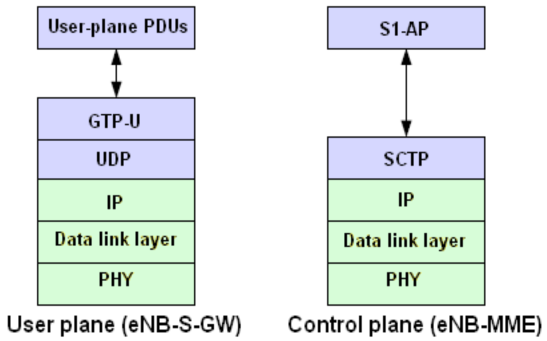

Fig.4. S1 Interface user and control planes

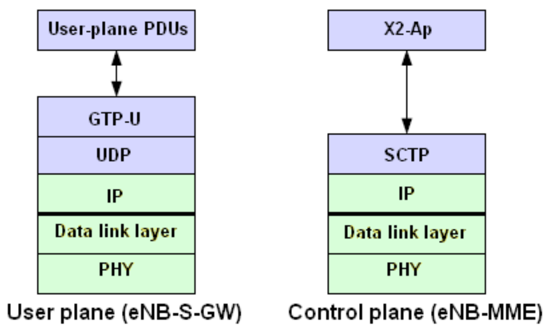

Fig. 5. X2 Interface user and control planes

S1-MME represents the S1 control plane interfacing between MME and eNodeB. Similarly, the transport network layer and user plane is based on IP transport and in case of reliable transport to the signaling messages; the Stream Control Transmission Protocol (SCTP) is applied over IP top. These protocol functions analogously to TCP confirming reliable, in sequence transmission of all messages with congestion control. SCTP drives analogously to Transmission Control Protocol (TCP) certifying reliable and offer in-sequence transport of messages with congestion control [ams abed]. The application layer signalling protocols are mentioned to S1 application protocol (S1-AP) and X2 application protocol (X2-AP) for S1 and X2 interface control planes respectively [16]. LTE, 3GPP is also defining IP-based, flat network architecture. This architecture is defined as part of the (SAE) effort. The LTE/SAE architecture and concepts have been designed for efficient support of mass-market usage of any IP based service [17].

The main part in the architecture of E-UTRAN is the improved Node B (eNB or eNodeB), that is provide the air interface between the control plane protocol terminations and the user plane towards the user equipment (UE). Both of the eNodeBs is a logical element that serving one or more E-UTRAN cells and the interfacing between the eNodeBs is termed the X2 interface.

The interfaces of network are built on IP protocols. The eNodeBs are connected by an X2 interface and to the MME/GW (Mobility Management Entity/Gateway) object by an S1 interface.

V. Conclusion

This paper provides the basic procedures to implement the link interface for LTE-Advanced networks by using network simulator NS-2. In addition, its offers the main features of user plane protocol and control plane protocol and the link interface of protocol stack and illustrates the parameters and values the limit and control the behavior of these protocols over LTE-Advanced networks. Also, this paper explained the simulation link parameters in details and showed the real animation topology to the transport layer for LTE-Advanced system.

VI. Future work

The future work of this research will focus when mobile node move from cell to another cell and also measure the effects of the handover on the performance of LTE-Advanced networks.

REFERENCES

[1] M. Kottkamp, "LTE-Advanced Technology Introduction," ed: Rohde & Schwarz, 2010.
[2] M. Kiiski, "LTE-Advanced: The mainstream in mobile broadband evolution," 2010, pp. 983-988.
[3] V. Stencel, A. Muller, and P. Frank, "LTE Advanced-A further evolutionary step for Next Generation Mobile Networks," 2010, pp. 1-5.
[4] Y.H. Nam, L. Liu, and Y. Wang, "Cooperative communication technologies for LTE-advanced," 2010, pp. 5610-5613.
[5] 3GPP, "Overview of 3GPP release 8 v.0.1.1," Tech. Rep., 2010.
[6] F. Khan, LTE for 4G mobile broadband: Cambridge University Press., 2009.
[7] L. Bajzik, P. Horvath, and L Korossy, "Impact of Intra-LTE Handover with forwarding on the user connections," 2007, pp. 1-5.
[8] P. Tapia, and J. Liu, "HSPA performance and evolution: a practical perspective" Wiley, 2009.
[9] A. Ghosh, J. Zhang, J. G. Andrews, and R. Muhamed, "Fundamentals of LTE," Prentice Hall, 2010.
[10] G. A. Abed, M. Ismail, and K. Jumari, "Appraisal of Long Term Evolution System with Diversified TCP's," Modelling Symposium (AMS), 2011 Fifth Asia, 2011, pp. 236-239.
[11] G. A. Abed, M. Ismail, and K. Jumari, "Traffic Modeling of LTE Mobile Broadband Network Based on NS-2 Simulator," Computational Intelligence, Communication Systems and Networks (CICSyN), 2011 Third International Conference on, 2011, pp. 120-125.