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Contents

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Foreword

This ETSI Technical Report (TR) has been produced by ETSI Special Mobile Group (SMG).

This ETSI Technical Report (TR) outlines some means by which data services could be handled in the Universal Mobile Telecommunications System (UMTS

1 Scope

This document identifies some of the work required in SMG4 for the support of UMTS. The objective of this Technical Report draft report is to provide SMG input on UMTS data services with a view to establishing some detailed work for SMG4 on UMTS. This Technical Report identifies UMTS changes required for the support of fax, store and forward fax, applet fax end to end, applet fax with interworking, data services (modem access, internet protocol, services of internet protocol), SMS (GSM SMS, UMTS SMS base level, UMTS SMS advanced, SMS routing), and Cell broadcast.

2 (Normative) references

This ETS incorporates, by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] ETSI/PAC: Baseline Document on "Global Multimedia Mobility".

[2] UMTS 23.01: "General UMTS Architecture"

[3] ETSI TC-SMG DTR 50102 (UMTS 01-02): "Vocabulary for the UMTS"; v.2.0.0.

[4] ITU TG 8/1: "Draft New Recommendation Vocabulary for FPLMTS (FPLMTS.TMLG)"; v.15/09/95.

[5] ETSI TC-SMG DTR 50303 v.1.2.1 (UMTS 03-03): "Principles for handling of (digital) data services in the UMTS".

[6] ETSI TC-SMG DTR 50301 (UMTS 03-01): "Framework of Network Requirements, Interworking and Integration for the Universal Mobile Telecommunications System (UMTS)".

3 Abbreviations and definitions

3.1 Abbreviations

For the purposes of this TR, the following abbreviations apply:

ADSL – Asynchronous Digital Subscriber Line

IWU – Interworking Unit (physical hardware)

IWF – Interworking Function (contained in an IWU)

MEXE – Mobile Station Application Execution Environment

3.2 Definitions

For the purposes of this TR, the following definitions apply:

applet: a small programme that is intended not to be run on its own, but rather to be embedded inside another application

4. Data services summary

UMTS is all about data services. Its whole premise is that there will be a high demand for bandwidth-intensive multimedia access. Yet UMTS will also require excellent support for more basic data services. Until now, little time and effort has been devoted to the definition of real tangible data services and how they work in the UMTS network, and where there is a mixture of UMTS and GSM coverage. In GSM a number of features to improve the functionality of services for users has been introduced in the phase 2 and phase 2+ specifications. Unfortunately it has been very difficult for services to be developed which use these features as mobile phones are at various stages of evolution. In hindsight it would have been useful if mobile phones could have been given “capability categories” indicating defined groups of features which have been implemented in a particular mobile phone and to make this information available in the network (to core elements and value added elements). It is proposed that UMTS provides a mechanism to do this, and this will need to include a capability to detect that a mobile has changed configuration (e.g. by being placed into some sort of docking station).

In the UMTS era, the opportunity should be taken to improve the data services offered by GSM, and yet a multi-environment situation tends to suggest that seamless support between the radio types is important. There is a significant conflict here - complete seamlessness demands a similarity which stifles innovation and results in GSM problems being inherited by UMTS. On the other hand, a complete break from GSM will provide a much better service level, yet will run into problems where users move about between areas covered by UMTS radio and areas where only GSM radio is available. There are other scenarios which merit some thought. New networks may be brought into existence where there is no existing GSM service (e.g. in Japan). Where this happens there is no need for backward compatibility and “fallback” to GSM service.

SMG4 has studied a number of services in this paper, whose purpose is to stimulate further discussion and help define areas where SMG4 is required to develop more detailed specifications. Some of the scenarios described are not considered to be essential but are offered for completeness and better understanding of the pros and cons of the different solutions. Many of the solutions could be offered on newer GSM access systems as well as UMTS access systems.

A future version of this document will draw conclusions on the most appropriate solutions from a technical viewpoint. Currently we can see the following:

- We need well-developed applications to ensure the success of UMTS
- We will need to support analogue modems and group 3 facsimile
- SMG4 needs to develop APIs and at least the higher levels of new protocols (e.g. MS<->IWF).

