

# Gateway 선택 시, 특정 가입자 번호 대역에 대해 부하 분산 방법

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## Load Distribution using IMSI Prefix to select Gateway in LTE

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### Abstract

This paper is for EPC(Evolved Packet Core) network to share the load balance by IMSI(International Mobile Subscriber Identity) prefix in MME(Mobility Management Entity). For the telecommunication, it needs to choose the anchoring gateway to use the specific gateway to avoid the traffic load to support the efficient telecommunication service. We propose the way to choose the effective gateway to avoid the traffic load in order for good quality service. We compare the load between the gateways which are the general gateway and the specific gateway used by proposed concept.

### 1. Introduction

Nowadays, 3G technology is old concept to be required for much high speed in mobile communication network such as internet and the streaming service. LTE(Long Term Evolution), called 3.9G, which is not fully fulfilled the requirement of 4.0G standard. But LTE is on the hot table between subscribers all over the world and will last in the future[1]. In Figure 1, it shows the interest of people toward LTE between 2012 and expected 2015 in the world.

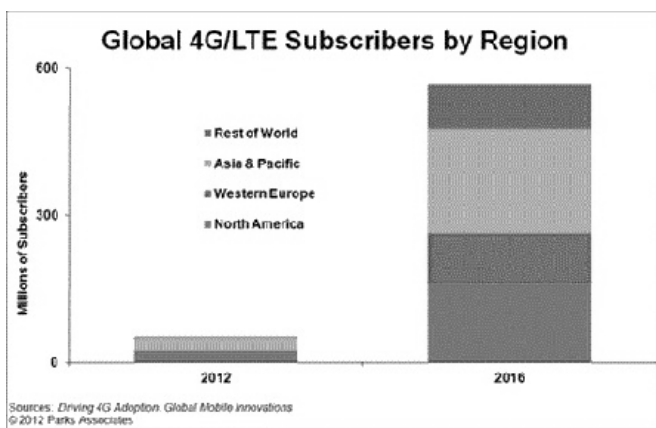


Figure 1. The proliferation Expectancy of LTE

As the proliferation expectancy of LTE in figure 1, there

will be much load in the each LTE device. It can cause the significant problem in the view of LTE devices. This paper suggests the key to solve the problem described above. We will explain the function, concept of LTE in section 2. In section 3, we will go deeper in LTE how to make a session in order to connect to the IMS network or to the telecommunication network. And then we describe the way to solve the load problem in section 4. Finally we compare the load between the gateway which are the general Gateway and IMSI prefix-selected Gateway in section 5.

Keywords – LTE; Gateway; selection; IMSI Prefix

### 2. The general of LTE

LTE technology has several nodes to support 3.9G telecommunication. LTE consists of two concepts which are E-UTRAN(Evolved Universal Terrestrial Radio Access Network) and EPC(Evolved Packet Core)[2].

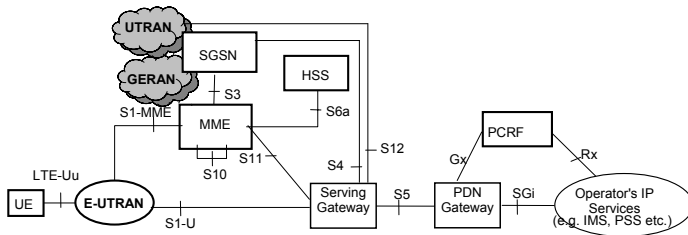


Figure 2. LTE nodes

In the EPC, there are several nodes to support LTE technology to connect to IMS(IP Multimedia Subsystem). It consists of UE(User Equipment) such as the cell phone, E-UTRAN, MME(Mobility Management Entity), HSS(Home Subscriber Server), S-GW(Serving Gateway), P-GW(Packet Data Network Gateway), PCRF(Policy & Charging Rule Function), and IMS Nodes(IP Multimedia Subsystem nodes such as P-CSCF(Proxy Call Session Control Function), I-CSCF(Interrogating Call Session Control Function), S-CSCF(Serving Call Session Control Function) and AF(Application Function).

UE connects to the eNB(E-UTRAN) by wireless interface. eNB provides the wireless interface for UEs. It has several functions which are wireless bearer controls, wireless control, dynamic wireless resource control, load balancing and so on. MME is communication entity between S-GW and eNB. It gets the profile of UE from HSS to make the connection. It controls Mobility Management and EPS Session Management. S-GW is the anchoring point for eNB handover and 3GPP handover. PGW is the connecting point between PDN network and internal 3G network. It provides the filtering service. It allocates the IP address to UE and charge the UE.

