# Review of Foreseen UMTS Services and Applications

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*Abstract* - **UMTS should support the same set of applications provided by second generation mobile systems. Moreover, a new set of applications, based on the enhanced capabilities offered by UMTS should be considered. In order to meet market and business requirements UMTS should support multimedia enhanced application. In the paper known services with brief description and foreseen UMTS services and applications are listed. In order to reach a better understanding about UMTS foreseen services/applications, the aim of this paper is to review and analyze existing criteria for their classification, identifying the most important and representative cases.**

*Keywords* - **Universal Mobile Telecommunication System, services, applications, classification criteria**

## I. INTRODUCTION

Most existing second generation mobile systems use circuit switched data transmission, but UMTS integrates packet and circuit data transmission. Packet data gives several benefits to users: virtual connectivity to the network at all times, asymmetric bandwidth in the uplink and downlink and new ways of billing – for example pay-per-bit, per session or flat rate per month.

UMTS is also being designed to offer data rate on demand, where the network reacts flexibly to the user's demands, his/her profile and the current status of the network. The use of packet-oriented transport protocols like IP is being studied for UMTS to enhance these abilities. Technical barriers will removed using the combination of packet data and data rate on demand and operation of the system will be much cheaper.

UMTS services are based on standardised service capabilities which are common throughout all UMTS user and radio environments. This means that a personal user will experience a consistent set of services even when he roams from his home network to other UMTS operators, e.g. - users will always "feels" on their home network, even when roaming.

The ultimate goal is that all networks, signalling, connection, registration and any other technology should be invisible to the user, so that mobile multimedia services are simple, user-friendly and effective.

The term "service" represents telecommunication capabilities that the customer buys or leases from a service provider[1]. Service is an abstraction of the network-element-oriented or equipment-oriented view. Identical services can be provided by different network elements, and different services can be provided by the same network elements

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The term "application" is used as the generic term to represent the set of features, combining communication and document processing, on which end-users may perform operations. The applications may depend on working methods and on allowed processing of documents [2].

Figure 1 shows the differentiation of applications and services in the mobile terminal. An application will be implemented in the Terminal/Application Domain of UMTS, which provides the contact to the user through an Man Machine Interface (MMI), and which exchanges information with the Basic UMTS Terminal Features and Services Domain. Service and bearer capabilities including speech, data, supplementary services, security, mobility are provided for UMTS services and further applications. Video and audio services may be provided as applications that directly access UMTS service and bearer capabilities.

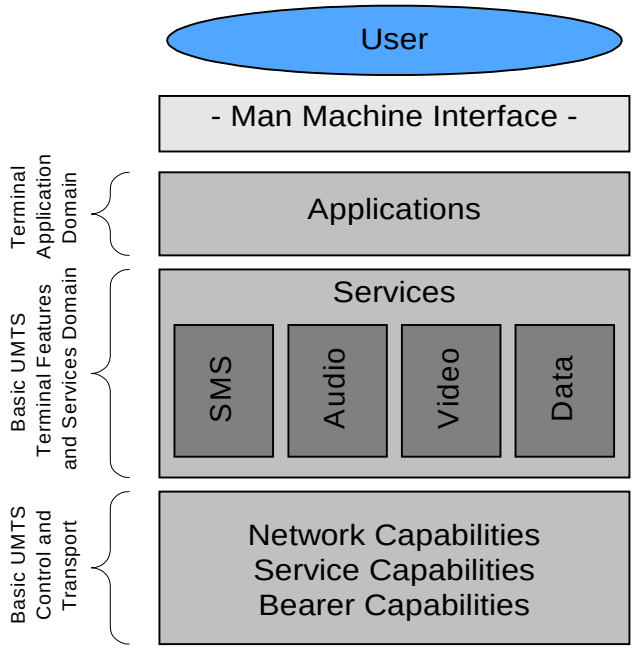


Figure 1: Differentiation of Applications and Services in the Mobile Terminal

## II. POTENTIAL UMTS SERVICES

The 3rd generation mobile communication standard is evolved from the existing GSM technology, which currently provides voice, and low speed circuit switched data applications. Data applications have always been included in the basic GSM design, although it was not consideration for the operators in the early days. These data applications provide robust, reliable connectivity with a guaranteed throughput for each user.