5. UMTS data services

GSM made a big leap forward for data with dedicated hardware in the network to support data services. Data over GSM was designed to work in the same way as data over ISDN, albeit at a lower speed. It has provided a very good basis for operators to offer facsimile, data and SMS services without the need for users to purchase and configure modems. In principle, the network handles all data services smoothly. In practice, however, this is not always the case.

Several evolution scenarios for the introduction of UMTS have been considered, however the most likely initial scenario is the existence of islands of UMTS coverage in a GSM sea. This will result in a multi-technology environment with some regions supporting UMTS,some supporting only GSM and others supporting only UMTS.

If UMTS is to become universally adopted and commercially successful then it must incorporate facilities which permit a large number of third party software developers to produce applications that make efficient use of the UMTS transport capabilities. This will be achieved by specifying new APIs or software language extensions that intelligently hide the intricacies of the various low-level transport capability interfaces from the software writer. These extensions will then provide a basis from which the service capabilities to be defined for UMTS may be exploited. It is essential to make the work of software developers as simple as possible in this respect. This paper does not develop these ideas further, but more study on the relationship between the basic services described in detail herein and advanced APIs will be essential to the success of UMTS.

For UMTS, the ideal would be to provide easy access to advanced and legacy services, with seamless service provision whether a UMTS network is available or a GSM network is available, with full handover between the two environments.

This paper sets out to describe some detailed ideas as to how data services might be provided in the UMTS era and to stimulate further discussion.

Backwards compatibility will remain an important part for the initial introduction of UMTS. Legacy services like fax and SMS will run much faster and therefore attract more traffic which will in turn lower charges (as data speeds increase) and encourage new applications to use the faster data platform offered by UMTS. Examples of these new applications are set out below.

5.1 Traffic Telematics

The majority of the world's traffic experts estimate that all major cities will face total grid lock by the year 2005 (ITTC report). Road construction cannot keep pace with the increase in traffic density in citites and therefore a means of controlling the present day topography of streets has to be found. Intelligent street systems and intelligent vehicles are being touted as the answer to most of the problems. However, just collecting data is not enough as it must be transmitted in real time to where it is needed (e.g. traffic lights). Here is where UMTS could play a major role, by being the bearer for all types of information such as:

- control information for traffic lights
- video information for traffic control centres
- speech for traffic control police offices

5.2 Supplement to PMR

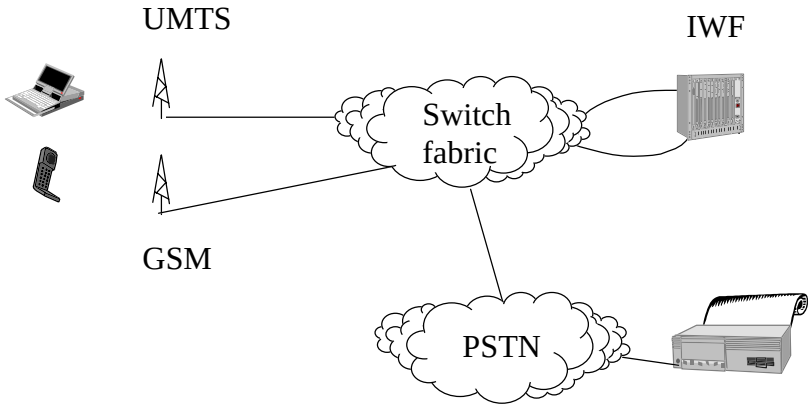
Private Mobile Radio, whether for emergency services or for taxi or construction site management is booming. Although TETRA and other sophisticate trunk radio systems will meet a lot of the demand, very high speed data applications running on UMTS could help increase the efficiency of for example the Police by supplying the real time information required for criminal investigation e.g. stolen vehicle data in the form of photos, licence details etc., finger prints and "Wanted Criminal" information including photos and even videos. The medical services could conduct real time diagnostics between hospital and paramedics on the scene. All types of medical records and data including x-rays and blood tests could be sent in real time which could save lives! A high speed bearer with full service capability for multimedia will find many uses, the list of applications for UMTS is endless and is only limited by engineering ingenuity.

6. Facsimile Services

The following section describes some possible scenarios for the support of facsimile group 3. It does not initially consider facsimile group 4. UMTS will also need to provide the means to support facsimile group 4, through provision of the appropriate service capabilities. Further study is required on this.

