TSG-SA Working Group 1 (Services) meeting #2
Edinburgh, Scotland 9th-12th March 1999

TSGS1#2(99)119

Agenda Item: 9.7
Source: Coordinator
Title:
Document for: Information

Service aspects;
Mobile multimedia services including mobile Intranet and Internet services
(UMTS 22.60 version 3.0.0)

TR 22.60 V3.0.0 (1998-04)

Technical Report

Universal Mobile Telecommunications System (UMTS); Service aspects; Mobile multimedia services including mobile Intranet and Internet services (UMTS 22.60 version 3.0.0)

UMTS

Universal Mobile Telecommunications System

ETSI

European Telecommunications Standards Institute

Reference
DTS/SMG-012260U (kxc000os.PDF)

Keywords
UMTS

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X.400
c= fr; a=atlas; p=etsi; s=secretariat

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Contents

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Foreword

This Technical Specification (TS) has been produced by ETSI Special Mobile Group (SMG).

1 Scope

This document discusses the issues related to mobile multimedia in UMTS environment. Specifically the foreseen mobile multimedia applications and their special requirements are referred briefly. The major technical challenges faced in the provision of multimedia services and Internet and Intranet access are discussed and highlighted in order to give guidance for UMTS system standardisation.

This document contains various views into these future topics and cannot be regarded as complete.

2 Definitions and abbreviations

2.1 Definitions

Call : a logical association between several users (this could be connection oriented or connection less).

Connection : is a communication channel between two or more end-points (e.g. terminal, server etc.).

Bearer service: is a type of telecommunication service that provides the capability of transmission of signals between access points.

Multimedia service: Multimedia services are services that handle several types of media. For some services, synchronisation between the media is necessary (e.g. synchronised audio and video). A multimedia service may involve multiple parties, multiple connections, and the addition or deletion of resources and users within a single call.

2.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

GSM	Global System for Mobile Communications
HPS	Handover Path Switching
HRR	Handover Resource Reservation
ISDN	Integrated Services Digital Network
IP	Internet Protocol
ITU	International Telecommunication Union
MHEG	Multimedia and Hypermedia Information Coding Expert Group
MPEG	Moving Pictures Experts Group
QoS	Quality of Service
PSTN	Public Switched Telephone Network
RSVP	Resource ReserVation Protocol
WWW	World Wide Web

3 General

Two major trends that have been seen during the last years are the increased use of both mobile phones and data communications. GSM and other second generation systems have expanded widely and penetration figures have climbed in certain countries up to 30%. Data communications, and specially the use of Internet (since the introduction of world wide web), has attracted a large number of users. Multimedia is a new area of communications and has been growing fast in the computer environments. It is also seen that multimedia will be an important area of telecommunications in the future.

UMTS is a third generation system that tries to merge these two trends, i.e. allow for mobile mass market as well as for optimised mobile data communications. Another additional important objective for UMTS is to provide capabilities for mobile multimedia.

4 Multimedia

Mobile multimedia services are seen to be important when UMTS is introduced and therefore UMTS should enable efficient support for such services. A multimedia service is a service that combines two or more media components within a call. The components can for instance be voice, audio, video, data or pictures. A multimedia service may involve several parties and connections and therefore flexibility is required in order to add and delete components, resources and parties during a call.

In addition to multimedia services UMTS shall also support the simultaneous use of multiple services associated with separate calls. This requires that different calls (these might be multimedia calls with several connections) can be added and dropped independently of each other.

4.1 Applications

Multimedia applications and services can be classified in two categories: interactive services which can be conversational, messaging or retrieval, and distributional services which can be with or without user control.

Most of the future applications containing multimedia information are basically the same as applications available already today. The visual richness of these service is increased by using multimedia instead of single media. The perceived end user quality of these applications will of course be better due to increase in system capacity, as well as developments in source coding and implementation technologies. However, technological development will enable also new types of services to be introduced. Such new components as virtual reality and 3 dimensional (3D) graphics, for example, enable totally new type of applications, e.g., electronic shopping, education, and entertainment. Also research, development and standardisation work is being done in areas of WWW, MPEG-4, ITU-T/SG16 and MHEG based interactive multimedia information retrieval. Passive multimedia application examples of information retrieval are video-on-demand, pay-TV, and audio-on-demand, all being important future applications. Interactive multimedia applications, as for example multimedia conferencing including audio, video and data applications, are also seen to be important.