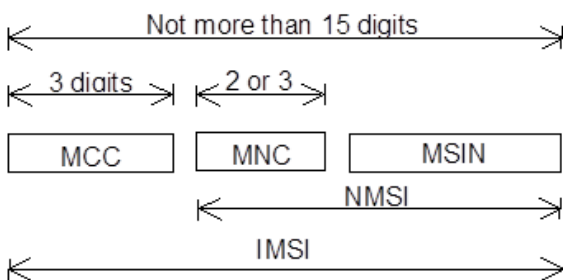


Figure 3. IMSI Value

In order to identify the Mobile User, the Telecommunication Provider such as SKT, KT and LGU+ uses IMSI(International Mobile Station Identity). The maximum digit of IMSI is 15. When user buys User Equipment and register for LTE service, IMSI is installed into USIM card and telecommunication provider provisions user's information into HSS. When UE connects to LTE, MME identifies User by IMSI and get the information about

user from HSS to prepare for the service. In order to serve this, IMSI must be unique. IMSI has several concepts to be combined for the unique identifier like Figure 3. IMSI is composed of three parts MCC(Mobile Country Code) , MNC(Mobile Network Code) , MSIN(Mobile Subscriber Identification Number). MCC consists of three digit which is uniquely identified among the county of domicile of the mobile subscriber[3]. It also calls the PLMN Id which is combined by MCC and MNC. MSIN is identified the mobile subscriber within a PLMN[4][5].

### 3. Call Setup[3][6]

For the supporting LTE technology, we learned that it needs lots of nodes like above. In order to make the phone call, we need some procedure from UE to EPC core network in 3gpp standarazation[XX]. Figure 4 describes the step in short. UE wants to connect to the network by Attach Request. It ends with Attach accepted from MME. When UE ends Attach Request, it contains its information into IMSI or GUTI. And MME sends Attach accept message which has TAI List, GUTI and so on. It has several procedures to identify the user, to authenticate, to set up NAS security, to register Location update, and set up EPS(Evolved Packet Session). Depends on the procedure, the initial call setup will be divided into several types. Getting IMSI and EPS Setup configuration procedure are common in the call procedure. But getting IMSI from whom will be essential for the type of initial call procedure. It has 2 types of initial attach in general. First case of Initial attach is that UE is unknown. This case is that MME doesn't have any idea of UE when MME requests the information about UE. UE is totally new in the network which UE tried to connect to. And MME no longer save the information of UE because the time expires to keep it for a certain period of time.

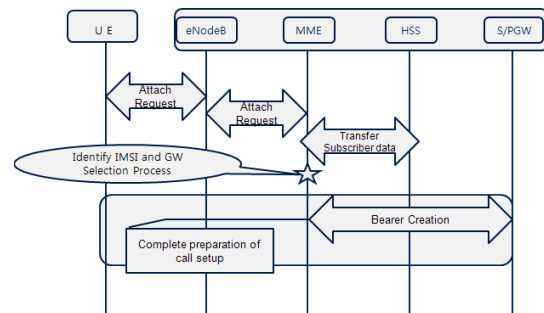


Figure 4. Call Setup

The second case of initial attach is that MME already has the information of UE. It keeps track of the UE's previous records which are GUTI, NAS security configuration information, subscription data and so on. There are several cases. UE connects to the MME which already connected once before. Another MME which has the information of

UE can transfer the data of UE to the MME in the current network UE connects to.

#### 4. Gateway Selection

In the previous chapter, it needs the call setup procedure in order to communicate with the network. At the several steps, MME needs to know where to send the request and packet. It can know by the procedure of selection Gateway. Gateway has a few functions. Main function of gateway is forwarding the data in the right position.

In the figure 4, MME gets the subscription data for gateway selection. It gives the information like what service the telecommunication provider serve and how good quality the user can achieve. It is called APN(Access Point Name). Also it is used for identifying PDN. APN has two parts. One is APN-NI(Network Identifier) and another is APN-OI(Operator Identifier). APN NI is for identifying Internet or cooperate VPN. APN OI is for identifying the telecommunication provider.

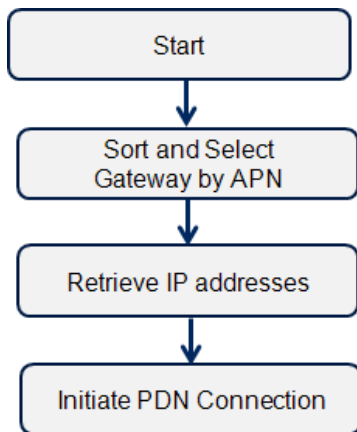


Figure 5. Normal Gateway selection

When MME receives the APN from HSS, it enters the step in Figure 5. MME saves APN table for APN-Gateway selection. It searches equivalent Gateway by APN to setup the bearer. It chooses the Gateway. It will try to initiate PDN Connection by exchanging message to Gateway.

In this procedure there is big issue in case the gateway has so much data to process. In the EPC network, Call setup message and disconnection message are treated as IP Packet to deliver to PDN gateway. Gateway can be the bottle neck for processing data. It causes the significant delay. It causes some problem for the user in hurry.