6.1 "GSM" Facsimile Service

GSM was originally supposed to be the "mobile arm" of ISDN and it was envisaged that by the time of deployment of GSM all the fixed networks in Europe would be using ISDN alone. This did not turn out to be the case and in fact of the use of analogue technology is still extremely popular. The group 3 fax machine is a very easy concept for people to understand - like a photocopier except that the "output" comes out of a distant machine. For this reason it is unlikely that group 3 facsimile will disappear in the next few years before UMTS is deployed. Therefore there needs to be strong support for group 3 fax. To make the introduction of UMTS as simple as possible one approach would be that all UMTS networks support the GSM fax service with no modification, and that full handover between UMTS and GSM is provided for this service:



In this context, full handover means that the call can be initiated either on the GSM or the UMTS network and if coverage of one of the networks disappears during a call then the call is handed to the other technology. Handover between cells on the same technology is also assumed.

The advantages of this approach are that it provides real time end-to-end connectivity and is ideal for a controlled application dedicated to fax (for example a one-box “fax mobile”). It also allows T.30-based equipment to be used at the mobile end.

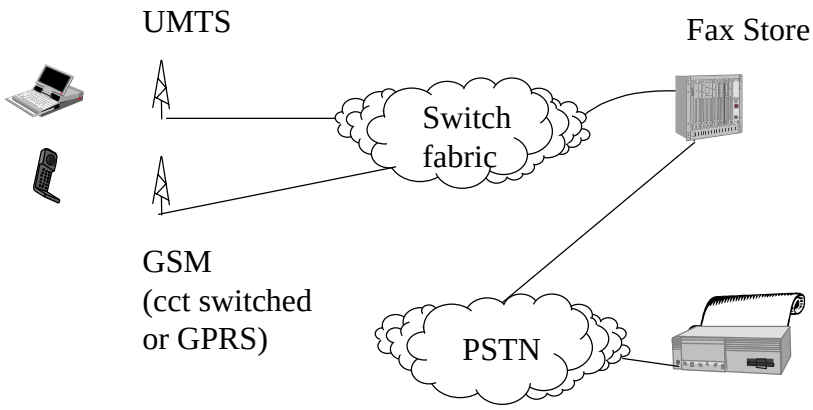
The disadvantages are:

- Mobile Terminated fax requires pre-knowledge and connection of devices before the call comes in
- Fax software is required at the mobile
- Because of the inherent problems of a radio interface and the nature of T.30 facsimile, this approach is very susceptible to call failures, premature disconnection, and corruption of the fax information.
- This approach may require the UMTS operator to offer dedicated IWU hardware which has been difficult and expensive to maintain and update in GSM networks.
- UMTS could offer access to existing GSM IWUs, but this would not be in any way innovative or revolutionary, and would offer the user exactly the same problems as GSM.
- Because of the difficulties outlined above, this solution is not recommended by SMG4.

6.2 UMTS Store and Forward Fax

It is very unlikely that people will want to carry around real “office” fax machines and most of the fax calls made on current GSM networks use a form of PC-fax at the mobile end. Since a PC fax starts life in electronic form there is no technical requirement to send the “fax image” over the radio in the same format as it is sent to the destination. And there need be no direct “end to end” communication using T.30 if the relevant information is passed at the right time (progress indicators). It is therefore proposed that a store and forward fax service is defined for UMTS. This service will not define repeat attempts between the fax store and forward machine and the destination fax machine - this will be left to the network operator to define. But the full communications protocol between the fax store and forward machine and the terminal equipment at the mobile end will need to be defined to ensure that the market for terminal applications

develops along one standard path. The mobile can initiate communication with the fax store from either a UMTS or a GSM radio environment.



Communication between the TE and the Fax Store could operate in the following manner:

TE Fax Store

--------Fax Forward Request----→

←--- Fax Forward Accept--------

----File Transfer (Fax Image)---→

←----- Fax Image Confirmation ---

←----- Dialling Progress Indicator ---

←--- Connecting Progress Indicator -----

←--- Connected ID Indicator (fax id) ----

←- Page Progress Indicators -----

←-- Disconnecting Indicator -----

←--- Final result indicator ----------

←-- Charge Indicator ----------

SMG4 should be responsible for the development of the above procedure, in particular the methodology used for transferring the image file transfer between mobile and fax store, which could include solutions being proposed in the Internet world for fax over IP.

