CHAPTER 1

INTRODUCTION

As the rise of varied IP-based multimedia services, Quality of service (QoS) becomes more and more important. Different service classes have different QoS requirements and should be controlled distinctly. Because the high error-proneness of wireless network and unreliable connectionless protocols of real-time services, QoS is definitely hard to achieved. In literature, most of the research resolves QoS problems from system perspective. However, the QoS problems are still away from users' expectation. To guarantee QoS from user's perspective, it needs dynamic QoS control. Per-class QoS control provides roughly QoS guarantee but lack of per-flow QoS control which is more sophisticated, fair and reasonable. This thesis proposes a feedback-based QoS control framework. It supports dynamic QoS control based on application's feedback.

1.1 UMTS

The specifications of UMTS were made by The 3rd Generation Partnership Project (3GPP) in December 1998. 3GPP is the international standardized origination for UMTS standard. It proposed R99 (called R3) at March 2000, R4 at March 2001 and R5 at June 2002. R6 is under construction now. In R4, control layer and bear layer are separated. R5 proposed IP Multimedia Subsystem (IMS) at packet switch domain. The network structure of R6 doesn't change a lot but add on new functionalities or extend the existing functions such as hyper net of wireless LAN and UMTS network.

1.1.1 3GPP R99

R99 focus on the compatibility of UMTS with GSM. UMTS must be compatible to GSM, and be co-operation with GSM. The structure of R99 contains the mean of transition and will cause some tradeoff of several wasted investment and resource to exchange the tolerance to existent network. The architecture is individual management and data transitions for circuit switch network and packet switch network. The products which follow R99 are more mutual and are more supportably. Constructing of network based on R99 is cheaper and could use the existent network and equipment. But it will pay the cost of low efficient and complexity of network because the individual management of circuit switch and packet switch.

1.1.2 3GPP R4

Two layer architecture which are bear layer and control layer where proposed in R4. Control layer control the setup of call, management of call processing and billing. Bear layer is so-called transfer layer which is used to transfer data. This architecture differs from 2G and 2.5G which are used today. Because the import of the layered architecture, all services which voice and message of circuit switch and packet switch can adopt new bear technique such as ATM or IP network. WCDMA use coding for voice to compress voice and provide good voice performance to saving bandwidth and increase the efficiency of network. By using the unified backbone network to transfer data could save cost and easy to manage. But the supportability of the new interface is differing from ISP and equipment provider. QoS management of IP network is still the hang in doubt especially on real-time service.

1.1.3 3GPP R5

IP-based technique was selected as transfer layer for UMTS after release 5 which called R5, and mobile network step into the age of ALL-IP. For solving the QoS problem for real-time service on IP-network, In R5 IP-Multimedia Subsystem (IMS) for control IP real-time multimedia such as voice, audio and video service, and integrated in packet switched domain.

1.2 Quality of Service (QoS)

International Telecommunication Union's Telecommunications branch's (ITU-T's) defines QoS【17】as follows:

- Quality is the totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs.
- Quality of service is the collective effect of service performances, which determine the degree of satisfaction of a user of service.

QoS can be viewed from the following points:

- QoS requirements of users
- QoS perceived by users
- QoS provided by service providers
- QoS offered by network

1.3 UMTS QoS

UMTS is a wireless mobile communication network with limited bandwidth, high

error-prone, unstable connection, and high mobility characteristics. For the rise of IP-based multimedia and real-time services, it is more and more important to effectively utilize network resource. Most real-time services use connectionless and unreliable protocols such as UDP that provides very limited error recovery capability and is hardly to have QoS control. Unstable wireless network make the usage of bandwidth unclear and hard to control. Bandwidth may not exactly be allocated or even fading by bad environment. Bandwidth usage of unreliable connectionless protocols is almost unknown because lack of acknowledge or some other control mechanism. Try to improve unstable wireless network is a difficult and huge work. Try to improve the unreliable connectionless protocols face the problems of acceptation and compatibility.

1.3.1 QoS Architecture of UMTS

UMTS use idea of bear service and layer architecture to provide end to end QoS. Bear service has four layer to support different network layer control as Fig. 1-1 shows.

