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AN ANALYSIS OF THE APPLICATION END TO END QUALITY OF SERVICE ON 3G TELECOMMUNICATION NETWORK

Cahya Lukito; Rony Baskoro Lukito; Deddy Arifin
Information Systems Department, School of Information Systems, Bina Nusantara University
Jl. K. H. Syahdan No-9, Jakarta 11480, Indonesia
cahya.lukito@gmail.com; rbaskoro@binus.edu; darifin@binus.edu

Abstract: End to End Quality of Service is a way to provide data package service in a telecommunication network that based on Right Price, Right Service Level, and Right Quality. The goal of this research is to analyze the impact of End to End QoS use on 3G telecommunication network for voice service and data. This research uses an analysis method by doing the application on the lab. The result that is achieved in this research shows that End to End QoS is very influental to the Service Level Agreement to the users of the telecommunication service.

Keywords: End to End Qos, SLA, Diffserv

INTRODUCTION

Background of Study

The development of the telecommunication device is very fast recently. Cellular phones are developing into Smartphones, it gives advantages for the users of the telecommunication network and the agents of information technology world to use the available service more effective, efficient, and attractive.

One of the problems, which is faced, is how to adjust the bandwidth and Quality of Service that is provided for the customers in accordance with the Service Level promised by the telecommunication operator on the products that is sold. The adjustment should be done from end to end, which starts with the Node-Radio, Transmission Radio, the element of CORE Network, and IP Backbone.

Problem Formulation

QoS in ITU E.800 is stated as the characteristic from a telecommunication service to be able to provide the best service to the customers. To see the impact and to make sure that End to End QoS can work well on 3-Generation network or usually shortened as 3G, then a trial and an analysis (functional test) are needed to be done to the system before this can be applied on Live Network.

Literature Review

In the following, there will be an explanation about the architecture of 3G network generally, the main point on the planning of CORE network, the architecture and the basic concept of End to End QoS.

The Architecture of 3G Network

The existence of 3G telecommunication technology as "service driven wireless communication system", gives more attractive experiences than 2-Generation (2G) telecommunication network, which more prioritize the voice service and Short Message Service (SMS). The 3G infrastructure is designed to be able to provide data package service that is more various and faster, that includes: voice over IP, e-mail, web browsing, and many else.

Basically, 3G telecommunication network is the development of 2G telecommunication network with a voice service that is usually called Circuit Switch (CN CS Domain), and a data service that is usually called Packet Switch (CN PS Domain) [1]. The implementation of 2G radio network (GERAN) and 3G radio network (UTRAN), based on the 3GPP Release-4, can be seen in the following figure. The IP Transport is used as the CORE Network Protocol in the CS/PS Domain. It is provided the User-plane as the pipe for the traffic of user data, and Control-plane as the pipe for the communication between Network Element on the telecommunication network.

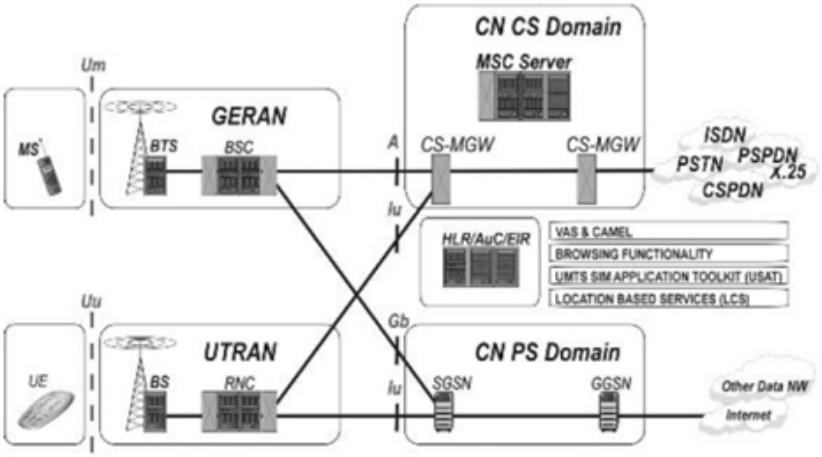

Fig 1: 3GPP Release 4 [1]

The Planning of CORE Network

In the planning of a CORE network, there are several important factors that need to be considered, which are: scalability, reliability, cost effectiveness, and the QoS dependence that is expected. In the following are several things that need to be considered while doing the planning of CORE network: (1) Determining the matrix traffic based on location and hardware capacity. (2) Determining the QoS level that is needed for every service. (3) Determining the transport technology that will be used to connect between network elements. (4) Making the estimating calculation of the number of network elements that is needed. Also the designer of topology network. (5) Calculating the number of link and physical-port that is needed to connect each of the network elements.