For today's services, based on bursty IP applications like E-mail and web browsing, these can be expensive for the user and the network operator alike. GPRS is designed to support from intermittent/bursty data transfers through to occasional transmission of large volume of data.

### *A. VHE*

Virtual Home Environment (VHE) is defined as a system concept for personalised service portability across network boundaries and between terminals. The concept of the VHE is such that UMTS users are consistently presented with the same personalised features, User Interface capabilities and services in whatever network and whatever terminal, where ever the user may be located. The exact configuration available to the user at any instant will be dependent upon the capabilities of the UMTS-SIM (USIM), Terminal Equipment and Network currently being used or on the subscription restriction (user roaming being restricted). A user with an USIM in another terminal, should receive maximum capability which are depended on the limitation of the terminal.

VHE will be created by a combination of capabilities located in the service provider, network operators and terminal equipment. In fact the VHE can be considered as a distributed user profile. The service provider will own – outline, at any instant it may be distributed between the Terminal Equipment, USIM, Network Operator and Service Provider. It should not be necessary for any network operator to permanently store any information relating to a Users VHE.

### *B. WAP*

Wireless Application Protocol (WAP) provides a universal open standard for bringing Internet content and advanced Value Added Services to mobile phones and other wireless devices. It is the platform for the new generation of "media phones".

Content is transported using standard protocols in the WWW domain and an optimised HTTP-like protocol in the wireless domain. WAP has borrowed from WWW standards including authoring and publishing methods wherever possible. The WAP architecture allows all content and services to be hosted on standard Web origin servers that can be incorporate proven technologies. All content is located using WWW standard URLs.

WAP enhances some of the WWW standards in ways that reflect the device and network characteristics. WAP extensions are added to support Mobile Network Services such as Call Control and Messaging. Careful attention is paid to the memory and Customer Premises Unit (CPU) processing constraints that are found in mobile terminals. Support for low bandwidth and high latency networks is included in the architecture as well.

WAP assumes the existence of gateway functionality responsible for encoding and decoding data transferred from and to the mobile client. The purpose of encoding content delivered to the client is to minimise the size of data sent to the client over-the-air as well as to minimise the computational energy required by the client to process that data.

As a result, WAP makes possible a wide range of wireless services which are independent of the underlying digital wireless network technology. WAP will enable users of mobile phones supporting the protocol to have access to information and transactional services, such as restaurant and hotel information, stock trading, banking services, directory services, exchange rates, flight schedules, and train and bus timetables.

### *C. MPEG-4*

MPEG-4 defines a generic model, comprising Compression Layer, Sync Layer and Delivery Layer, where the Compression Layer is Media aware and Delivery unaware, the Sync Layer is Media unaware and Delivery unaware and the Delivery Layer is media unaware and Delivery aware (Figure 2).

The Compression Layer does MPEG-4 media encoding and decoding into Elementary Streams, the Sync Layer manages Elementary Streams, their synchronisation and hierarchical relations and the Delivery Layer ensures transparent access to MPEG-4 content irrespective of delivery technology. Delivery technology is a term used to refer to a transport network technology (e.g. the Internet, or an ATM infrastructure), as well as to a broadcast technology or local storage technology.

Moreover, ISO/IEC 14496-6 (MPEG-4/DMIF) defines the DMIF Application Interface (DAI), which represents an Application Programming Interface (API) fulfilling the requirements exposed above. DMIF defines the minimum semantics for the DAI, and this is fine as far as model and architectures are concerned.