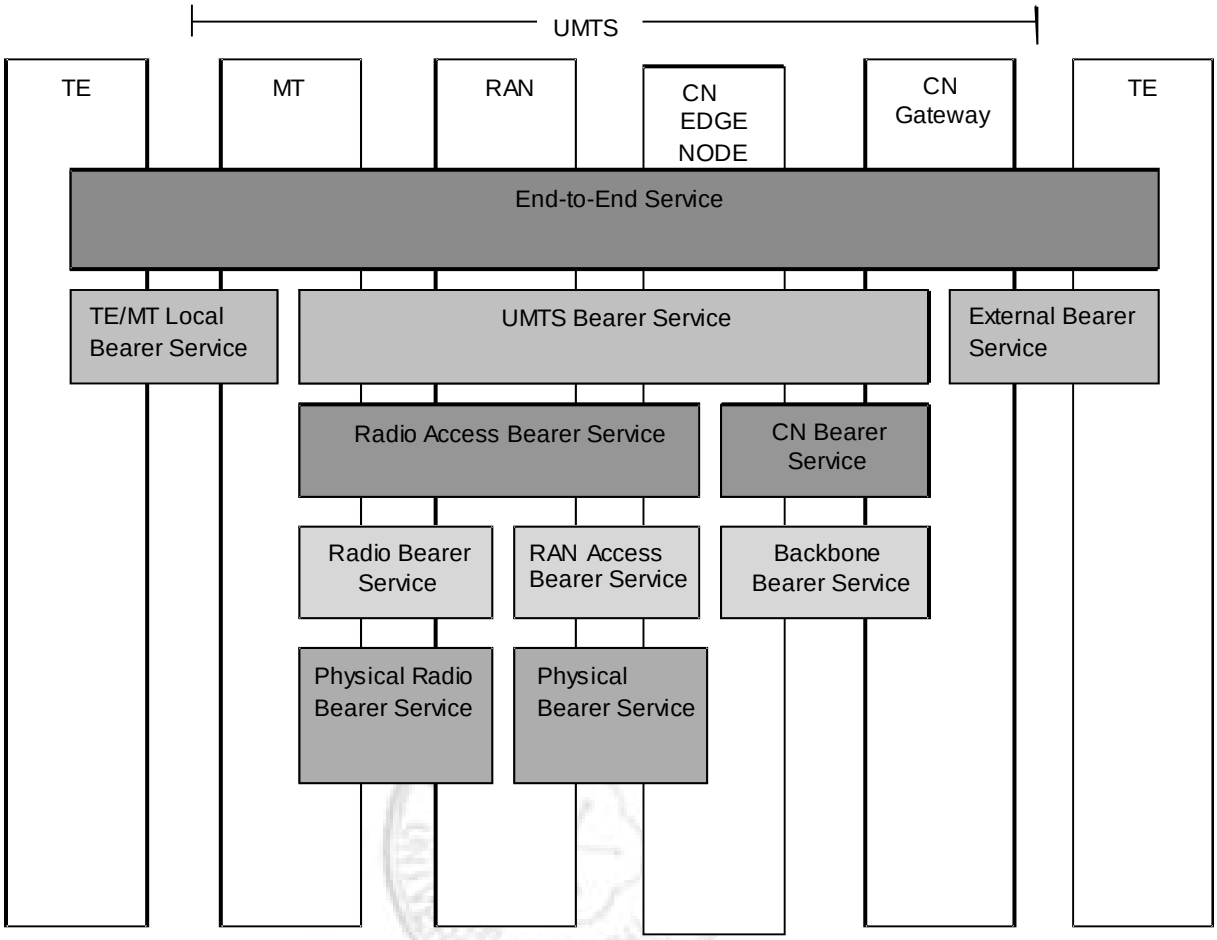

Fig. 1-1 UMTS QoS Architecture 【6】

1.3.2 QoS Management Functions

QoS management functions manage bear service in UMTS with a specific QoS. Management functions shall ensure the provision of the negotiated service at the access points of the UMTS bearer service.