The determination of QoS in the planning phase is very important. The quality of service for videos, voices and data need to be differentiated, as well as to pay attention on the service which is sensitive to error or not.

The Architecture of QoS

The End to end QoS service, provided by 3G network, is passing through several QoS provider with different characteristics as seen in the figure 2. In the part of local service manages the mapping between Terminal Equipment (TE) and Mobile Terminal (MT) for user service. UMTS bearer service has charge on managing the mechanism of QoS on 3G radio network, transmission, and CORE network [2]. The last part is the External Barrier Service that is in charge on managing QoS from 3G network to external network.

Every service need different mapping of QoS for every bearer service. The grouping of QoS can be divided into several classes, such as: (1) Conversational class: Usually used for two-way communication or in a group, not allowed to be done to the safe of several packets (buffering). The arrival of the package that is not the same will cause a change on delay value that is usually called jitter. The high jitter value will cause unclear voice that cannot be heard. (2) Stream class: is a service for one-way communication. It is possible to do data buffering, so the change of a small delay value is still permitted. (3) Interactive class: an example of the use of this class is WEB browsing, online long-distance control, and access to the computer. Round Trip Time (RTT) delay is the principal parameter in this class. Every request-packet will wait to get respond-packet. Therefore, delay is not the problem, permitted to do the buffering and includes in asymmetric traffic group. (4) Background class: the characteristics from this class are not sensitive to the delay, and the data that is sent transparently with a small bit error rate. Example for the use of this class is to e-mail sending, file downloading, and SMS.

End to End QoS Concept

In the following is the important attribute in determining QoS, which are: maximum bit rate, guaranteed bit rate, high transfer delay that is permitted. An attribute for UMTS bearer service and radio access bearer service in every QoS classes can be seen in the below table.

End to End QoS service started with the demand from the User Equipment (UE) [3]. As seen in the figure 3, the demand of the service will be grouped according to the QoS attribute on CM service class criteria, which is next continued to the CORE network (CN) through the UTRAN radio network. The same process happens on CN, the demand of End to End QoS service is mapped again on CM. The next step is to check the requirement on UMTS bearer that is continued with RAB allocation and QoS negotiation between UTRAN and CN. If it worked, then UMTS service with QoS that is agreed between UE and CN is formed.

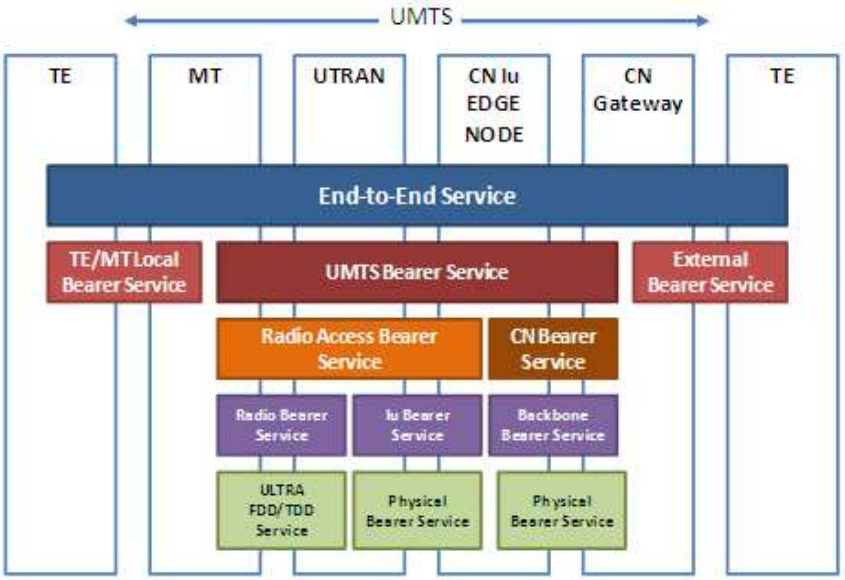

Fig 2: UMTS QoS Architecture [3]

Table 1: UMTS barrier serviceAttribute

	Conversational	Streaming	Interactive	Background
Maximum bit rate (kb/s)	< 2048	< 2048	< 2048	< 2048
Guaranteed bit rate (kb/s)	< 2048	< 2048	N/A	N/A
Symmetry	Symmetric	Asymmetric	Asymmetric	Asymmetric
Transfer delay (ms)	100-250	250-seconds	N/A	N/A

