Universitas Esa Unggul

Smart, Creative and Entrepreneurial

www.esaunggul.ac.id

Jaringan Mobile
Quality of Service Management in UMA

Taufik Rendi Anggara., MT
Teknik Informatika
Fakultas Ilmu Komputer

Quality of Service

The QoS of a network refers to the properties of the network that directly contribute to the degree of satisfaction that users perceive. The perceived QoS depends on the type of application the user is running. There are many examples for this: the same network can have a poor quality if a user wants to hear an audio signal, but can be sufficient to download a text file relatively quicker. In the business world, the QoS determines whether a normal voice conversation is possible, whether a video conference is of sufficient quality, or if a multimedia application improves productivity for the staff. At home, it determines whether the savings offered by an inexpensive voice service are worthwhile, or if there are complaints about the quality of a video-on-demand movie. Around the world, discriminating businesses and residential users demand higher QoS from the network

Internet QoS

The flexibility of the Internet Protocol (IP) has enabled the huge success of the Internet as a complex network providing delivery service to numerous sophisticated applications. QoS has always been a major issue of debate in the Internet community. Up to now, even though several standards for Internet QoS exist, a majority of providers manage QoS by simple overprovisioning, hoping that this alone would be enough to satisfy the majority of the users. It is necessary to present the two main QoS architectures developed for the Internet, the Integrated Services (IntServ) Architecture and the Differentiated Services (DiffServ) Architecture . The IntServ Architecture is based on a per-flow reservation of QoS.

Cont.

A special protocol, the Resource Reservation Protocol (RSVP), has been standardized to carry reservation messages through the network. The IntServ Architecture is generally considered to be inefficient because it is not scalable and provides a complex per-flow QoS management. Today, the RSVP is frequently used as the QoS reservation protocol for IP-based networks. The Differentiated Services (DiffServ) Architecture is a much more promising concept, offering a framework within which providers can offer each customer a service differentiation, where a “service” is defined as the overall treatment of a defined subset of customer traffic within the network.

Quality of Service in Cellular Networks

Wireless cellular networks have been developed in the last decades and have been a huge success in providing means of communications to millions of users. The main application of these networks has always been and is still voice. With this in mind, it is clear that the foundation of any QoS scheme, algorithm, or management framework needs to satisfy the requirements of a large number of voice users. This makes the QoS requirements very different from those on the Internet. The GSM/GPRS network, although providing basic data services to the user, did not have full QoS support for data applications. The implementation of traffic classification and QoS in GPRS is constrained by the fact that GPRS can differentiate QoS only on the basis of the IP address of a mobile station, but not on the basis of individual IP flows.

Cont.

In GPRS, a specific QoS profile (part of the Packet Data Protocol (PDP) context profile) is assigned to every subscriber upon attachment to the network. Further to this, the GPRS core network uses IP tunnels, which makes the applicability of IP QoS schemes troublesome. On the other hand, the recent emergence of the third-generation mobile network (through the standardization of the UMTS network, e.g.) has made the QoS problem in cellular networks more interesting. The UMTS network contains two major network domains, the circuit switched (CS) for the provision of voice applications and the packet switched (PS) for the provision of multimedia and Internet-based applications. Network operators recognize the potential of multimedia applications and also the need for a sophisticated QoS management framework to support multimedia applications

Quality of Service in Wireless LAN

The success of the wireless LAN technology based on the IEEE 802.11 standard (the so-called Wi-Fi) has been tremendous, mostly due to the simplicity and flexibility of this networking technology. The 802.11 networks can be established anywhere. They operate in a distributed or, more frequently, centralized network topology with a special station—AP—controlling the communication between the end stations and the outside network. The 802.11 standard defines the bottom two layers of the protocol stack, including the medium access control, which is controlled using a Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA). The basic 802.11 standard offered no specific support for QoS. A good survey of open QoS issues for 802.11-based LANs is given in Ref. However, a number of recent modifications to the standard do offer some QoS support. The QoS enforcement in Wi-Fi networks is based on the concept of prioritization between participating end stations.

Policy-Based QoS Management

Management of QoS in modern multiservice networks is a complex task. In general, QoS management refers to the activities of QoS specification, QoS negotiation, and monitoring and control of network resources to meet end-to-end user and application requirements, business objectives, and resource availability. The problem becomes even more complicated in the heterogeneous network environment, where more than one network is responsible for traffic forwarding and QoS provision. A universal and well-defined method of communicating QoS requirements and QoS management is needed. In recent years, a dominant management concept for complex network operation management has been the PBNM. The PBNM framework defines the space for definition of policies—sets of rules and actions that need to be performed by network entities to achieve certain performance goals.