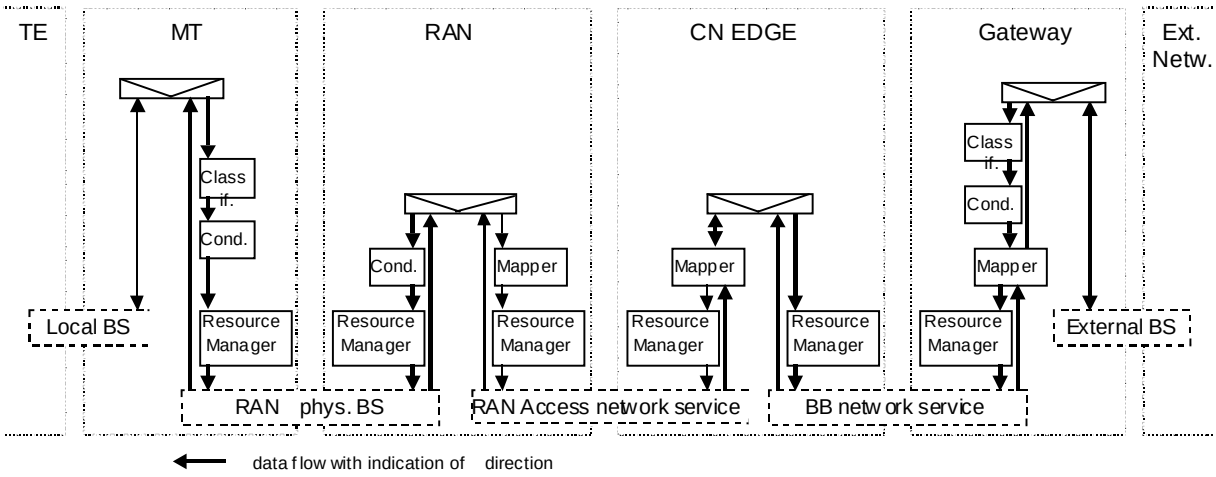

Fig. 1-2 QoS management functions for UMTS bearer service in the user plane【6】

QoS management functions for UMTS bearer service in user plane is shown in Fig. 1-2. Functions for UMTS bearer service in the user plane are described below.

1.3.2.1 Mapping function

Mapping function provides marking data unit with specific QoS requirement.

1.3.2.2 Classification function

Classification function provides classification of data unit according to specific QoS attributes.

1.3.2.3 Resource Manager

Resource manager distributes available and appropriate resources between services sharing the same resource.

1.3.2.4 Traffic conditioner

Traffic conditioner provides conformance between the negotiated QoS for a service and the data unit traffic.

1.3.3 IP-Multimedia Subsystem (IMS)

3GPP has decided to use a layered approach to architectural design. Transport and bearer services are separated from the control and signaling plane. Control, signaling network and session management are independent layer. The layer approach aims at a minimum dependency between layers. A benefit is that it facilitates the addition of new access networks. Importance of application layer is increased because the layered approach. When applications are isolated and functionalities can be provided by the underlying IMS network the same applications can run on UE using diverse access types.

UMTS QoS architecture provides a general end-to-end QoS control architecture. Transport layer, control layer and session management are divided and work independently. IP multimedia management is separated for multimedia session management. Detail managing procedures are not described and essence of QoS guarantee is abstract. This generates many research issues such as QoS signaling and dynamic QoS control which is our research objects in this thesis.

1.4 Perception of User and QoS Control

The ultimate judgment of QoS is user instead of network or service provider. Throughput of

network doesn't really represent the user's satisfactions neither really satisfy user. Wireless network is high error-prone and hardly to provide QoS control. Most real-time application use connection-less protocol which has very few error control ability and hardly to provide QoS control. QoS control by user's feedback could reduce the effect of unstable network and connectionless unreliable protocols to QoS. We can use a QoS Agent (QA) to tell how the QoS which user experience actually then we can control the QoS more exactly and reduce the effect of unstable wireless network and unreliable connectionless protocols.

The research objectives of this thesis are QoS feedback algorithm, flow control in DiffServ, QoS negotiation algorithm, and Feedback-based QoS control framework. The thesis organization is as follows:

Chapter 2 is the related work. Chapter 3 is the proposed methodology of feedback-based QoS control framework for UMTS. Chapter 4 shows the simulation results. Chapter 5 is our conclusion and future work