

Quality of Service and Resource Management in UMTS

Frank Y. Li , PhD candidate
Department of Telematics
Norwegian University of Science and Technology (NTNU)
e-mail: frank.li@item.ntnu.no

I. BACKGROUND

Third generation mobile communication system, namely Universal Mobile Telecommunication System (UMTS) in Europe, is currently under standardization worldwide and will emerge as early as in year 2001. Multimedia services will be supported by UMTS according to 3rd Generation Partnership Project (3GPP) specifications, i.e. the supported bit rates will be at least 144Kbps for rural area, 384Kbps for urban/suburban area and 2Mbps for indoor/low range outdoor environment[1].

UMTS is referred as Wideband Code Division Multiple Access (WCDMA) based, because Frequency Division Duplex (FDD) and Time Division Duplex (TDD) are applied to paired and unpaired bandwidth respectively at 2GHz band. For Core Networks (CN), the traditional circuit switched network will evolve to modern packet switched network e.g. IP-based network. As the merging of internet and mobile applications, the UMTS users are capable of accessing both telecom and internet resources. But since historically IP networks provide only best-effort service and is not multimedia oriented, Quality of Service (QoS) becomes a critical issue for the success of UMTS. To provide end users with perceptive QoS, the network resources at various nodes must be optimally utilized. Therefore, resource management plays an important role in provision of UMTS services.

Applications emerging from internet are continuously developing to be capable of defining the required QoS level. Two approaches namely Integrated Service (IntServ) and Differentiated Service (DiffServ) have been proposed to provide end-to-end QoS in internet. But how these approaches perform in mobile environment remain uncertain and need to be further investigated. Lots of research work are currently undergoing within the area of QoS and resource management, but still more efforts are desired. My thesis work is therefore on QoS and resource management in UMTS.

II. SYSTEM MODEL

QoS is defined by ITU as the collective effect of service performance which determine the degree of satisfaction of a user of the service. It means it is the end user that decides whether he is satisfied with the provided QoS or not. In order to provide the end-to-end service to users, a UMTS bearer service layered architecture has been recently specified by 3GPP[2].

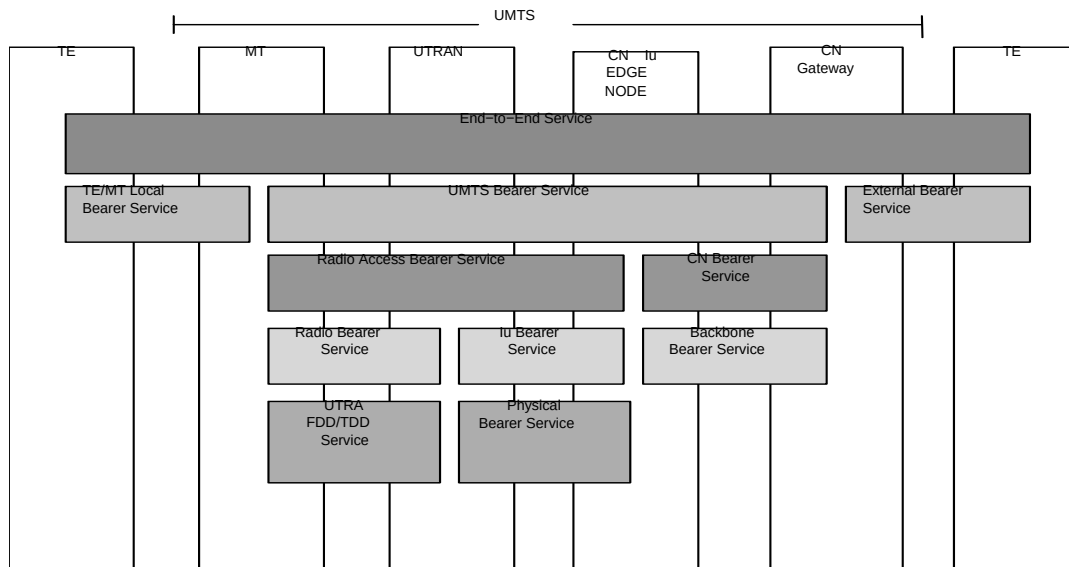


Fig. 1: Quality of Service Architecture for UMTS.

According to above architecture, the provision of the end-to-end service is conveyed over several networks and realized by the interaction of the protocol layers. In our work, we'll mainly focus on the provision of UMTS bearer services with emphasizing on resource management related aspects.

Four different traffic classes have been defined in the same 3GPP technical specification according to how delay sensitive the traffic is. They are listed below with the conversational class having the most stringent delay constraint and the background class having the loosest delay constraint.

1. Conversational class (e.g. voice);
2. Streaming class (e.g. streaming video);
3. Interactive class (e.g. web browsing);
4. Background class (e.g. background download of emails).