Handover between UMTS and GSM environments would be feasible (not to/from existing 03.45/03.46 facsimile, but to/from an equivalent service which can easily be developed for GSM). A quality of service parameter in the original request could ask the network to ensure continuity of the call. But this could operate from the mobile end just like GPRS, if the data above is all packet-oriented. As mentioned above, this service should be made available in "enhanced GSM" too - either via a Non-transparent circuit switched call or via GPRS.On the mobile terminated side, the fax store could be used to hold MT faxes until the user is ready to dial up and retrieve them. Notification of a received fax is easily provided via SMS. Another alternative would be for the transfer to the mobile to be made page-by-page as the pages of the fax arrive at the fax store.The advantages of this approach in a non-ISDN environment where the type of incoming call is not always signalled are that there is no need to allocate multiple numbers in the mobile network numbering scheme and the HLR need not be as complicated. Users will need numbers for MT fax, however these can be allocated in the wired network dialling plan and need not impact the HLR at all. This approach also allows the operator to rationalise the number of data services running through the switch fabric. Mobile originated fax is much easier to handle and ensure that delivery of a perfect fax results in the most difficult of radio environments.

The disadvantages are that the mobile user now has to make another call to retrieve a fax (although this makes fax very similar to voicemail), and that mobile terminated fax is not real time (so the calling party will not know when the mobile user receives the fax).

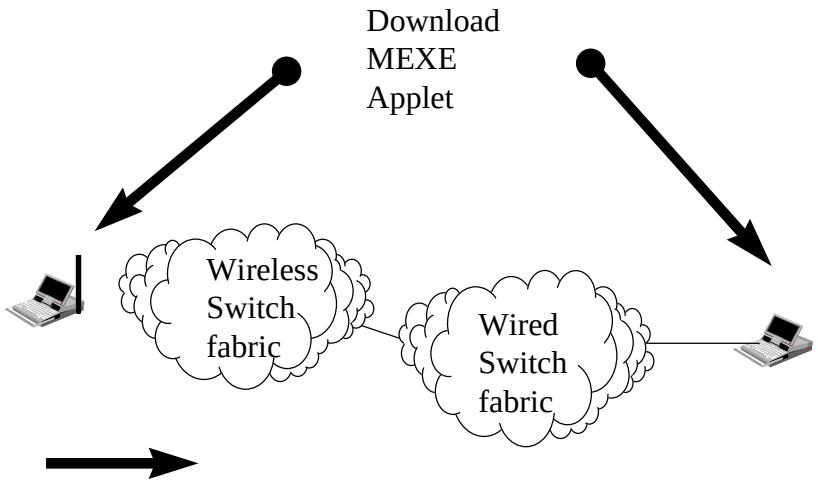
Further work is required to establish the best way of providing this store and forward service. In particular it may be found to be better to start the T.30 procedure in a mobile originated call before all pages are received at the fax store.

In conclusion, the service capabilities to be defined by SMG1/3 need to be capable of supporting a fax store and forward service similar to the one outlined above.

SMG4 is very much in favour of this solution.

6.3 Applet Fax end to end

This allows a MEXE applet at one end of the connection to send a fax to a MEXE applet on the other end of the connection without any intervention by any network inbetween. In technical terms there is no reason to send a bitmap of information when each end can cope with electronic representation of the material, however people are used to the term "fax" and if a MEXE applet can provide the functionality to send and receive "faxes" then the customer may be more comfortable with that than with some new service which the customer might not understand. This is a good example of how MEXE provides a very good end to end service with no need to upgrade network infrastructure. Fixed Mobile Convergence (FMC) is discussed at many levels in many fora. The following example shows a mobile terminal interworking with a wired terminal with no differences at either end save the physical connection means. This is therefore fulfilling the FMC goal.