In the MPEG-4 group an implementation activity has been set-up (IM1 - Implementation 1), that also instantiates a real implementation of the DAI on the receiver side. The interface used in this project derives from that work, but provides extensions and a specification also for the sender side.

The successors of MPEG-4 data compression technologies such as fractal coding which are currently in the early stages of development, are potentially very important both in reducing transmission bandwidth (spectrum) requirements and the storage density for content. High data rate services, especially involving multimedia, may become surprisingly viable in mobile environments, and pressure for further advance in data compression will continue.

### *D. H.323 Standard*

H.323 is an umbrella standard which references many other ITU-T recommendations among them H.261 and H.263 for video, T.120 for data conferencing. In addition to the multimedia terminal, other H.323 components are defined which provide for conference admissions (Gatekeeper), multipoint communications (MCU) and interoperability (Gateway) on other types of network.

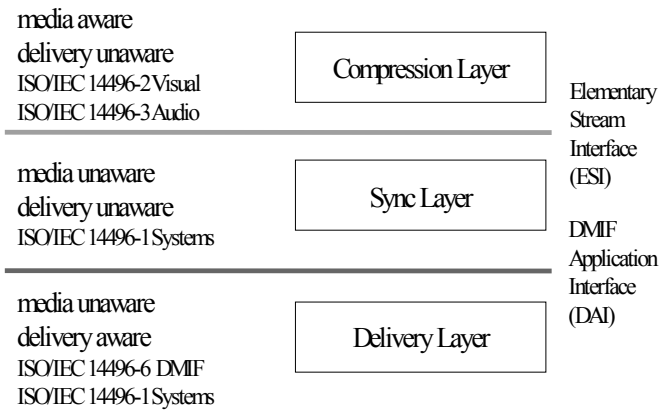


Figure 2: Generic MPEG-4 terminal architecture

H.323 was initially developed for LANs with non-guaranteed NQoS (Network Quality of Service) and version 1 of the recommendation has no support for NQoS. However in version two there are several tools in H.323 v2 to support NQoS.

Already today H.323 is the base of IP-telephony; a field where massive usage is expected. When H.323 is used in an intranet it can be assumed that a substantial proportion of the traffic on that network is UDP traffic resulting from H.323 video.

### *E. H.324 Standard*

The multimedia standard H.324/M is specifically designed for low bit rate and wireless transmission systems. The ITU-T H.324/M standard is compatible to the H.32X standards family that are designed for a multitude of communication networks. It requires no additional complexity in the UMTS core network as gateways are not necessary to achieve interworking with other members of the family. It is designed for mobile systems and therefore can cope with high errors on the link and consumes low overhead for signalling. H.324/M can be easily adapted to various networks. Due to the low impact of H.324/M on core networks, the investment of UMTS operators will be very low, one of the prerequisites for a successful introduction of videotelephony in UMTS.

The multimedia protocol H.324/M seems to be both technically and economically the best choice for UMTS systems.

### *F. WWW*

World Wide Web (WWW) architectures for mobile environments may offer the user with the ability to use these services everywhere they move since they provide the means for mobility aware computing (content dependent on user's location, content change according to network conditions and capabilities). Requirements are posed, though, for the access network (content conversion, cache relocations, etc.) as well as mobile terminal software.

### *G. E-mail*

An E-mail service for mobile communications should provide additional functionality compared to fixed network implementations:

Different access methods to remote mail servers should be provided. For terminals with sufficient storage capacity, a user might desire off-line operation. Terminals with limited storage resources should have additional options: For this case, it should be possible to perform any remote mailbox manipulation online at the server side only.

Mail messages increasingly transport multimedia content, i.e. combinations of text, audio, image and video attachments. Users should be able to retrieve messages on demand and also be able to request the quality that these files should be transferred. The messaging service provided on move support all the above requirements by utilizing proxy facilities at the client and server sides.

## III. POTENTIAL UMTS APPLICATION

This chapter identifies some applications which could be of interest in the context of foreseen UMTS applications. The applications are intended to be representative, and the goal is to identify and select one application in order to provide a reference scenario. UMTS applications shall support multimedia services and provide the necessary capabilities.

