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Evolution of the GSM platform towards UMTS
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4. Scope

This document is examining issues related to the evolution of the GSM platform towards UMTS with the overall goal of fulfilling the UMTS service requirements, the support of the UMTS role model, support of roaming and support of new functionality, signalling systems and interfaces.

5. 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.

ETSI TC-SMG UMTS 22-01: "Services Principles"

6. Definitions and abbreviations

6.1. Definitions

The following definitions~~documents~~ have been introduced within this document.

BSS: it includes all the pieces of equipment needed to perform RAN functionality. If considered as black box; its physical implementation can make use of one or several network entities and its boundaries are the Uu interface on the User Equipment side and the Iu interface on the network side.

NSS: is a network switching subsystem with the necessary functionality and/or potential to support, in a uniform manner, the whole set of UMTS services (available to)/(accessible by) fixed and mobile subscribers. A mature UMTS NSS will satisfy the UMTS service requirements without any limit. Its boundaries are the Iu interface on the Access Network side and any kind of NNI (Network to Network Interface) towards other compatible networks (e.g. GSM, ISDN, PDN) on the opposite side.
The UMTS NSS term is used to address any network respecting the above-mentioned characteristics whatever its origins or whatever network it is evolved from (e.g. GSM/UMTS CN, ISDN/UMTS CN, PDN/UMTS CN).

GSM PLATFORM: GSM Core network (MSC, GSN, HLR,VLR etc) + SIM

6.2. Abbreviations

For the purposes of this ETS the following abbreviations apply.

7. Capabilities of GSM Phase 2+ architecture

7.1. GSM Phase 2+ architecture

For a description of the GSM phase 2+ architecture the reader is referred to TS GSM 03.02. The capabilities described in this section are the capabilities defined in the SMG 1997 release.

7.2. Key features of GSM Phase 2+ architecture

Key features of the GSM phase 2+ architecture with respect to UMTS are listed in the following sections. The reader should also refer to TS GSM 03.60.

7.2.1. GPRS

- GSNs may be based on a variable bit rate packet-switched architecture.
- There is not a one-to-one relationship between an MSC area and GSN area. For example, a PLMN with 10 MSCs may only have 1 GSN. GSNs may be added in line with traffic growth.]
- A high speed packet-switched multiplexing backbone may exist between GSNs. The network service shall be based on the Internet protocol. The underlying layers are not specified and may be based on ATM, Frame Relay, X.25 and so on.
- A session, defined by a PDP context including traffic and Quality of Service parameters, can be set up by a subscriber in GPRS.
- The GPRS Tunnelling Protocol (GTP), operating between GSNs, allows the subscriber set up sessionsto invoke one of 4 traffic classes per communication.; Aa subscriber may have many sessionscommunications in operation simultaneously between GSNs, if subscribed to and if supported by the end-user equipment (TE). Therefore, the GPRS network subsystem may support ATM-like classes of traffic (table 1).

Table 1: Possible Traffic Classes between GSNs (taken from ATM)

	Class A	Class B	Class C	Class D
Timing Sensitivity	Yes		No	
Bit Rate	Constant	Variable		
Connection Service	Connection-oriented			Connectionless

- Thewo NSS to BSS interfaces is the Gb interface whichare supported. The A-interface is based on an ISDN 64kbps per user trunking structure. The Gb-interface is based on Frame Relay.

7.2.2. Shared IWF

The Shared IWF "Server" provides IWF services to a number of MSs. The MSC is used as a service routeing node. Several MSCs may access the same IWF server at the same time.

7.2.3. Service Differentiation in GSM Phase 2+

7.2.3.1. Intelligent Network (CAMEL)

A way to provide service differentiation in GSM phase 2+ network is based on the Intelligent Network approach that relies on triggers within the supporting network infrastructure to suspend call processing and communicate with a remote computing platform before proceeding to handle the service functions.

7.2.3.2. SIM Toolkit

The current SIM toolkit standard (GSM 11.14) allows the SIM to be used to intercept calls made from the mobile, and block or change the number dialled. The SIM can also directly manipulate the menu structure of the terminal's user interface, adding new menu options tailored dynamically to the service being used.