Cont.

Internet Engineering Task Force (IETF) has defined a policy framework with two main architectural elements: the policy decision point (PDP) and the policy enforcement point (PEP) (Figure 3.1).The PDP is the element that makes the policy decision. The PDP can make the decision on its own or may consult a remote policy repository (PR). The PDP makes a policy decision on the basis of the information it receives from the end user station, for example. This information can be the QoS requirement sent via a RSVP message. The PEP is the element where the policy is actually enforced. For example, in a Wi-Fi network, the PEP would be located at a wireless router, which connects the Wi-Fi with the external Internet. The PDF would, in most of the cases, be a separate entity or it would be located somewhere in the network of the ISP

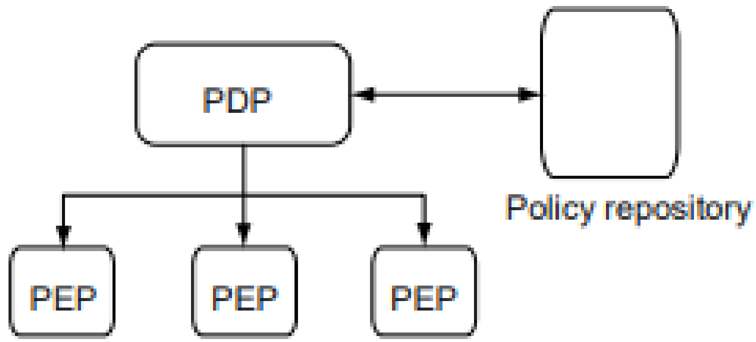

Figure 3.1 PBNM architecture.

QoS Management for Heterogeneous Mobile Networks

A majority of the existing solutions are based on PBNM. Architectures are presented that relay policy information, negotiate requirements, and enforce policies on various network technologies. A good example of this is the work done by Chakravorty et al. They present a complex system for QoS management over a network link that includes a generic IP network and the UMTS network. The analysis is based on different methods of relaying the information between different network points. In more detail, they assume that the mobile station determines the QoS requirements. Crucially, this information is mapped to the PDP context parameters. The main element for the processing of a QoS management model is the GGSN. When the GGSN learns about QoS requirements, it configures the IP classifier and provides interworking between the PDP context and the backbone IP network.

Cont.

The existence of an authorization token is assumed, where the token would include authentication information, packet handling action, and event generation information. Further, they point out that in the case the UE supports RSVP, RSVP can be used instead of PDP. They assume a system consisting of a number of functions responsible for subscription, classification, mapping, and policing. A substantial body of work deals with the implementation of IMS to manage and provide QoS. The IMS Architecture enables the establishment and management of multimedia sessions on broadband mobile networks, most importantly on UMTS. The IMS architecture is complex, consisting of a number of hardware and software entities and is managed by a range of protocols.

Generic Access Network

GAN is a 3GPP standard covering the scenario of a new mobile station wanting to access UMTS network services using an access network other than UTRAN/GERAN (GSM with EDGE Radio Access Network/UMTS Terrestrial Radio Access Network). The GAN is a continuation of the standardization effort UMA. The main elements of the GAN architecture are the GAN controller (GANC) and the up interface between the GANC and the mobile station. The GANC communicates to the UMTS core network using standard A and Gb interfaces. The security gateway (SEGW) is also a part of the GANC, communicating using the Wm interface with the AAA server in the UMTS core network (Figure 3.2)