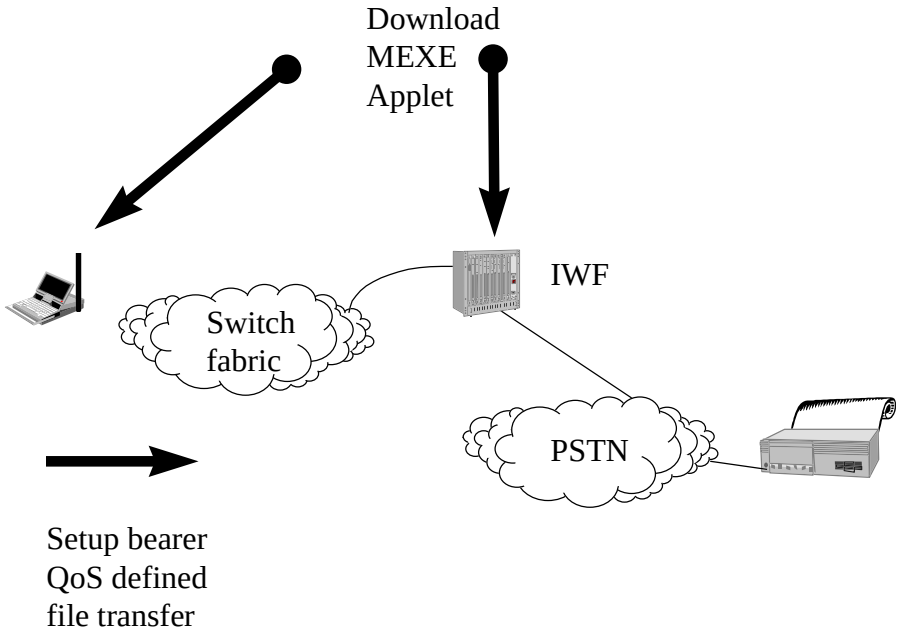


In this case handover between UMTS cells, between GSM cells and between UMTS and GSM could be negotiated in the Quality of Service.

This scheme has the advantage that it is real time end to end, and that the network need not be upgraded. The mobile end of the connection is very much simplified because there is no need for any external terminal.

The disadvantages are that UMTS and MEXE are required in the wired networks, and that this approach does not work with standard Group 3 fax machines.

6.4 Applet Fax with interworking



This permits an advanced terminal in a UMTS or enhanced GSM network to communicate with a fax machine in the PSTN using MEXE to define the functionality at the mobile terminal and the network equivalent (sometimes called NEXE) to define the functionality in the interworking function. Upgrades to hardware are not required given that the support of the execution environment is available.

The Interworking Function described here is a new network element and is unlikely to be a simple upgrade to existing GSM IWU functionality. It could offer store-and-forward fax, or the service could be provided real time end-to-end, depending on the design of the MEXE/NEXE applet.

Again, handover would be possible in any environment, depending on the QoS negotiated. Handover between UMTS and GSM would only be possible where this is supported in both access networks.

Further study is required, particularly on security of the network elements (who is permitted to download code onto the IWF).

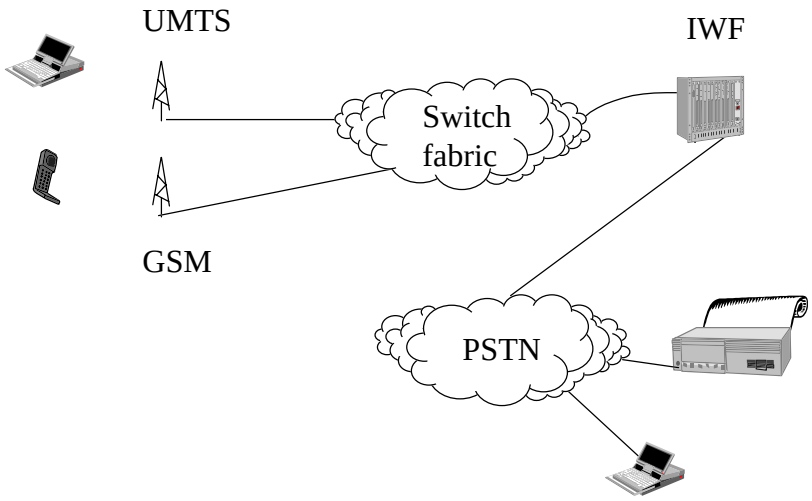
This is effectively an example of client/server architecture in UMTS specifically applied to fax and MEXE. The requirement from SMG4 on UMTS is therefore the service capability to identify and access clients with programmable generic service equipment.