7.2.3.3. Mobile Station Execution Environment (MEXE)

MEXE provides environmental support for operator-defined services in the MS, with the emphasis on functions in the ME. MEXE is still being defined, but it is likely to include standards for:

- A Java execution environment on the MS and mechanisms for downloading Java and other applications,
- control of MMI aspects of the MS in real-time from the network to allow user friendly control of applications in the network and applications distributed between the MS and the network.
- Mobile station clients for common applications such as address books.

8. UMTS Concepts.

8.1. Support of multimedia services

One of the most important requirements for UMTS is the capability of supporting multimedia services.

The following principles should guide and apply to the support of multimedia services in UMTS:

- Multimedia services in relation to UMTS should be standardized and handled according to emerging multimedia standards. SMG should not standardize multimedia services solely for UMTS networks. SMG should take advantage of existing and emerging main stream standards for multimedia, in reality defined outside of the UMTS.
- Multimedia applications according to such main stream standards should be *supported* (transported and handled) *efficiently* in the UMTS.
- Multimedia requirements on the UMTS should, as far as possible, explicitly be related to such multimedia application standards to be supported – rather than to generic statements or assumptions related to the architecture.

- The multimedia bearer capability requirements, incl. QoS, are expected to effect the core as well as the radio network.

Among others, tTwo requirements for an efficient support for multimedia applications, which currently can not be achieved by GSM, are sufficient bandwidth allocation and flexibility of bearers.

- The bandwidth requirement relates to the transport technology used on (both the radio and network sides). In particular switching and transport capabilities within the network must be able to support, in an efficient and flexible way, air interface rates of at least up to 2 Mbit/s. It is unlikely that a 64 kbit/s based switching system will be able to do this in the most efficient manner.
- Separation of call control from connection and bearer control. This is an important requirement to satisfy the concept of Quality of Service for media components: a call/session may use various connections at any one particular instant (making use of one or several bearers). It should then be possible to add or remove bearers during such a call in order to cope with user needs or problems on the radio path. (Ref. ETS 22.01 Service Principles)

8.2. Support of services requiring variable bit rate

- If a number of applications use VBR data flows then packet transfer mode on the radio and network side has to be considered in order to make efficient use of resources.
- If packet transfer is allowed on the radio side, a finer degree of location management is/may be needed for radio resource optimisation (if only the LAI is used as in GSM, packets addressed to one single mobile terminal would need to be broadcasted over its entire Location Area; a new routing concept playing a similar role to the GPRS routing area is then needed).These additional Radio Resource/Mobility Management functions could be located in the Radio Access Domain, containing data strictly related to the access techniques that could be hidden from the serving network.

8.3. Standardised capabilities for supporting services (instead of standardised services as in GSM)

To cope with future market needs, UMTS will standardize service capabilities and not the services themselves as outlined in ETS 22.01. Service capabilities consist of bearers defined by QoS parameters and the mechanisms needed to realise services. These standardized capabilities will provide a platform which will enable the support of speech, video, multi-media, messaging, data, other teleservices, user applications and supplementary services and enable the market for services to be determined by users and service providers. The best way to achieve the standardised capabilities and provide a flexible and time-proof system is by defining Application Protocol Interfaces. These could be used by many services instead of trying to hypothesise what the future services might be and rigidly defining these services. However, it should be noted that in designing an API assumptions will inevitably be incorporated about the kinds of features the API will be required to support. Therefore mechanisms will also be needed to evolve APIs (i.e. the APIs should be designed with forwards compatibility mechanisms). Additionally, this will reduce the time required to deploy new services in the network.

8.4. New Handover functionalities

The radio access network has to be capable of connecting to a variety of existing core networks. This leads to a requirement that the UTRAN will be allowed to connect with evolved forms of existing CNs. There will be the need to support new Handover functionalities between UMTS and 2G systems.

The support of multimedia services and the separation of Call Control and Connection Control (many connections: telephony, video, data could be associated with one single call and handed over separately), together with a micro or pico-cellular environment will cause increased complexity of Handovers compared with GSM.

Developments will be needed of the contemporary GSM/GPRS platforms to enable handover/cell reselection of communications between GSM/GPRS and UMTS. To enable this specific developments are needed for:

- Handover/cell reselection of communications which have inherent delay and error requirements (e.g. speech as for contemporary GSM circuit switched and speech/ video).
  (This may be viewed as an equivalent of GSM circuit switched handover).