4.2 Technical challenges

Introduction of mobile multimedia services will set stringent technical challenges for the underlying systems. This chapter reviews the most important of those new challenges; sensitivity of coded video stream, synchronisation of media components and interworking aspects between different networks.

4.2.1 Sensitivity of coded video stream

Compression of information is typically optimised in terms of compression efficiency, coding complexity and quality. As is the case with the highly optimised video coding algorithms targeted for multimedia applications. From the transmission point of view, the most critical side effect is that the error resilience is often sacrificed. As a rule of thumb, it can be said that when the coding algorithm compression ratio increases, the sensitivity for transmission errors increases, i.e., bits inside the compressed multimedia bit stream are very significant and therefore highly sensitive for errors. Transmission errors in video stream can cause loss of synchronisation of hierarchical picture format or false symbol decoding.

Extra difficulty for video transmission is introduced by the picture update schemes used by video codecs. A transmission error in coded video stream is potentially present for long time, due to the idea of sending only the changes in the consecutive pictures (Figure 1). An intra picture is coded independently from previous pictures. Predicted picture, on the other hand, consists of motion vectors and prediction error, therefore representing the changed information of the picture. Potential intra picture update in the video stream removes the artefacts caused by transmission errors. Intra updates on the other hand produce higher amount of information to be transmitted causing refresh rate to slow down momentarily.

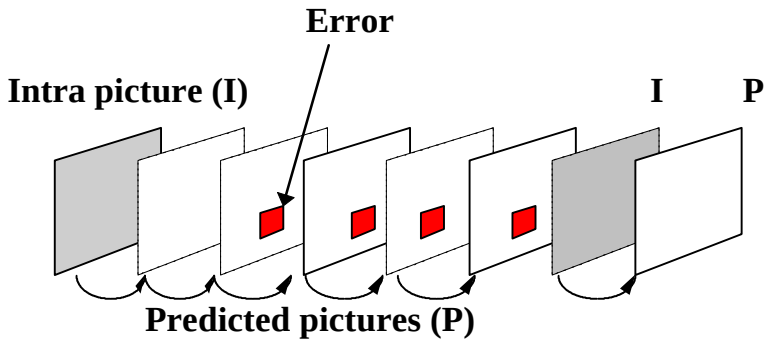

Figure 1: Effect of an transmission error for coded video stream

4.2.2 Synchronisation

In a multimedia system, different media streams have to be synchronised in order to guarantee proper presentation of the information. Synchronisation of media streams means maintaining the temporal relations of involved media. For time-dependent media components, such as speech and video, intramedia synchronisation is essential. Intermedia synchronisation is needed to guarantee the temporal relations between time-dependent and time-independent media components.

Intramedia synchronisation refers to a technique of maintaining the constant delay between consecutive samples of source video or audio from the time of generation to the time of presentation. The timing difference between consecutive data components inside a single media component is called jitter. The involved transmission systems in delivering the information might cause cumulatively jitter to the stream. Jitter is relevant only for time-dependent components, because in time-independent components jitter ceases to exist in buffering phase before presentation. In circuit switched transmission the transmission dependent jitter can be easily managed by having synchronised transmission modes in use. However, in packet switched transmission jitter exist more easily due to the possible packet transmission delay and possible non constant packet switching delay.

Intermedia synchronisation refers to the maintaining of the relative time dependencies between several continuous media streams from the time of generation to the time of presentation. This important multimedia QoS related parameter is the temporal dependence between separate media components, e.g., maintaining the so called lip-synchronisation between a video and an associated audio component is crucial for the quality. A parameter, often called skew, represents the timing difference of the different media components (Figure 2). Basically, the same reasons presented for jitter can also cause skew. Additionally, skew might be a result of different transmission characteristics of the used parallel channels. Straightforward ways to manage skew and to resynchronise media components are by catching up, e.g., by skipping, a delayed component or delaying a fast component. Both of these techniques reduce the resulting QoS.

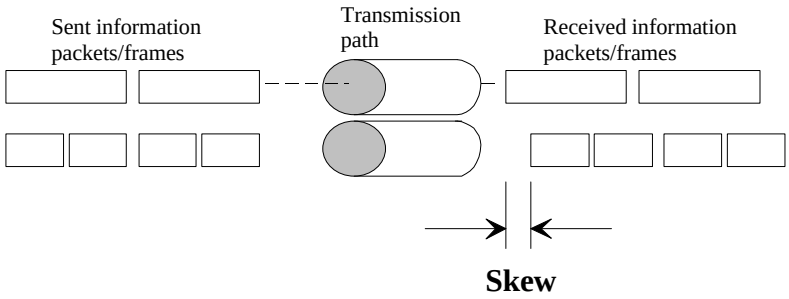

Figure 2: Transmission skew between two media components

Several different synchronisation techniques have been developed for ensuring the proper time alignment between different components. These techniques can be roughly divided into two categories, namely production level and presentation level synchronisation.