Multimedia is a service that combines two or more media components within one call. The components can be voice, audio, data, video or pictures. Multimedia services are typically classified as interactive or distribution services.

Interactive services are typically subdivided into conversational, messaging and retrieval services. The distribution services on the other hand can be with or without user control.

### *A. Conversational Applications*

These applications provide means for bi-directional communication with real-time (no store and forward) end-to-end information transfer from user to user where low end to end delays (<100 ms) and a high degree of synchronisation between media components are required. The flow of user information may be bi-directional symmetric or bi-directional asymmetric. Examples of conversational applications are outlined in subclasses:

***Video Conferencing*** - sending video over the network is already today possible. Due to bandwidth limitation, the quality is not as good as in commercial broadcast television. By introducing more sophisticated coding techniques, the required bandwidth can be reduced.

***Groupware (Collaborative Work)*** - A Collaborative Work Application offers the user videotelephony, data-conversation, and information retrieval services. Videotelephony allows the calling and called user to establish a face-to-face dialogue. During the conversation, users are able to exchange multimedia documents, to edit the same file, to make their cursors visible on the opposite terminal, and to retrieve information from databases.

***Voice over IP*** - Voice using Data Bearer employs transport mechanisms and networks which are more usually associated

with the transport of data. The service may be invoked after the user has provided a set of criteria which can be met e.g. voice quality, cost of connection, stability of connection. Some examples are: Net2Phone (Irvine Communications), VocalTec Internet Phone, Voice response and recognition and Voicemail

*B. Information Retrieval Applications*

These applications provide the user the means to retrieve information stored in information centres provided for public and private use. This information will be sent to the user on his demand only. The information can be retrieved on individual basis. Moreover, the time at which an information sequence is to start is under the control of the user. Each information centre accessed may provide a different media component, e.g. high resolution images, audio and general archival information. Examples of information retrieval applications are outlined in subclasses:

***Video on Demand*** - The Video on Demand Application will allow for the access of (possibly compressed) films, stored in a Video on Demand server. The (compressed) stream will be transmitted in real-time from the server to the terminal. While playing, the user, through a control menu, can control playback with commands like forward, rewind, stop and pause. Video on demand will be found to have high adaptability in areas such as: electronic shopping, education and entertainment.

***Road Traffic Assistance Systems*** - is an application where the user receives information specific to situations which involve the use of a motor vehicle or public transport.

The application should allow users to customise their interface i.e. create a home environment for the service which should adapt to the characteristics of the terminal. This should include the preferred method of indicating the information to the user. The information could be displayed graphically, textually or verbally depending on the terminal capabilities and the users preference. Graphical information could be downloaded dynamically (either continuously or in blocks) and stored locally on the terminal.

Where the user roams from one access network to another with differing capabilities, the application should adapt the manner by which the information is indicated (e.g. the user goes from a high bandwidth environment which is capable of sending graphical information to a low bandwidth situation which can only accommodate verbal instructions).

***Travel Assistance and Entertainment Systems*** - is an application where the user receives information specific to situations which involve travel and entertainment. The functionality could include:

The application may learn the users preferences for both business and leisure and suggest possible destinations for either option and automatically provide a complete package to the user. Typical information could be Frequent Flyer, dinner, hotel accommodation, preferred days of travel, seat location, car size etc.

The application could be further integrated into a group ware product, so that it filters dates, finds conflicts in schedules etc.

On arrival at the location, the service could arrange for travel to restaurants, booking of restaurants, provide local maps, news and weather reports in conjunction with any traffic information from the Travel Assistance System. Maps and animations of them (a kind of virtual reality) are especially good for orientation to local events and conditions. Weather forecast related to the country or area and animation to show weather evolution through time;

City info locating services and providing explanations of them;

Travel info within the city and the country

At the entertainment side a user will be able to receive information such as: audio on demand, games on demand, video clips and virtual sightseeing

The above applications will be supported best if they are based on information technology tools with networking following the evolutionary path of the Internet.