- Handover/cell reselection of communications which may not have inherent delay requirements but do have error requirements (e.g. packet data communications such as IP/GPRS, file transfer, SMS).
  (This may be viewed as an equivalent of GPRS cell-reselection).

This also requires the ability to potentially 'negotiate' and modify communications parameters when handing over between GSM/GPRS and UMTS.

- It would be useful to provide new procedures in UMTS in order to make handover a totally Radio Resource Management procedure fulfilled as far as possible by the BSS without the intervention of the NSS part. The proposed interconnection of BSSs to allow for handover streamlining could be a step in this direction. (This may be difficult when performing hand-over between different environments, and a traditional GSM-like handover procedure is likely to be used in this case).

- It is likely that the network performance during handovers will be increased by restricting handover to the access network, leaving the core Network to deal with the Streamlining procedure without any real-time constraints. (In the case of a successful GSM inter-BSC handover, eight messages are exchanged real time on the A interface between the MSC and the two BSC; if Streamlining is used, this could be potentially reduced to two messages (Streamlining Request - Streamlining Acknowledge) with a significant saving in the signalling overhead.

As part of the overall QOS negotiation between user and network, mechanisms will be needed to enable parameters such as handover delay, jitter, packet/information loss/acceptable error etc to be applied as part of the communications path requirements utilised during the communications 'session'.

A number of options are available to support handover within the UMTS Core Network; real time support within the core network, real time handover within the UTRAN with subsequent 'streamlining'. Irrespective of the final mechanism developed within the UMTS Core Network for UMTS handover, functional developments are needed within the Core Networks (both GSM/GPRS and UMTS) to support handover between UMTS Core Networks and evolved GSM/GPRS core networks.

8.5. Support of the Virtual Home Environment concept

- VHE is a set of tools that enable a more flexible service creation environment, faster deployment of new services, and service differentiation. The VHE concept will ensure a uniform appearance, or presentation, of services, features and tools to a service user, or subscriber, in an identical manner independent of serving network or location.
- Users VHE capability will be supported from both UMTS and GSM access, subject to the relevant limitations of the GSM/GPRS core networks. This means that mechanisms are required to support the delivery of VHE capability when handover between GSM/GPRS and UMTS occurs. The impact of the handover between GSM and UMTS on VHE should be minimised.

The design of the UMTS architecture has a strong impact on the efficient realisation of the Virtual Home Environment (VHE). In UMTS phase 1 VHE consists of: GSM services & roaming principles and, service capabilities. UMTS phase 1 service capabilities are:

- Bearers:
  - GSM CS data,
  - UMTS bearers for circuit and packet,
  - GSM GPRS data and,
  - SMS & USSD[1].
- Mechanisms:
  - CAMEL,
  - MExE and,
  - SIM Toolkit.

In the following, different mechanisms for the distribution of software, service logic and service data, are shown. Typically service may be formed from a combination of these mechanism.

[1] Note : SMS is originally defined as a Teleservice and USSD as part of the GSM Supplementary Service operations. This means that they were originally intended for both presentation of- and carrier of end-user information (e.g. the SMS-alphabet for SMS), but has over time evolved into bearers of encoded application information (e.g. carrying WAP information).

8.5.1. Modelling of VHE Implementation Approaches

This section presents a model which can be used as a basis for a comparison of VHE technical implementation options.