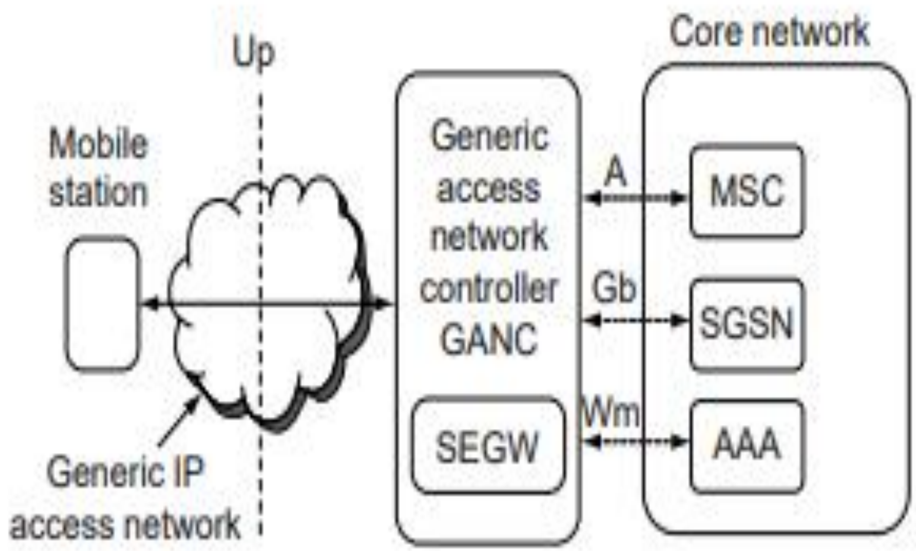

Figure 3.2 GAN architecture.

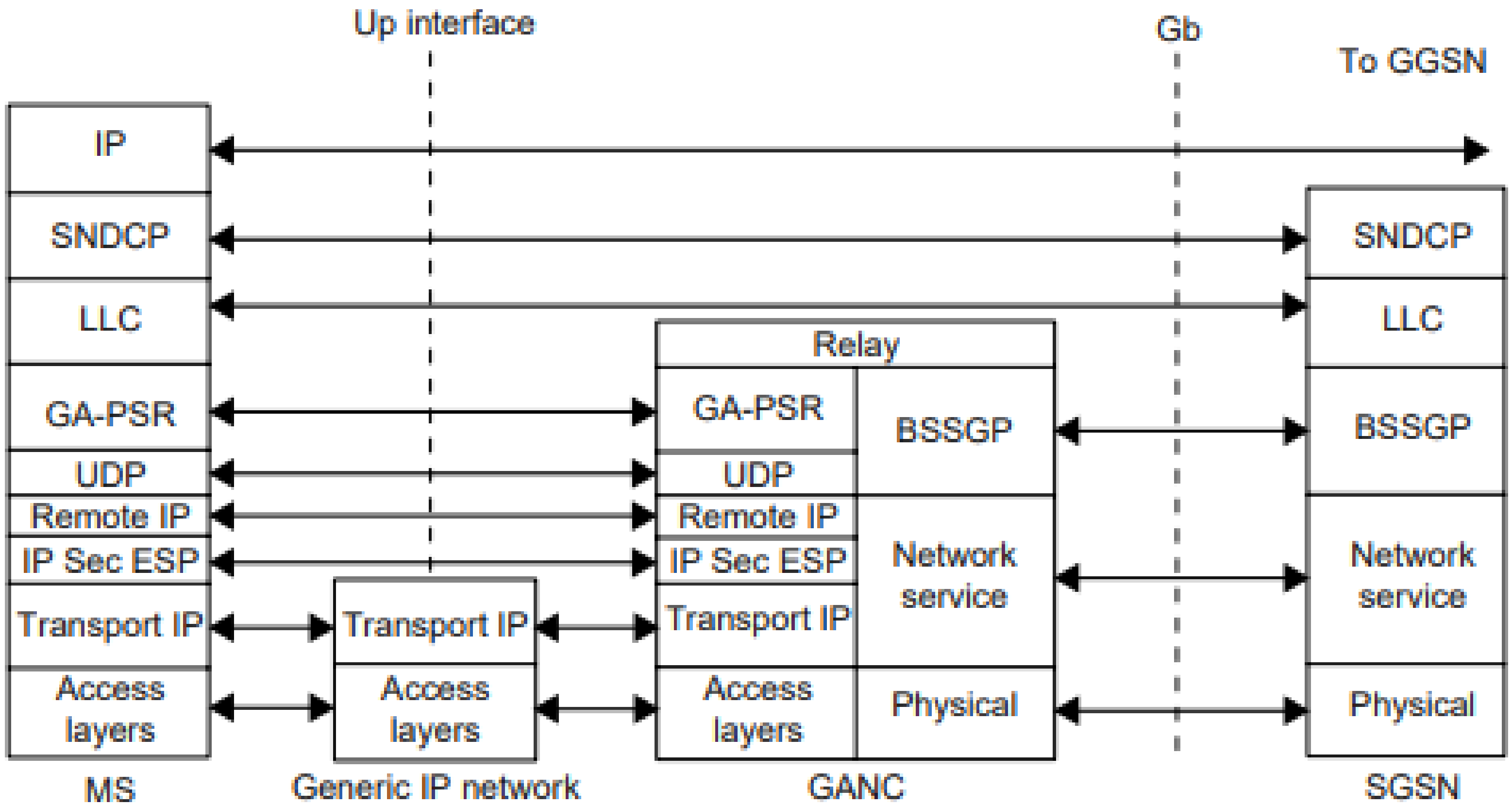

Figure 3.3 Up PS Domain User Plane Protocol Architecture. (From Generic Access to the A/Gb Interface; Stage 2 (Release 7), 3GPP TS 43.318, November 2006.)