*C. Messaging Applications*

Messaging applications offer user-to-user or user-to-user-group communication via storage units with store-and-forward, mailbox and/or message handling (e.g. information editing, processing and conversion) functions. Messaging applications might typically provide combined voice and text, audio and high resolution images, in areas such as: SMS (short message service) and paging, E-mail delivery, broadcast and public information messaging and ordering/payment (for simple electronic commerce).

***Messaging of Photographs and Video*** - denotes the transfer of images to a single user or to a group of users. The application can be sub-divided into two transfer methods: 1) transferring of images in real time and 2) the storage of images and transfer at a later time. Value can be added to the application by the addition of functionality.

***Image Annotation*** - allows a user to annotate images with text or other images so that the receiving user can be referred to specific content. e.g. a video of an event can be annotated to highlight other events which have been captured in the background. If the user does not have the correct reception capabilities, textual or verbal information could be used to inform the user of such information.

***Electronic Postcard*** - This application allows a user to capture an image and use this as the front of a postcard. Text can then be added to the back of the postcard either in a typed or free form format, with any additional images. Once completed, the user is then able to send the postcard to another user either electronically or via a third party provider which turns the electronic postcard into a physical card, which is then put into the local postal service.

When an electronic method of transfer is used, the postcard may be attached to another or group of applications e.g. emailing an image with a schedule date for a meeting.

Where the receiving party does not have the full capabilities to retrieve all of the information, the application can indicate the information accordingly (e.g. textual information can be visually presented or verbally spoken). Static images may be forwarded to a fax machine or other electronic devices which can display the information.

***Event Driven Messaging*** - This application sends information to a user or a group of users when a certain business event occurs (e.g. a share value or a stock market performance index crossed a predefined threshold). If there is a house or car alarm, the responsible person could also alarmed.

### *D. Information Distribution Applications*

These applications include broadcast of information (without user individual presentation control) and distribution of information with user individual presentation control.

Distribution applications without user individual presentation control are broadcast applications which provide a continuous flow of information which is distributed from a central source to an unlimited number of authorized receivers connected to the network. The user can access this flow of information without the ability to control the start and order of the presentation of the broadcasted information. Such examples are: TV or audio broadcast applications.

Distribution applications with user individual presentation provide the broadcasted information as a sequence of information entities (e.g. frames) with cyclical repetition. So, the user has the ability of individual access to the cyclical distributed information and can control start and order of presentation.

***Distribution of Business Information, News and Weather***- Today, business information (e.g. Stock Market Information) can be broadcasted by several service providers using television channels. This technique of information distribution has the advantage of being very spectrum efficient since no individual connections are required. The broadcast information is organised in pages which are broadcast in a cyclic sequence. 3G mobiles should provide the capability to receive such broadcast business information.

***Advertising*** - The advantage and difference from a fixed service is that a mobile user takes his/her terminal with them. Information can be sent to a user that are area-specific. What is needed is to have the Mobile users position. A user can also tailor their own profile, searching specific information.

An example could be to request low price offers in the home shopping area and get the information automatically presented.

***Emergency Call*** - An emergency call can be viewed as a special case of the speech service. The service might be activated by pressing an emergency call button or dialling the number of emergency services. An emergency call is routed to the appropriate emergency service centre and user location information is provided to the emergency service centre. The emergency call service should be considered as a basic UMTS service, ideally universally available via terminal equipment in all environments. UMTS has to allow emergency calls to be made without the UIM present; also when the UIM is present and the credit limit is exceeded and/or when outgoing calls are barred, emergency calls shall be allowed. The IMEI shall be available for identification purposes.

### *E. Remote Control Applications*

A *Remote Control Applications* denotes an application, which remotely controls terminals from a server.