- Production level synchronisation is a technique where skew is minimised already on the point of time when the actual information is produced. Interleaving and multiplexing of different media components are possible

production level synchronisation schemes. A multiplexed multimedia stream can be transmitted using a single traffic channel, i.e., there is no need to synchronise separate traffic channels. E.g. ITU H.320/H.324 and MPEG-based techniques use multiplexing synchronisation method.

- Presentation level synchronisation guarantees the minimal skew while presenting the information. For example by recording the generated time difference between transferred components during the transmission phase, the skew can be controlled in the presentation of the information. Alternatively synchronisation can be managed in different phases of transmission and presentation, e.g., by time stamping the streams. This method requires more synchronisation functionality from the underlying system, i.e., to synchronise separate traffic channels used for multimedia components.

4.2.3 Interworking aspects of mobile multimedia

In order to achieve seamless interoperation and communication between different systems, such as mobile systems, Public Switched Telephone Network (PSTN), Integrated Services Digital Network (ISDN), etc., functionality for interworking is needed. In principle, interworking means the conversion from the protocols and formats used in system A to the protocols and formats supported by the system B. Possible interworking functionality causes additional delay to the transmission and drop of QoS provided.

The importance of efficient interworking is highlighted by the fact that multimedia is driven by the development in fixed networks and therefore seamless interworking between wireless and fixed systems is a necessity. Minimised interworking functionality needed is an obvious goal, i.e., wireless multimedia should be supported seamlessly by the future wireless systems. The fact that UMTS and wireless broadband services are not standardised, i.e., provided services are unknown, makes the implementation of interworking more difficult, even impossible in some cases, and therefore telecommunication services provided should be transparent from the interworking point of view.

4.2.4 UMTS Relation to Multimedia source coding

Multimedia services are very diverse and will include very many different codecs and applications. Some services are interactive and require low-delay channels while some others are retrieval services where delay is not critical. Moreover, some multimedia services also usually include a system layer for multiplexing different media types and for controlling the applications. Many multimedia applications emerge from the computer, telecom and Internet industry and it is necessary that the system is able to support such services as efficiently as possible.

In UMTS the multimedia services will use generic bearer services with the required QoS parameter values. This assumes that the system is able to offer bearer services with a wide range of different QoS values (BER, delay). Optimally, the system should provide a way to have multiple QoS values with one bearer service (”QoS on demand”). For the purposes of UMTS there will not be any UMTS specific video/still image codecs specified, moreover the work done by ITU-T SG 16 (H.32x) and ISO/IEC (MPEG) will be closely followed.

5 Internet and Intranet

It is clear that access to Internet is one of the most important usage of UMTS data services. Therefore the UMTS relation to Internet is discussed here. Intranet is considered similar to Internet from the applications and technology point of view, however restricted for a certain group of users.

5.1 Applications

Applications mainly used in Internet are e-mail, WWW-browsing and file transfer. These applications are also important in the future. However it is seen that information in Internet will also be more and more multimedia oriented and new types of application will emerge (interactive, virtual reality, etc.).

Already today multimedia applications are used in Internet. For example Microsoft Netmeeting is a conversational multimedia application that can include voice, text messages (often called chat), shared documents (that can be edited by several parties at the same time) and also video components. Other examples of interactive services in Internet are games as Quake where players from different places in real-time can compete in a 3D-world, and applications like Realplayer by which distributed video and audio from for example TV and radio stations can be viewed and listened

to. There are also different real-time conversational services in Internet as telephony and text message/chat applications. Electronic shopping is also becoming popular in Internet. All these applications can be important for UMTS as users might expect to get the same possibilities wireless as in wired environments. The evolution of Internet and applications will probably be of great importance for which services and applications that will be offered to UMTS users.

Many companies today are using Intranets for spreading of information. The Intranet can comprise all sorts of applications that are available in Internet (e.g. multimedia conferencing, e.-mail, www etc.). One important category of UMTS users are business men. These users will require capabilities comparable to the ones they have in their offices. Therefore it is important that UMTS enables the development of mobile office environments that have the same capabilities as the wired office computer will offer.