Table 2: UMTS radio access barrier service Attribute

	Conversational	Streaming	Interactive	Background
Maximum bit rate (kb/s)	< 2048	< 2048	< 2048	< 2048
Guaranteed bit rate (kb/s)	< 2048	< 2048	N/A	N/A
Symmetry	Symmetric	Asymmetric	Asymmetric	Asymmetric
Transfer delay (ms)	80-250	250-seconds	N/A	N/A

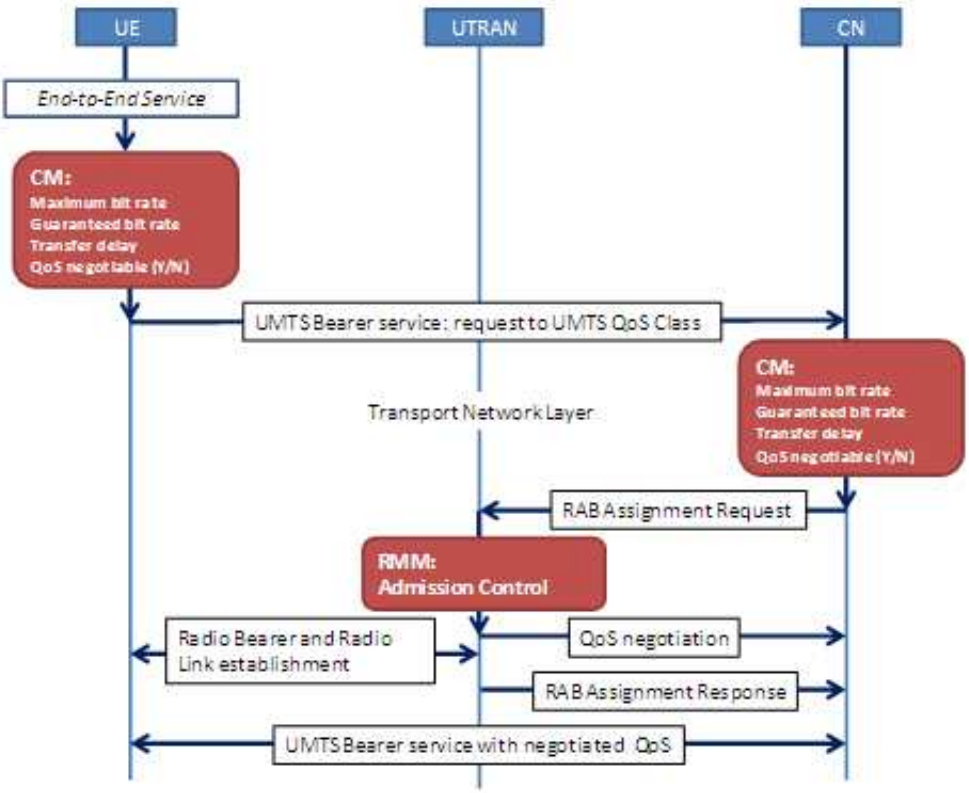

Fig 3: The Basic Principle bearer management [3]

Differentiated Services (DiffServ)

There are two ways to apply End to End QoS. One of the mechanisms that is often used on Iu interface, CN and external network are DiffServ. Every packet will pass through the network that is given marking according to the service class priority that is grouped based on each of service types. Each of the Network Elements (RNC, MGW, SGSN, GGSN) will use the marking to determine the priority of packet delivery on every interfaces, where the packet with the higher priority will be sent first.

For all the packets regularly will get best-effort delivery service. DiffServ uses six bits that usually called as Differentiated Services Code Point (DSCP) on the Header of an IP packet with certain QoS needs. DSCP located in the Type of Service field for Ipv4 or Traffic Class field for IPv6. This mechanism will help reduction of jitter and delay for a certain service.

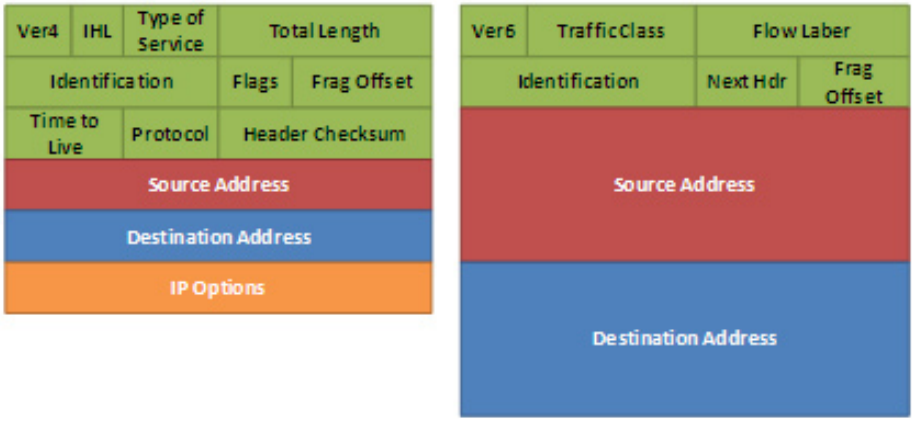

Fig 4: Header from IPv4 and IPv6 [4]