***Mobile Process Control Terminals*** - For some services, the network will act as a client application and the terminal as a server application. One example can be to control equipment. The equipment sends alarm over the radio interface. The network application can perform operation like SET/GET and carry out required actions on the equipment. This implies that the network must support both client/server and server/client applications.

***Remote Application Execution*** - Supporting hardware/software functionality in the network can facilitate light weight and small terminals. This is in line with the Network Computer concept, promoted by e.g. SUN, Oracle, where the network is the computer. The network should support the required functionality and applications as well as the execution environment and required storage capabilities. Examples are: LAN-to-LAN interconnection,application sharing and corporate servers.

### *F. Multiparty Games and Entertainment*

Multimedia Telecommunications opens up a variety of new possibilities for games between users at distant locations. Games may be of conversational nature (playing together) or of messaging nature (e.g. moving virtual creatures through the network). It is difficult to imagine the games that will be most widely used in the future and it is noted that the most stupid game may provide an incredible profit.

### *G. Electronic Commerce*

Electronic Commerce is seen as one of the enablers of the future information society. In the context of the wired networks such as Internet, it is envisaged to put in place an infrastructure to provide secure financial transactions. Potentially, similar applications can be provided on mobile terminals. The type of applications will include: Mobile Shopping including (mobile requests for offers, mobile ordering, mobile product delivery, mobile payment transactions) and mobile Banking including (online payment for value added services, payment for content services).

Electronic Commerce places strong requirements on security, privacy, and accountability. Thus, there is a need for secure transactions, mutual authentication mechanisms, and the like. In this regard, various studies are currently carried out in different fora and standardization bodies. It is required that the infrastructure for electronic commerce is fully supported by UMTS.

| **TABLE 1.** | UTRA Service Class | | | |
|---|---|---|---|---|
| | **First Class** | **Business Class** | **Tourist Class** | **Cargo** |
| Typical Applications | Conversational real-time | Streaming real-time | Interactive best effort | Background best effort |
| Features | Guaranteed capacity<br>Unreliable | Guaranteed capacity<br>Light ARQ | Reliable (ARQ) | Reliable (ARQ) |
| Delay | 100 - 500 ms | < 1 seg. | ~ 2 seg. | Unlimited |
| BER | $10^{-3} – 10^{-6}$ | $10^{-6}$ | $< 10^{-6}$ | $< 10^{-6}$ |
| Peak bit rate | Guaranteed | Guaranteed | Not guaranteed | Not guaranteed |
| Minimum bit rate | Guaranteed | Guaranteed | Not guaranteed | Not guaranteed |

## IV. Classification Criteria for Services and Applications

They are divided into two main categories: (1) Quality of Service and Network Performance (QoS/NP) criteria and (2) specific mobile communications criteria.

In this section, the classification criteria related to QoS/NP are presented. These criteria refer to requirements on quality and performance and seem to have more direct implications on applications, so further comments about affected applications can also be included.

QoS requirements are:

- Delay constraint
- Delay jitter
- Bandwidth/Throughput
- Bit error rate
- Availability
- Reliability
- Precedence (priority) & Service Interruptions

As the set of possible criteria is very large, it could be useful to combine them into several categories which include some of the criteria already mentioned, with specific values for all of them. As an example, in Table 1, there is a classification of multimedia applications in four main classes, which could be extrapolated to all applications.

A possible refinement of this classification would take into account the factors considered in the previous section, like the radio environment or the mobility level. In this sense, what may be considered a Tourist Class application in a certain environment, may be Business Class in other.

## V. CONCLUSION

The scope of this paper is to provide a definition of services and applications and based on this definition to foreseen UMTS services and applications. Taking into account that there are different point of views to declare the meaning of services and applications one definition has been chosen (ITU-T).

However, knowing the capabilities of the service and application layers some applications and services are identified which could be of interest in the context of the 3G generation mobile systems. The most important criteria's for classification of the already discussed foreseen services and applications are identified too.

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