The applications provided and used in Internet and Intranet environments will be implemented in servers and service platforms which are separate from the transporting network.

5.2 Technical development foreseen

Internet transmission and presentation technologies, such as TCP/IP and HTTP protocols and Java, have a significant role in transporting multimedia services and applications. The development of Internet protocols to support delivery guarantees and QoS by introduction of Resource Reservation Protocol (RSVP), Real Time Protocol (RTP) and IPv6 will drive real time multimedia applications also to Internet. An important enabling technology area for Internet multimedia will also be packet transmission specific low bit rate video coding and related protocols. It is important that above used protocols can be efficiently supported in UMTS.

Techniques to enable electronic commerce in Internet have also been developed, and will play a significant role as a driver for applications and multimedia content in Internet. Internet security can be treated as end-to-end security and appropriate for many types of usage, e.g., electronic commerce and electronic banking. An example of security in Internet is the SET-technique which can be implemented on IC-cards and is used for end-to-end security. It is expected that SET or some other technique will become widely used in Internet for electronic commerce. Proper interoperation of Internet and UMTS security schemes should be guaranteed.

Mobile Agents are pieces of software that can exchange information with their environment. Some important capabilities of mobile agents are: independence and flexibility (the agent can independently react to changes in the environment), communication (the agent can communicate with users other agents and the environment) mobility (the agent can transport itself between different environments), self activation (the agent can activate itself when changes in the environment occurs), personalisation (the agent can react in different situations according to its state and characteristics). A common way of using agents are for information search. The agent can then compile the information in an intelligent way (e.g. according to the users preferences). Agents are designed to be able to move around in different environments and therefore they can be used in order to make a system less centralised. E.g. instead of downloading a whole lot of files in order to search them through an agent can search them through in their original environment. One problem with agents is security, as agents can be used as computer viruses. In UMTS agents can e.g. be used for decentralised service management (i.e. personalising services and execute the management procedures in terminals).

The computer world currently has many platforms, among them Microsoft Windows, Macintosh, OS/2 and UNIX; some software (e.g. C++) can be compiled by different platform dependent compilers to various multiple platform dependent machine codes. The advantage is that developed software can be reused must not be rewritten for on various platforms but , the drawback is that it must be recompiled (you need to know the destination platform in order to choose the correct compiler)..

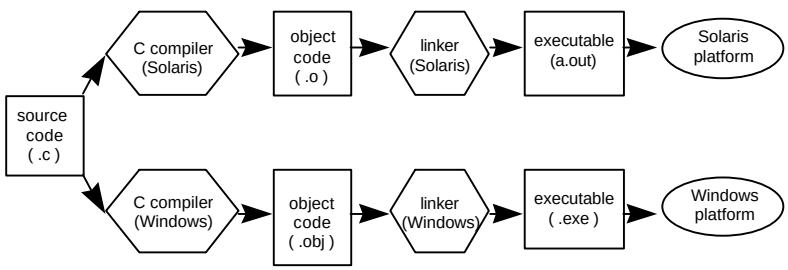

Figure 3:

The benefit of Java is that it can be compiled by different platform dependent compilers to one bytecode, which is platform independent. This intermediate code can be interpreted and executed on every operating system which has an abstract computing machine, called the Java Virtual Machine.

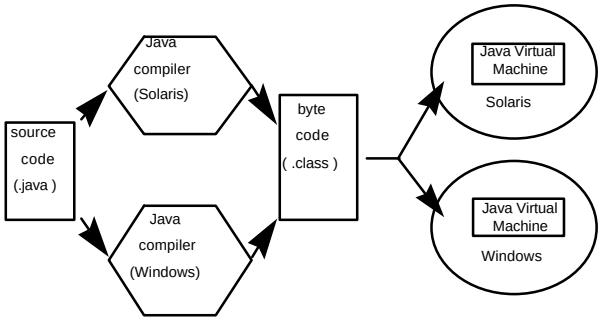

Figure 4:

More than 20 operating systems already support the Java Virtual Machine. Because the programmer (or service provider) doesn't have to worry about the operating system of the customer making, the Java Platform is the ideal platform for delivering and running highly interactive, dynamic, and secure software (called applets) on network devices. In UMTS it should be possible to download software, e.g. JAVA applets to JAVA platforms in terminals. Parameters for the JAVA Virtual Machine need to be standarised.