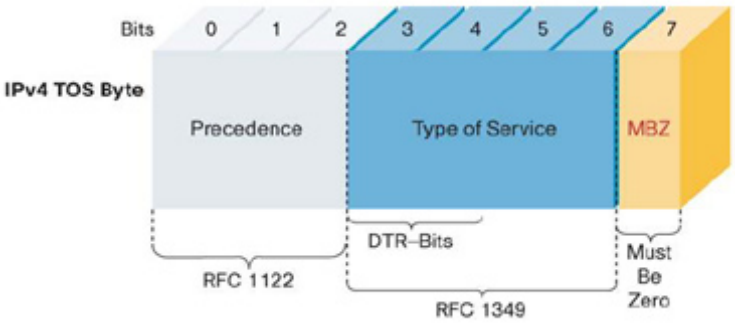

Fig 5: The Original IPv4 ToS Byte [5]

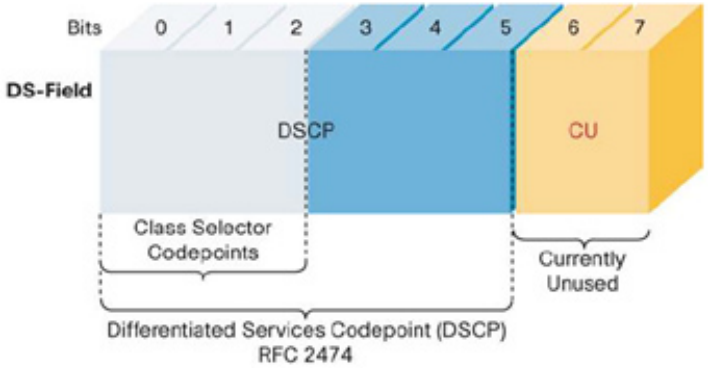

Fig 6: DiffServ Codepoint Field [5]

METHOD

The research is done by using these following methods: (1) the Descriptive analysis method is by analyzing and identifying the problems that show up with the application of End to End QoS on 3G telecommunication network. (2) Literature study is a collection of information through books in the library or articles in the internet.

The research is done in the telecommunication laboratory for 3G network.

RESULTS AND DISCUSSION

The trial of End to End QoS application is conducted for two services: a voice call via CS network and a file transmission (FTP) via PS network. The point of measuring instrument for the observation done in the Iu-PS and Iu-b. To see the network behavior, seven experiments had been conducted with the following scenario: (1) Scenario-01: Without QoS, a voice call session: A-number on 3G network, B-number on 2G network, a FTP session, and the capacity of bandwidth interface Iu0b is 100 Mbps. (2) Scenario-02: Without QoS, a voice call session: A-number on 3G network, B-number on 2G network, a FTP session, and the capacity of bandwidth interface Iu0b is 1 Mbps. (3) Scenario-03: Without QoS, two voice call sessions: A-number on 3G network, B-number on 2G network, a FTP session, and the capacity of bandwidth interface Iu-b is 512 Mbps. (4) Scenario-04: Without QoS, a voice call session: A-number on 3G network, B-number on 2G network, a FTP session, the capacity of bandwidth interface Iu-b is 512 Mbps, and the Bandwidth allocation for voice service is 128 Kbps. (5) Scenario-05: Without QoS, a voice call session: A-number on 3G network, B-number on 2G network, a FTP session, a UDP Stress-test session, the capacity of bandwidth interface Iu-b is 512 Mbps, and the Bandwidth allocation for voice service is 256 Kbps. (6) Scenario-06: Without QoS, a voice call session: A-number on 3G network, B-number on 2G network, a UDP Stress-test session, and the capacity of bandwidth interface Iu-b is 512 Mbps.

The result of throughput measurement for Iu-Ps interface can be seen in figure 7. Even though without QoS, a conversation can be heard well on scenario-01 and 02, but when the bandwidth Iu-b is minimized to 512Kbps (scenario-03), caused the disturbance of voice because the voice packet and data packet have the same priority levels. In addition, a call failure also happens because the available bandwidth has already occupied with the data service.