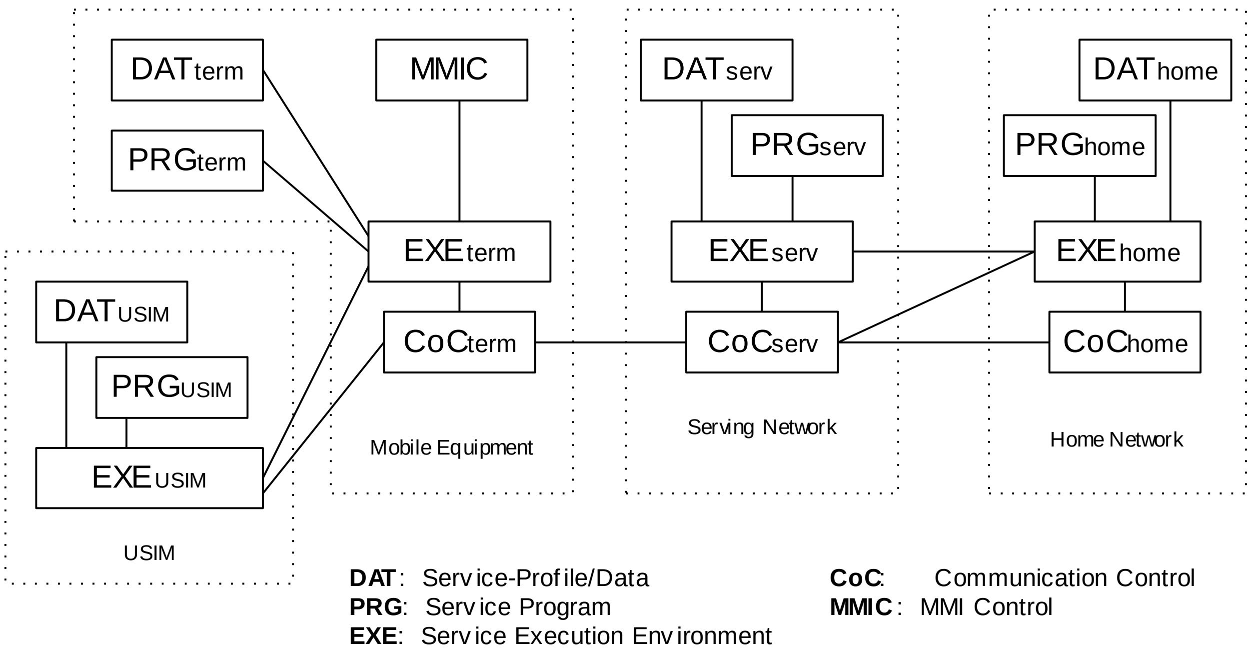


Figure 1: Basic VHE architecture model

The following **functional components** are introduced:

- The Service Program **PRG** describes behaviour of a service and its corresponding service elements by means of (standardised) commands. The behaviour described by the PRG may be standardised, network- or even user-specific.
- The Service Execution Environment **EXE** provides (standardised) platform to execute a service program and provides access to the communication resources. The service execution environment is accessed via (standardised) Application Programmers Interfaces (API), e.g. Java-based. The execution environment also protects the communication control from unauthorised access.
- The Service Profile/Data **DAT** provides user- or network-specific input data to run a service program
- The Communication Control **CoC** handles actual communication (i.e. allocates bearers, handling of SMS, etc.)
- The MMI Control **MMIC** provides network/user-specific control of MMI (triggered by Execution Environment)

The corresponding **network components** are:

- The **ME** (Mobile Equipment) which provides CoC, EXE, DAT, PRG, MMIC
- The **USIM** (User Service Identity Module), which may provide user-specific and probably also home network specific DAT and PRG as well as an EXE
- The **Home Network**, which holds CoC, DAT, PRG as well as EXE

- The **Serving or visited Network**, which holds similar to the home network CoC, EXE, PRG, DAT

The implementation of VHE raises questions such as:

– Which party provides service data DAT?

– Which party provides service program PRG?

– Which execution environment EXE controls the service?

– When do the parties interact (at registration time/during call set-up)?

– Which 'service elements' are essential to create a certain 'home service experience'?

– Which parts of the service program has to be download (complete or only parts) ?

– Which kind of communication and/or synchronisation between different service programs has to be defined?

A key characteristic of the architecture model is that service data and service programs may be stored in a distributed way in the UMTS network (e.g. home network, serving network, ME, USIM). The data and program codes may be transferred in a flexible way in the network (either 'downloaded' or 'pushed', indicated by doted arrows in the following figures) as required by the service provider and/or user. A flexible co-ordination and administration (e.g. validity, update procedures, location, etc) of the transferred programs and data has to be defined to maintain the network.