6 Requirements set for the UMTS

Internet, Intranet and multimedia services will be of great importance for UMTS. Internet services are becoming more and more multimedia influenced. However, Internet services are using packet transmission without guarantee for QoS and the performance of real time services in Internet today varies a lot. For multimedia services it is important that QoS can be guaranteed, and therefore resource reservation and QoS guarantee is important in Internet for high quality multimedia applications. Despite that current standards allow videoconferences in Internet but they are without guaranteed QoS (e.g. the H.323 standard).

6.1 Transport of multimedia

There are different options for how multimedia calls can be transported as is described above in section 4.2.2. Some multimedia applications (e.g. MPEG4, H.320, H.324) multiplex all media components onto a single bearer. However, there are ideas (e.g. in B-ISDN standardisation) for using different bearers for different media components. This has the benefit of using different QoS or bearer service attributes for the different components, which may optimise the use of radio resources.

6.2 A UMTS Service Platform

New multimedia, Internet and Intranet applications and services will be implemented in servers, terminals and service platforms, and will require transparent bittransport in between the terminal and another terminal or a server or a service platform (see figure 5). In order to enable easy and fast creation and adoption of such new services and applications in UMTS an application programmers interface, a service platform, might have to be specified (see I/f figure 5). This interface shall enable the possibilities for control and management of the transparent transportation of services to UMTS terminals and users via UMTS bearer services.

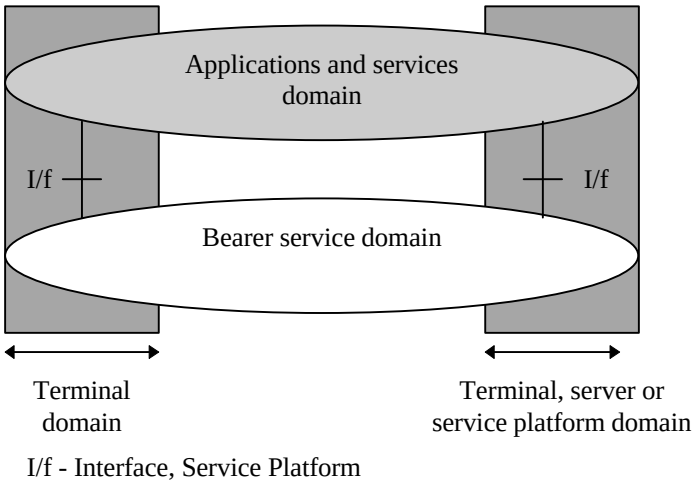

Figure 5. The separation applications and services from the bearer services

The service platform shown in figure 5 shall enable flexible negotiations of bearer services. The negotiation capabilities shall include changes in QoS and Information attributes, adding and dropping of parties involved in a call, adding and dropping of connections (media components) in a multimedia call and possibilities to have multiple calls simultaneously.

When setting up calls for multimedia in UMTS a negotiation about QoS for the call phase has to take place. Requirements and capabilities from applications, codecs, terminals, access networks and other networks for both originating and terminating side has to be considered (compare for retrieval and distributional services). A user may want to establish a communication with certain QoS. If some part cannot fulfil the requirements then the connection may not be established, or a degradation of QoS will occur.

Renegotiations of QoS for calls shall be possible. This can be used to add media components or to set up new calls (i.e. multiple service usage) during a call.

Since the services that will be provided to UMTS users can not be predicted it is of most importance that the UMTS bearer services are specified in a generic fashion. This will make UMTS future proof and will not limit the areas of use for UMTS.

6.3 Download of software

Download of software to terminals in UMTS is important for enabling easy and fast delivery of new services. A lot of possibilities for downloading software exists via Internet. If the existing Internet solutions for software download are considered standardisation work can be minimised. Also download of software or service logic to network components is desirable.

6.5 Internet access

An optimized access to Internet is of importance for UMTS. The most important benefits achieved by the definition of Internet Access would be:

- Optimized transmission of IP traffic over the UMTS radio interface to minimize the amount of information transmitted
- Optimized usage of encryption protocols/algorithms over the UMTS radio interface
- Interoperation of QoS mechanisms used in both, UMTS and in Internet
- Provision of IP addresses for the UMTS users using Internet applications and accessing Internet

For the purposes of optimized access to Internet one or more of the generic UMTS bearers will be used. On top of the bearer a UMTS protocol profile can be defined. This profile could be based on the work done by IETF or other

relevant fora, and will consist of a recommended set of protocols and parameters to be used in UMTS. In the case of Internet traffic it would be possible for the user to select the encryption to be used (e.g. no encryption, end-to-end encryption, encryption over UMTS radio, etc.). The QoS mechanisms defined for UMTS packet access mode shall be harmonized with those defined for Internet (e.g. RSVP, RTP). UMTS users should have IP addresses enabling the usage of IP applications.