7. Data Transport Services

Data services are difficult to understand and properly develop unless there is a real application at the back of peoples' minds. But many data applications occupy specific niches, which means that it is important for any data support functionality to be as flexible as possible. Data can be provided over circuit switched (traditional GSM 9.6 or 14.4, possibly combined with multislot to increase speed) or packet switched (GSM-GPRS or the UMTS equivalent). End to end circuit switched services need to be supported between the mobile environment and broadband ISDN access in the wired networks, although initially this section does not consider this requirement. Another area for further study is ADSL modems which are becoming popular in wired networks.

Some of the interaction between the "switch fabric" (which is intended to represent the SMG3 network infrastructure domain) and the data services is discussed here, however the interaction between service control and data services will need significant further development to enable advanced location-based data services for example. This cuts across SMG3 and SMG4.

7.1 Modem Access



The IWF provides a range of modems which can be accessed via a circuit switched or packet switched connection. These modems could talk over the PSTN to other modems or to fax machines, entirely at the discretion of the caller. The caller would first establish a connection to the modem and the instruct the modem as to how to set the call up from there. When the call is disconnected then a message is sent back to the user advising of the call cost.

This scheme effectively extends a V.24 port on a modem in the interworking function all the way to the terminal connected to the mobile. The IWF no longer contains a DTE/DCE interface and the modems can be controlled completely transparently from the mobile.

For the mobile terminated case, where the type of incoming call is not always signalled, multiple mobile numbers need not necessarily be allocated - either a two-stage call setup is possible or the IWF can be allocated numbers in the wired network domain.

A two-stage call setup is less of an issue than it was for GSM because we can use a combination of packet switched and circuit switched technologies. For example, in the mobile terminated case a packet alert mechanism could be used to advise the user of the incoming call and give them the opportunity to connect the data equipment to the mobile terminal before the circuit-switched incoming call arrives.

The disadvantages are:

- This scheme does not work with the scenario where UMTS radio access is provided together with GSM infrastructure without a considerable design effort, since packet data needs to be transported over the MSC infrastructure
- Mapping of the UMTS radio access over the GSM A interface signalling becomes complicated or impossible if the modems are configured in-band (as described above) in UMTS and with out-band signalling in the GSM infrastructure.

Detailed discussion between SMG3 and SMG4 would be required to determine how to establish the Quality of Service required over the switch fabric based on the connection established over the PSTN. This could be achieved for example by control from the mobile (based on information received from the IWF) or directly conveyed between IWF and switch fabric.

An intelligent protocol needs to be established between the mobile and the IWF to allow communication at the right level. This would be developed by SMG4. SMG1 and SMG3 need to provide the generic service capabilities to support the transport of such protocols in a transparent manner.

MEXE/NEXE applets could also be used with modem access as in sections 2.3 and 2.4

7.2 Indirect Modem Access

Another way to support modem access would be to offer an equivalent service to GSM. The requirements for a service are captured at the mobile end and signalled to an interworking function which sets up a modem appropriately and calls from there. This has the advantage that it follows the GSM way of working, and makes interworking between UMTS and GSM much easier.

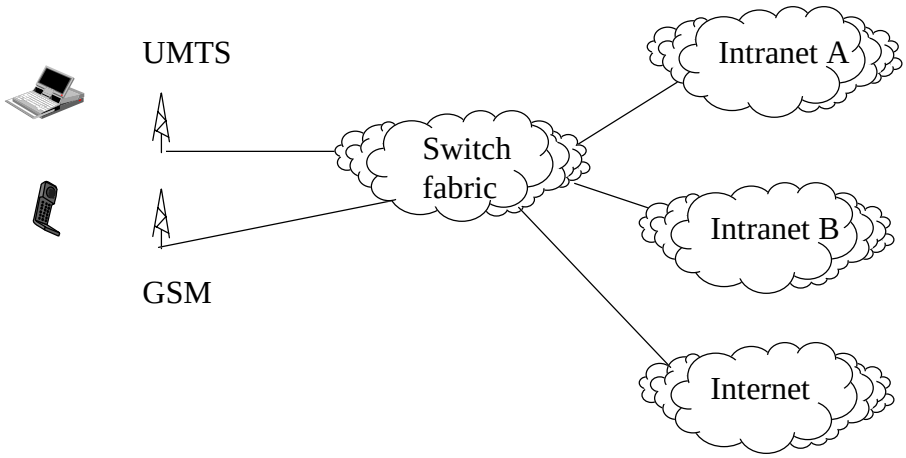
A more client/server based approach would be to provide conditional triggers for the switch to determine that a modem is required. The switch would then allocate a modem from central resources. The requirement in this case would be to identify the need in the originating switch, and the service capability support to interact with a server to allocate the resource.