The next test is by using QoS. There is a little bit distortion for the voice service with the minimum bandwidth. In contrast with the adequate bandwidth, it can be obtained that voice service can experience a reduction of quality, although it is given a stress-test.

Stress-test is conducted by sending the UDP packet. It can be seen that the throughput of FTP packet becomes zero, meanwhile the UDP packet fulfills the bandwidth capacity, although at that moment already become congestion.

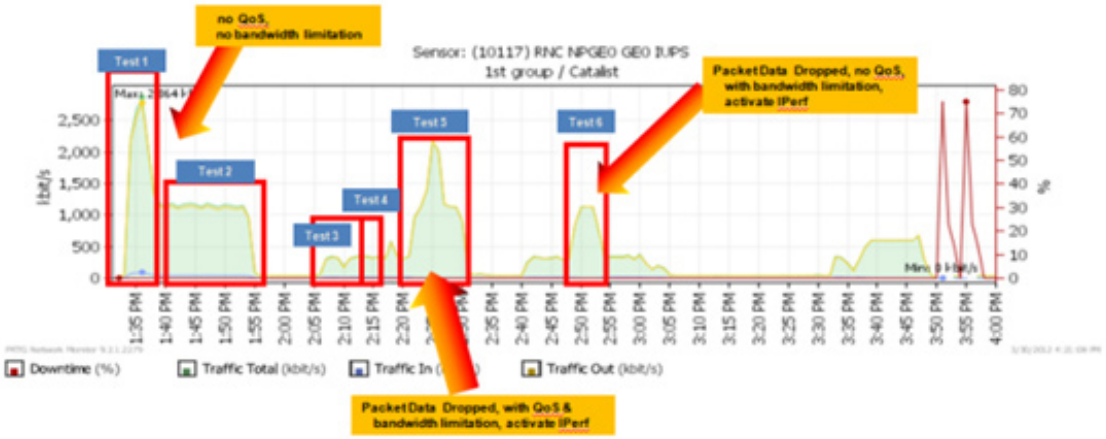

Fig 7: Throughput Characteristics for Iu-Ps interface

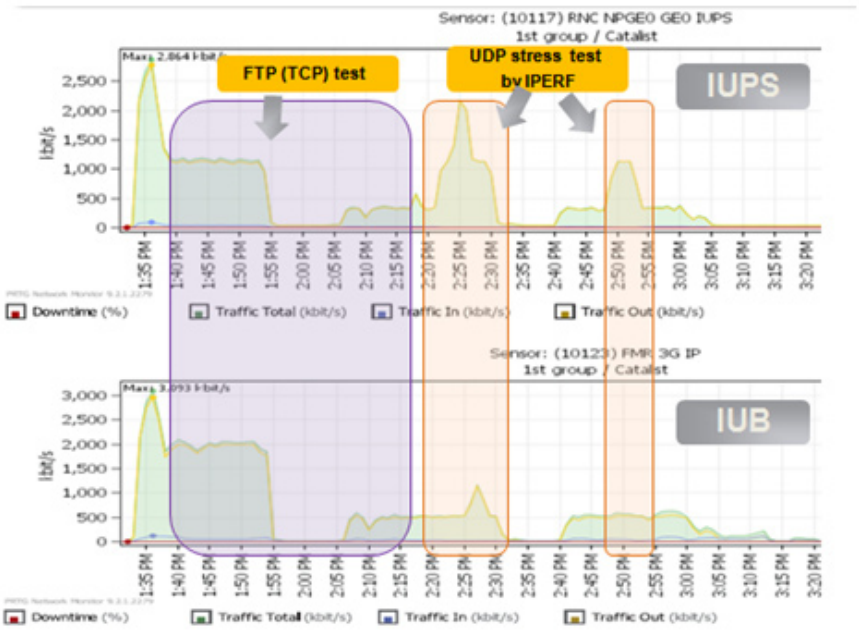

Fig 8: Comparison of Throughput TCP to UDP

CONCLUSION

From the result of the research about the application of End to End QoS on 3G network, it can be concluded several advantages or benefits that are obtained, like: (a) with QoS guarantee, then the bandwidth and the voice service quality is not disturbed by the data packet service. (b) the bandwidth capacity can be managed and used in accordance with the service level, that is expected, and also can increase efficiency value of the provided infrastructure use. (c) an application of End to End QoS should be applied on every Network Elements in a telecommunication network. If this thing is not done, then the system cannot be working perfectly.

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