6.5 Handover

Handover is the function that hands over the communication path. It comprises two different functions: handover resource reservation (HRR) and handover path switching (HPS). The HRR reserves and activates the new radio and wireline resources that are required for handover. After this is done the HPS will perform the switching from the old to the new communication path, including the intermediate path combinations required.

For multimedia services in UMTS handover might raise additional requirements compared to handover for speech in for example GSM. Different multimedia services raises different requirements for bitrate, bit error rate, delay etc. on the bearer services they use. Therefore the HRR has to consider the specific communication path it is going to handover and reserve resources according to the requirements on it. A user may allow degradation of QoS to a certain degree when handover is executed if resources are not available in the new cell. E.g. a multimedia call including audio, data and video components might after handover only consist of audio- and data components due to scarce resources in the new cell, or a 500 kbps call might be reduced to a 200 kbps connection after handover (there are a lot of similar scenarios that can occur for handover of multimedia services). Some kind of call admission control function for allowing new connections in a cell is might be useful. One possibility is to consider resource conditions in neighbouring cells and probabilities for handovers between cells when allowing call set-ups.

For the case when multimedia services are handed over from UMTS to GSM QoS will most probably drop.

Changes in QoS during calls require adaptable applications and codecs in terminals and bridges.

It is also important to consider different scenarios for buffering for packet based services (e.g. Internet) in order not to lose packets. Packets may be buffered and redirected when handover occurs. Another solution may be that packets are sent to both the new and the old address during handover. The protocol Mobile IP forwards packets from the old address to the new address after handover and the mobile terminal updates the originators with the new address. The originators then sends the packets directly to the new address.

7 Impact on standardisation

This chapter describes the impact of multimedia, Internet and intranet services have on standardisation.

7.1 Control of bearer services and calls

The following has to be supported in UMTS standardisation:

Generic bearer services for transport of multimedia, Internet and intranet applications.

Set-up and release of calls.

Negotiation of bearer service attributes (QoS) both at call set-up and renegotiations during calls.

Resource reservations and guarantee of QoS.

Adding and dropping of parties during a call.

Multiple calls with different QoS.

[Not agreed if ”Set-up and release of bearer services within a call” shall be supported or not.]

7.2 Download of software

Support of download of software and service logic to terminals and networks. Existing techniques might be used, e.g. from Internet.

7.3 Handover

Handover of multimedia, Internet and intranet applications shall be supported, though they may result in change of QoS.

7.4 Service platform

A UMTS service platform should enable the use of multimedia, Internet and intranet applications. Parameters for the JAVA Virtual Machine shall be standarised.

7.5 Internet protocols

For optimized Internet access following should be provided in UMTS standards:

- Optimized transmission of IP traffic over the UMTS radio interface to minimize the amount of information transmitted.
- Ability to turn off encryption schemes over the UMTS radio interface.
- Interoperation of QoS mechanisms used in both, UMTS and in Internet.
- Provision of IP addresses for the UMTS users using Internet applications and accessing Internet.

7.6 Charging

UMTS charging for multimedia, Internet and intranet usage should include charging based on amount of traffic, time of usage, type of service etc.

Annex A (informative): Change history

Change history					
SMG No.	**TDoc. No.**	**CR. No.**	**Section affected**	**New version**	**Subject/Comments**

History

Document history		
0.0.1	June 3rd, 1997	First draft created during SMG1 WPC#11, Antwerpen
0.0.2	July 7th, 1997	New version presented at SMG1 WPC#12, Malmesbury
0.0.3	Sept. 9th, 1997	Presented at SMG1 UMTS, London
0.0.4	Oct. 16th, 1997	New version presented at SMG1 UMTS, Sophia Antipolis
0.1.0	Dec. 2nd, 1997	New version presented at SMG1 UMTS, Helsinki
0.2.0	Dec. 4th, 1997	Changes agreed during Helsinki meeting.
1.0.0	Dec. 9th, 1997	Format and editorial changes by ETSI sec. SMG#24 for information
1.1.0	Feb. 4th, 1998	Changes made as agreed in drafing group during SMG1 UMTS Vienna meeting.
1.2.0	Feb. 5th, 1998	Changes agreed at SMG1 UMTS Vienna meeting.