7.3 Digital Access

Access to ISDN UDI should be possible in UMTS. Two scenarios should be considered:

- A bit-transparent (clear channel) 64k access identical to today's ISDN
- Rate adapted access like today's GSM access to ISDN but potentially with higher speed.

7.4 Internet Protocol (IP) Access



This scenario shows how connections can be established to the Internet or Intranets, following the GPRS model.

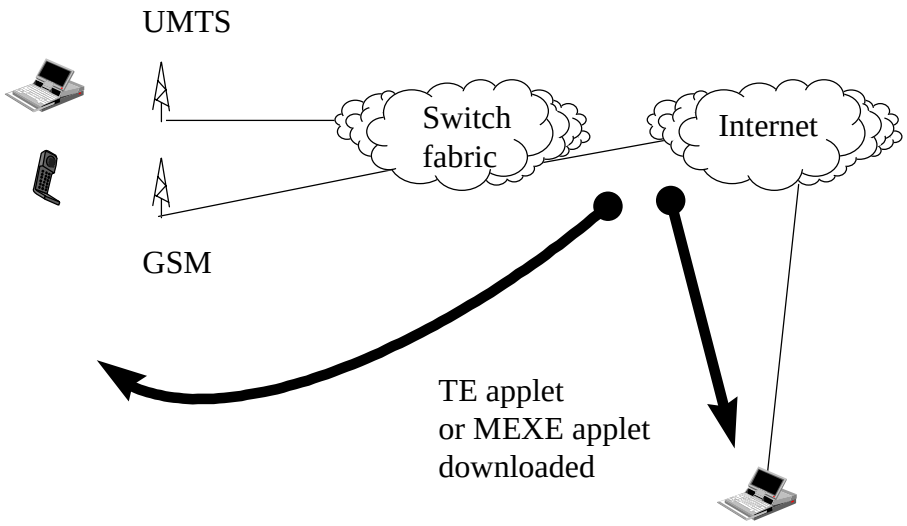
Handover could be handled for IP access in a similar way to GPRS, as the above diagram really does not add anything to the GPRS access for UMTS. Handover between GSM (GPRS or circuit) and UMTS should be supported (either mobile-initiated as in GPRS or network-initiated).

The introduction of IETF Mobile IP has been resisted in GSM GPRS for two reasons. The first is simply because it is not yet ready. It could be argued that the time scales involved in UMTS would allow for the completion of the mobile IP standards. It has also been stated that Mobile IP requires an underlying Ipv6 network, this is however untrue. Mobile IP in all but its most advanced form is implemented over Ipv4.

Mobile IP should be considered most carefully. The vast majority of the potential usage scenarios are covered by mobile IP, so it could be argued that there is little need to reinvent another way of providing service in these situations.

7.5 Services over Internet Protocol (e.g. Voice over IP, Multimedia over IP, Fax over IP)

Given the model shown above there is no need for explicit definition of any IP-based Multimedia services. The services simply run as end to end applications based on downloaded applets to the wired and wireless sides.



Again, quality of service could be negotiated at call setup, including handover parameters. For multimedia services over IP this will require different ports on the same IP address being provided with a different level of QoS over the switch fabric.

8. SMS

SMS has been very successful in the GSM era. It is useful to study the reasons for this, which are many. Firstly, the mobile terminal contains everything that a user needs to send and receive SMS on a basic level. Secondly, any user can send to any other user confident in the knowledge that whatever handset is owned, the message will be delivered and read successfully (subject to provision of network connectivity). Thirdly SMS is stored in the network until it can be delivered. SMS has become the standard way of exchanging information with only a mobile phone at either end.

In order for the UMTS era to continue the success of SMS as a highly popular and extremely useful service it will be necessary to interwork with older systems and terminals. Complete interworking with GSM SMS is essential. And although UMTS will provide the basis for text messaging using APIs and third party applets, it is believed to be essential that a basic level of SMS is provided on all UMTS handsets so that a sender can be assured that the message can be read at the other end, just like GSM.