Correspondingly, 12 QoS attributes including maximum bit rate, maximum Service Data Unit(SDU) size, residual bit error ratio, etc. have been defined for each class, along with their value ranges. To provide QoS effectively, several resource managers must be employed throughout the whole network, as shown in Fig.2 below.

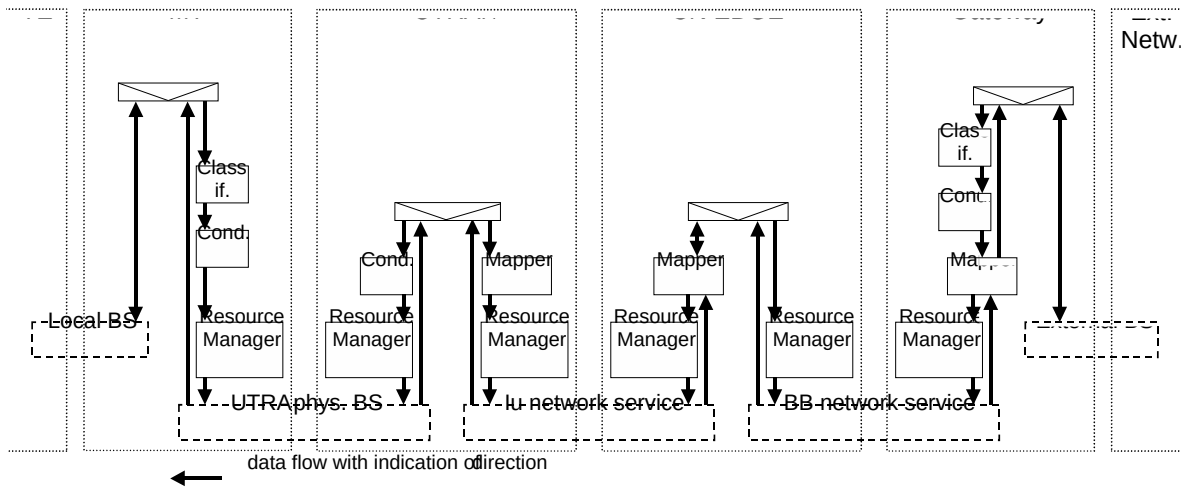


Fig. 2: QoS management functions for UMTS bearer service in the user plane

The QoS management functions include service manager, translation function, admission/capability control and subscription control for control plane and mapping function, classification function, resource manager and traffic conditioner for user plane.

We shall choose one application from each traffic class based on above definition and study some of the relevant resource management techniques as described below.

III. RESEARCH PLAN

Although resource management is important in provision of end-to-end QoS, most of the research work currently conducted are related to radio resource management [1, 3]. Starting from interference management within one cell, we are going to further stretch our studies into one or more aspects of the following issues:

- Radio Network Controller (RNC) resource management. Resource management in the RNC is certainly very interesting to study. Acting as the gateway interfacing the external networks and radio networks, the RNC controls more resources than base stations (Node Bs) and co-ordinates the service requirements from both the mobile stations and the external networks. Many interesting issues are under consideration within the resource management of the RNC, for instance, the resource management mechanisms when umbrella structure is introduced in a RNC area, how handover is conducted without QoS degradation and how renegotiation mechanism is employed to accept more higher priority calls while not dropping existing connections.

- Traffic shaping schemes. As many internet applications are very bursty, the resource manager needs to regulate the incoming traffic to allocate resources efficiently. A traffic shaping scheme known as “Token Bucket Algorithm” is proposed by IETF where the constant token rate R represents the maximum bitrate and the bucket size B corresponds to bounded burst size. But how this algorithm performs for UMTS applications needs to be further investigated.
- QoS parameters mapping. Mapping of UMTS bearer service parameters to core network (e.g. IP based) bearer service parameters is actually operator-dependent. As 3GPP and IETF have different definition on QoS parameters, how to match e.g. DiffServ classes to UMTS service classes and provide required QoS to end users is a great concern. We’ll focus our work on QoS specification translation and parameters mapping between different protocol layers at network edge gateways.
- Resource reservation for UMTS. Resource ReSerVation Protocol (RSVP) is an important component for IntServ approach. But as for mobile systems, resource reservation might not be practical because the available bandwidth in a connection is highly variable for a reservation to be meaningful. However, it seems prudent if some resource allocation and admission control could be applied even if hard guarantees of resource provision are not possible. We shall further study RSVP for UMTS.

IV. REFERENCES

- [1] R. Prasad, W. Mohr, and W. Konäuser (ed.), *Third Generation Mobile Communication System*, Artech House, London, 2000.
- [2] 3GPP TS23.107v3.3.0, “QoS Concept and Architecture,” <http://www.3gpp.org>, June 2000.
- [3] N. Dimitriou, G. Sfikas, and R. Tafazolli, “Quality of Service for Multimedia CDMA,” *IEEE Communications Magazine*, vol. 38, no. 7, July 2000.