

# Chapter 16

## End-to-End Quality of Service in Evolved Packet Systems

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### ABSTRACT

*The recent emergence of new IP-based services that require high bandwidth and low service latency such as voice over IP (VoIP), video sharing, and music streaming have motivated the 3<sup>rd</sup> Generation Partnership Project (3GPP) to work on the all IP-based cellular networks called Evolved Packet System (EPS). It is challenging for EPS not only to meet the Quality of Service (QoS) requirements of new services but also to make sure the QoS of existing services not impacted. In this chapter, the authors will first present an overview of EPS, and then focus on the aspects of QoS principles and mechanisms in EPS. End-to-end QoS models have been developed to analyze the application performance in EPS. Simulation results have shown that VoIP service requires resource reservation to guarantee its QoS requirement, and e-mail service does not experience significant performance degradation even when assigned a low service priority and the system experiences short period congestion. However, web browsing performance may not be improved proportionally to the network bandwidth increase due to the inherent network probing procedure of the transport protocol.*

### INTRODUCTION

This chapter gives an overview of the Evolved Packet Systems (EPS) including the system architecture and key network elements and their main functionalities. Some of the new essential features of EPS are highlighted. Among these features, this chapter will focus on the Quality of Service (QoS)

in EPS. As EPS is the first all-IP based mobile cellular network, it is challenging to provide the QoS not only to traditional IP-based data services but also to services such as voice that has been usually provided through circuit-switched systems. The EPS QoS principles and mechanisms will be introduced in aspects such as service differentiation and admission control. We also present the end-to-end QoS performance analysis of the basic services such as

DOI: 10.4018/978-1-61520-674-2.ch017

VoIP, e-mail and web browsing through simulation study of EPS QoS model.

## BACKGROUND

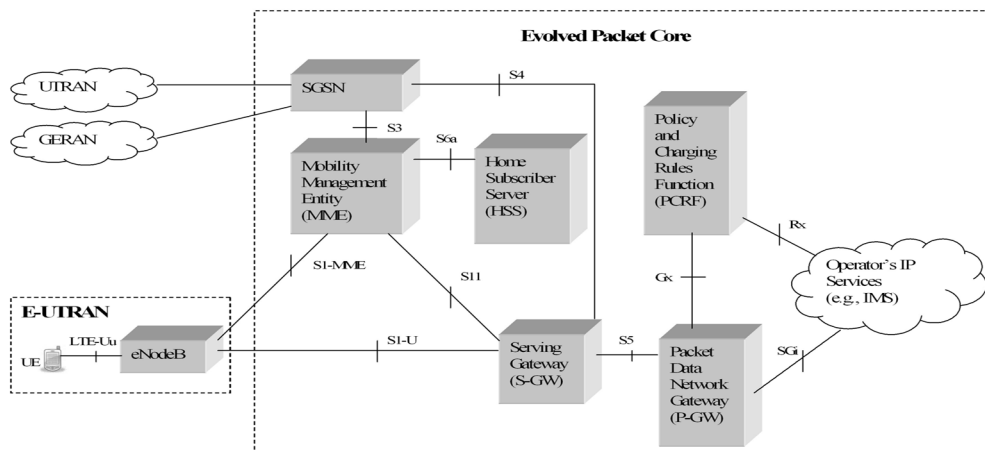
Current generation mobile cellular networks such as Global System for Mobile Communications (GSM), Enhanced Data Rates for GSM Evolution (EDGE) and Universal Mobile Telecommunications System (UMTS) have been designed for the circuit-switched voice service and low to medium bit rate data services such as e-mail and web browsing. The recent emergence of new IP-based services that require high bandwidth and low service latency such as voice over IP (VoIP), video sharing, and music streaming have motivated the 3<sup>rd</sup> Generation Partnership Project (3GPP) to work on the all IP-based cellular networks called Evolved Packet System (EPS). Compared to the existing systems, the EPS is targeting to provide higher user data rates, reduced latency, improved system capacity and coverage, reduced network complexity and lower operating costs. The following lists some of the major performance objectives of the EPS (3GPP TS 22.278, 2008; 3GPP TS 25.913, 2008):

- To support instantaneous peak data rates of 100 Mbps on the downlink and 50 Mbps on the uplink in the radio access network.
- To provide low user and control plane latency with a target of less than 10 ms user plane radio access network round-trip time (RTT) and less than 100 ms channel setup delay.
- To be capable of supporting large amount of mixed traffic including voice, data and multimedia.
- To optimize the level of system complexity and mobility management signaling in order to reduce infrastructure and operating costs. UE battery consumption shall also be minimized accordingly.
- The interruption time during handover shall not exceed the 300 ms for real-time services and 500 ms for non-real-time services.

## EPS System Overview

Figure 1 shows the overall EPS system architecture, which consists of the evolved packet core (EPC) and long term evolution (LTE) radio access network (RAN), also known as, evolved

Figure 1. EPS system architecture



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