8.1 SMS Types

8.1.1 GSM SMS

This will operate in the same way as GSM phase 2+. It will be mandatory for a UMTS handset to be able to send and receive UMTS SMS and at least be able to interwork with GSM SMS using all the phase 2+ capabilities of GSM SMS. Whether this means that UMTS terminals need to directly support GSM SMS or whether an Interworking Function is required needs further study.

8.1.2 UMTS SMS BASE LEVEL

In order to “kick-start” more advanced SMS applications it will be necessary at least for UMTS to define a base level for new SMS such that UMTS to UMTS SMS always works and the recipient can always store the message on their SIM. This level of SMS is also proposed for GSM release 99.

In GSM it has been difficult to identify the capabilities of the MS with respect to SMS features and to ease this situation it is proposed that UMTS provide a mechanism to do this. The information could be held in the equivalent of the HLR to avoid enquiries to the MS for every message attempt. SMG3 should provide appropriate solutions to enable the MS capabilities to be identified.

Some additional proposed features are:

- Maximum length of message without concatenation: [1Kbyte] (note that a maximum is needed so that mobiles can be designed to store a minimum number of messages). A message could be shorter than this and the storage in the mobile could be allocated flexibly. Longer messages would be sent using concatenation of messages in a similar way to email attachments.
- Alphanumeric addressing expanded from 11 characters to 255 characters amongst other things to greatly simplify email<->SMS interworking; specifically to carry email addresses in the Originating Address and Destination Address.
- Addressing to allow IP address plus port to enable SMS to be sent/received directly to/from a machine on the Internet. [This could also be added to GSM].
- Email to SMS is defined such that all SMS fields can be controlled to and from the email side
- Header fields are restructured and made more logical and optional. The general GSM TLV format or its successor in UMTS would be a useful starting point.
- Encoded in a standard 8-bit character set or UCS/2.
- A conversion service is provided between UMTS SMS Base Level and GSM SMS. The conversion service may either concatenate the message or truncate the message. If either is necessary to complete the transaction then the sender is informed.
- Signalling connections are not used for UMTS to UMTS SMS; instead a dedicated MO or MT packet-based connection is established (note that packet and circuit is always possible; in UMTS and advanced GPRS mobiles this can be concurrent).

- Direct mobile to mobile SMS is possible without using an SMS Service Centre but using the network infrastructure in a real time end-to-end way. Implications for billing will need to be considered. If such an attempt fails then it should be possible to drop the message into a Service Centre for additional attempts.
- A real-time 2-way SMS service is possible.
- End to end error transport is provided
- Data compression is mandatory in mobiles.

8.1.3 UMTS SMS ADVANCED

Once the market is established for UMTS SMS services then application developers will start to develop more advanced services based on MEXE applets. The sender and recipient will need to download the MEXE applet which will provide a more advanced form of SMS between the two. When the recipient receives the message the source of the MEXE applet is identified so that the recipient can download the applet if it is not already in the mobile.

8.2 SMS Routing

Routing of SMS messages is left for further study. It may be that a means is provided to route SMS over the Internet, although the user should be in full control of the quality of service requested (e.g. additional delays over the Internet, lower security over the Internet).

If GPRS or the UMTS equivalent is used as the bearer for UMTS SMS then the routing issues are the same as for any GPRS packets (i.e. the network operator decides on the most appropriate routing, based on network management and user requirements)..

9. Cell Broadcast

Cell Broadcast in UMTS needs significant study. It may be that the point to multipoint services (multicast and groupcast) from GPRS can be used but then it would not be possible to use the existing infrastructure for GSM Cell Broadcast. This could have a big negative impact on someone implementing GSM Cell Broadcast in 1999 or later. Another approach might be for SMG1 to offer the service capability to support CBS messages using GPRS as a mechanism for delivery to BSCs.

There is some support for continuing a Cell Broadcast service in UMTS but this needs further study.

Annex A:
Document history

Document history		
Date	**Status**	**Comment**
May ‘98	First draft	V 0.0.1
June 1998	Second draft	V 0.0.2
June	Third draft	V 1.0.0 presented to SMG#26