QoS Management in UMA

In general, the translation of policies and QoS management functions between network domains is necessary. Because UMA is used to connect different network domains, the translation of these policies at the GAN controller point is a natural design decision. The standard defines two alternatives available to an external IP user station at the PDP context activation point: the basic GPRS connectivity service using local bearer policy decisions and the enhanced GPRS connectivity service where network-level policies are applied. The standard defines four methods to achieve interworking:

- Signaling along the flow path
- Packet marking or labeling along the flow
- Interaction between policy control and resource management entities
- SLA enforced by border routers between networks

QoS Architecture

UMA has never been designed to provide a comprehensive session QoS management. The recent development of IMS gives means to provide complex QoS and security management for complex applications. With this in mind, in this section we point out the main issues in QoS management and provision for QoS and highlight the implementation and evaluation methodology that should be used to finalize the QoS management architecture. In this chapter, we use QoS scenarios identified in Ref. [6]. Figure 3.4 shows the simplified end-to-end QoS scenario for a mobile station (UE) running a communication session with a remote Internet host. We use this topology to present a general case, even though for the QoS management in UMA it is completely irrelevant whether the receiving end is in an external IP network or within the UMTS network domain.

Cont.

QoS management assumes that application-layer QoS negotiation has taken place (this can be done in a number of ways, the current dominant method is using SDP/SIP). This negotiation results in the creation of a logical IP bearer service. We also assume here that the UE is capable of managing the IP bearer service. Physically, the traffic will have to pass through different network domains. The traffic will first use an access IP network to reach the GANC, where it will be forwarded using the mobile network protocol stack to the GGSN. The GGSN is the gateway node in the mobile core network, responsible for communication to the external IP network. From the GGSN to the remote receiving node the traffic will again be transported through the IP network.

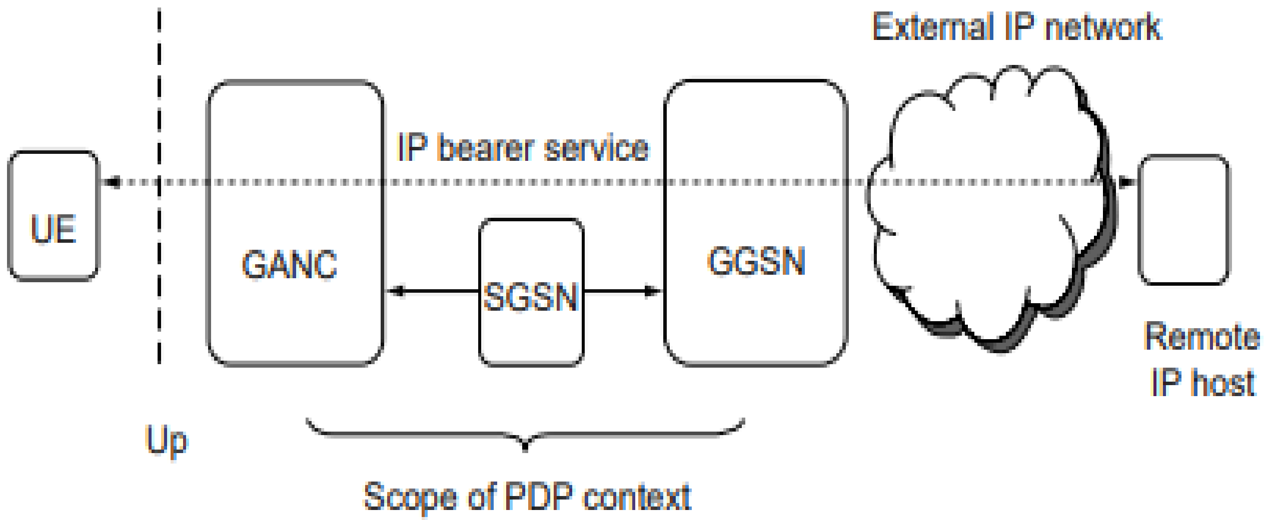

Figure 3.4 End-to-end QoS architecture.

