

Chapter 2

Quality of Service in UMTS Mobile Systems

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1.1 INTRODUCTION

Mobile systems and particularly UMTS are growing fast. These systems convey data based services in addition to customary voice services. Quality of service is a function of data rate, delay and signal to noise plus interference ratio in these systems. In this Chapter first the author pays attention to UMTS and its QoS architecture, then to service categorization due to QoS. Afterwards he reviews some QoS parameters. Then he studies Layer 2 QoS parameters and general concepts about Transport channels. Then he review TCP effects on the throughput in the air interface. he introduces HSDPA in the next section. Finally he pays attention to data traffic models and their effects on the system capacity and Erlang capacity and delay in the system.

1.2 UMTS Architecture

Figure 1 shows the layered UMTS architecture and protocols as outlined in 3GPP TS 23 107 (2007). The figure shows the UMTS architecture in terms

of its entities User Equipment (UE), UTRAN and Core Network. The respective reference points Uu (Radio Interface) and Iu (CN-UTRAN interface) are shown. The protocols over Uu and Iu interfaces are divided into two structures: User plane protocols and Control plane protocols.

This figure illustrates furthermore the high-level functional blocks into the Access Stratum (AS) and the Non-Access Stratum (NAS).

The Access Stratum offers services through the following Service Access Points (SAP) to the Non-Access Stratum:

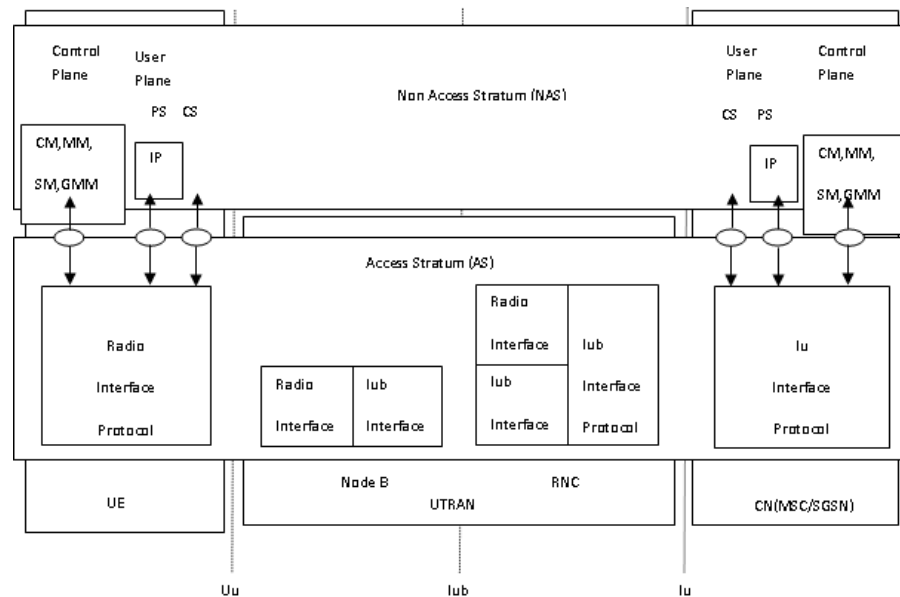
- General Control (GC) SAPs
- Notification (Nt) SAPs
- Dedicated Control (DC) SAPs

The SAPs are marked with circles in Figure 1.

The NAS protocols enable the transfer of information between the UE and CN. The information can be either user or control information carrying all the signaling required to set-up or tear down the service connection as well as to perform other functionalities specific to a mobile network (e.g. mobility management). This information is almost

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Figure 1. Layered UMTS architecture (Prez-Romero et al., 2005; TS 25 401, 2007)



independent of the underlying layers of the protocol architecture and of the elements of the access network that are traversed in the path between the UE and the Core Network.

Two examples of NAS functions in the control plane are the Connection Management (CM) and Session Management (SM) functions which are responsible for the establishment and release of the connections or sessions for an UE respectively. Other examples are Mobility Management (MM) and GPRS Mobility Management (GMM) functions which are responsible for mobility functions at the network layer (e.g. subscriber location area updating, routing area updating, paging, etc.). In the user plane, the main NAS function at the network layer for packet switched services is the IP protocol while for the circuit services, information comes directly from the source without the need for a network function.

NAS functions rely on the AS functions to exchange information between the UE and the CN, as shown in Figure 1. The AS consists of a group of functions that are specific to the access network being used (3GPP TS 23 107, 2007). This means

that even if the NAS functions are the same for a UMTS or a GSM/GPRS access network, the AS protocols that allow the transfer of these messages through the different nodes may be different. In the UMTS architecture, the AS includes three different protocol stacks, namely the radio interface protocol Uu, the Iub interface protocol and the Iu interface protocol which may be specific for data or circuit switched connections. The radio interface protocol stack establishes communication between the UE and the UMTS access network (UTRAN). Note that the protocols at the upper layers terminate in the UE and RNC, while the lower layers terminate in the UE and Node B. Iub interface protocols involve the communication of the lower layers of the RNC and the Node B. Iu interface protocols allow communication between the RNC and the CN. Iu is divided into two protocols Iu-CS and Iu-PS. Iu-CS is responsible for the communication between RNC and MSC and the Iu-PS is responsible for communication between RNC and SGSN.

The AS provides the NAS with a service of information transfer between the UE and the CN

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