So we propose the new concept to solve this problem. It doesn't need any additional devices or complicated concept

to support proposed concept. It is IMSI Prefix Gateway selection function.

During authentication of UE, MME knows the IMSI values. IMSI has 15digits. There is a part to identify the value and extract the IMSI value for the manipulation. If telecommunication provider requests more than one user to want to use other Gateway, IMSI Prefix is the key. IMSI Prefix is less than 15digits. When IMSI prefix configure with 14 digits, 10 users will be affected by this function. In order to support 100 users, IMSI Prefix is configured with 13 digits. It depends on the taste of telecommunication provider. APN is no longer used in the step to select Gateway. If UE belongs to the configure IMSI prefix, it uses the preconfigured Gateway instead of APN-Gateway Table. If UE doesn't belong to the range of pre-configured IMSI prefix, it uses APN-Gateway table to choose the gateway.

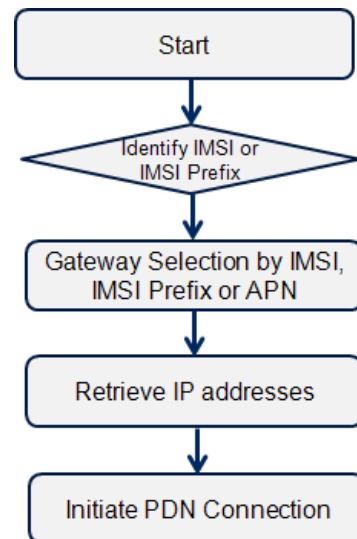


Figure 6. Proposed Gateway Selection

In the figure 6, it describes the procedure for suggested concept in this paper. The procedure is different when the UE get the step of Identifying IMSI or IMSI Prefix. Additional Gateway will be setup to share the load between the APN-based Gateway and IMSI Prefix based Gateway.

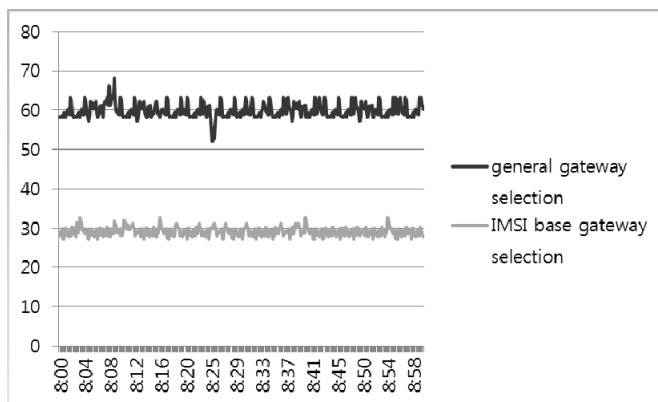
If user decides not to use the IMSI Prefix based Gateway, it is possible not to use this function to trigger for no use.

Also, the specific user in the range of IMSI can choose the APN based Gateway in case for no use. It can register the Exception Mode in the function. It meets all of requirements to support this concept.

## 5. Conclusion

Figure 7 shows that the significant reduction of load in the general Gateway. The black graph is the Gateway Load in the original gateway selection by MME. In the contrast, the load is reduced in half by the function of IMSI Based gateway selection. When we use the IMSI based Gateway selection, we can choose another gateway in the MME not by APN value or Static Gateway address. It uses IMSI Value. It acts like APN for the choice of dedicated Gateway. In the field, the environment could be harsh to support LTE technology.

We can group more Gateways to support LTE in order to reduce the load. It will reduce more load than figure 7. We just want to deliver the concept that there are more ways to choose the gateway not by APN.



**Figure 7. Comparison between proposed selection and general selection**

In this paper, we get through lots of information about LTE technology. It's hard to convey all of LTE information in this paper. We just deliver the brief concept and the one of the solution to the load concentration in the Gateway.

With several technologies for load concentration, we suggest that IMSI prefix Gateway selection is one of the key solutions to fulfill the requirement of load distribution.

## References

- [1] Abeta, S. "Toward LTE Commercial launch and future plan for LTE enhancement", Communication Systems(ICCS), 2010.
- [2] Jinho Hwang, Nakpo Kim, Yungba Ji, Jongseog Koh, "A Mobile VoIP Architecture over LTE & WLAN networks", Advanced Communication Technology(ICAT), 2010.
- [3] 3GPP TS 23.401 "General Packet Radio Service(GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network(E-UTRAN) access", Sep.2009.
- [4] 3GPP TS 23.003 " Numbering, addressing and identification", Dec.2010.
- [5] ITU-T E. 212, "The international identification plan for public networks and subscriptions".
- [6] "A Direction of Response Policy and Evolution of 4G Mobile Communications Technology", 제 35 회 한국 정보처리학회 추계학술대회 논문집 , May.2011.