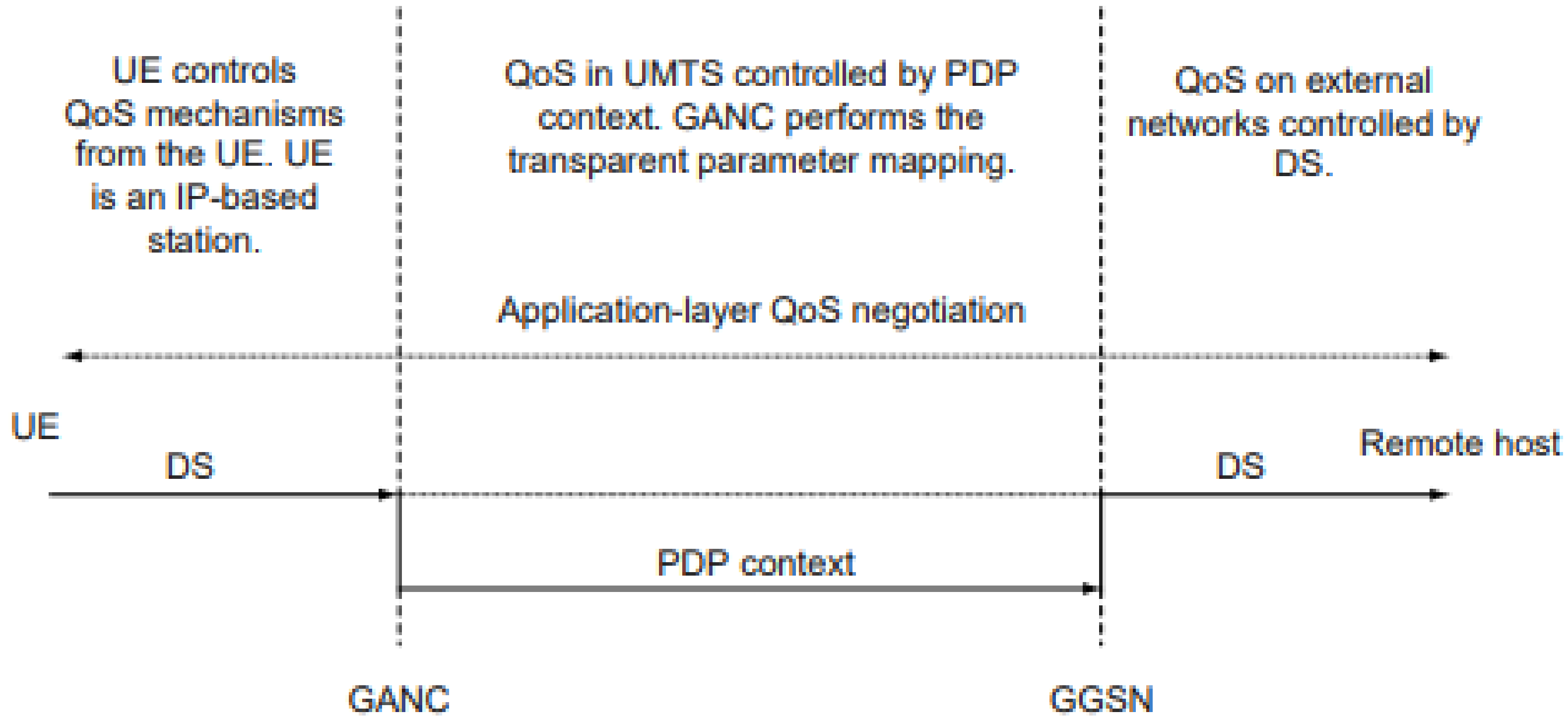

Figure 3.5 Separation of contexts.

Summary

This chapter presented the problem of QoS and analyzed how QoS is currently supported in UMA and what needs to be done to enhance the QoS support. QoS management in UMA networks, although important and required, cannot be considered as the highest priority for the developers and users of UMA technology. However, the establishment of a policy-based QoS management infrastructure in existing UMA networks is desirable, and can prove to be an efficient and scalable method of integrating UMA implementations to a next-generation network that will be fully capable of managing complex multimedia applications. In other words, the implementation of a QoS management system in UMA can help existing UMA systems to become a more efficient element of the architecture for next-generation mobile networks. The IMS system, which has been only mentioned throughout this chapter, will be able to fully support end-to-end QoS, and UMA can prove to be an important element of this architecture.