8.5.2. Possible mechanisms to realise VHE

The following possible solutions for the realisation of VHE were identified, which differ in the "place" where the service execution (service control) is located:

- Service Execution in the Home Network
- Service Execution in the USIM
- Service Execution in the Mobile Equipment
- Service Execution in the Serving Network

The following sections will demonstrate how these identified possibilities could be fulfilled by existing GSM toolkits (e.g. CAMEL, SIM-Toolkit, MExE) and new techniques. They also show how the architecture model is used for the different scenarios and which components are involved.

8.5.3. Service Execution within the Home Network

The service execution within the home network gives the subscriber the possibility to use his own VHE services ('service tunneling') although the serving network might not be able to support the desired service or the storage and execution of the appropriate data. E.g. when using some of the 2nd Generation systems for access to 3G services.

Possible Realisation: Evolved CAMEL/IN supports this mechanism by the use of remote procedure calls (RPC).

Requirements: The integration of packet and circuit switched service is one aspect of UMTS. Therefore also in GPRS a CAMEL control is needed. This integrates GPRS into the VHE concept.

Uses: Support of VHE in non UMTS networks, of GSM CAMEL services in UMTS, of simple Terminals and of supplementary services.

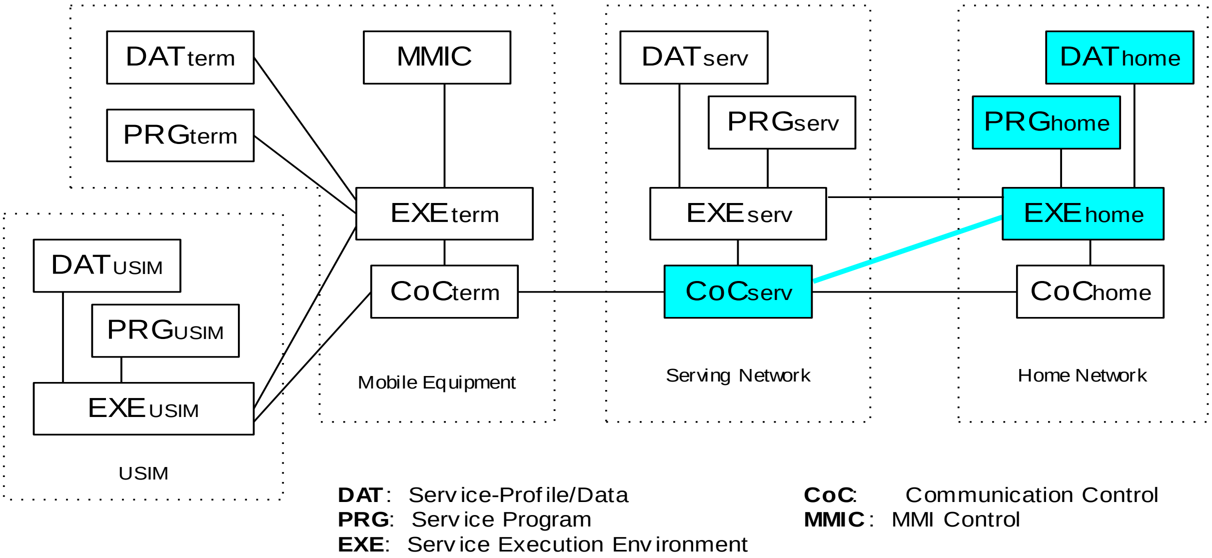


Figure 2: Involved entities (shaded) for service execution in the home network

The service control as specified in CAMEL would be described in terms of the architecture model in the following way: The execution environment of the home network directly interacts with the communication control in the serving network. The corresponding interface (API) of the communication control is either standardised (e.g. to one of the CAMEL phases) or bilaterally agreed between home and serving network. No service program and service data needs to be transferred between home and visited network.

8.5.4. Service Execution within the UMTS Subscriber Identity Module (USIM)

The support of the VHE can be realised by exchange of service related data or service logic from the home network to the USIM. The software is then executed on the IC-Card.

Possible Solutions: Remote Programming, (enhanced) SIM-toolkit, JavaCard

Requirements: A secure and standardized execution environment and API within the USIM is needed. This requirement lead to an open USIM operating system. An electronic certification process by using hash algorithms or encryption techniques can be used to guarantee the source and the quality of the downloaded software. Also the copyright question has to be solved.

Uses: This mechanism can be used for personalised MMI for operator specific services, banking application or update of subscriber data.

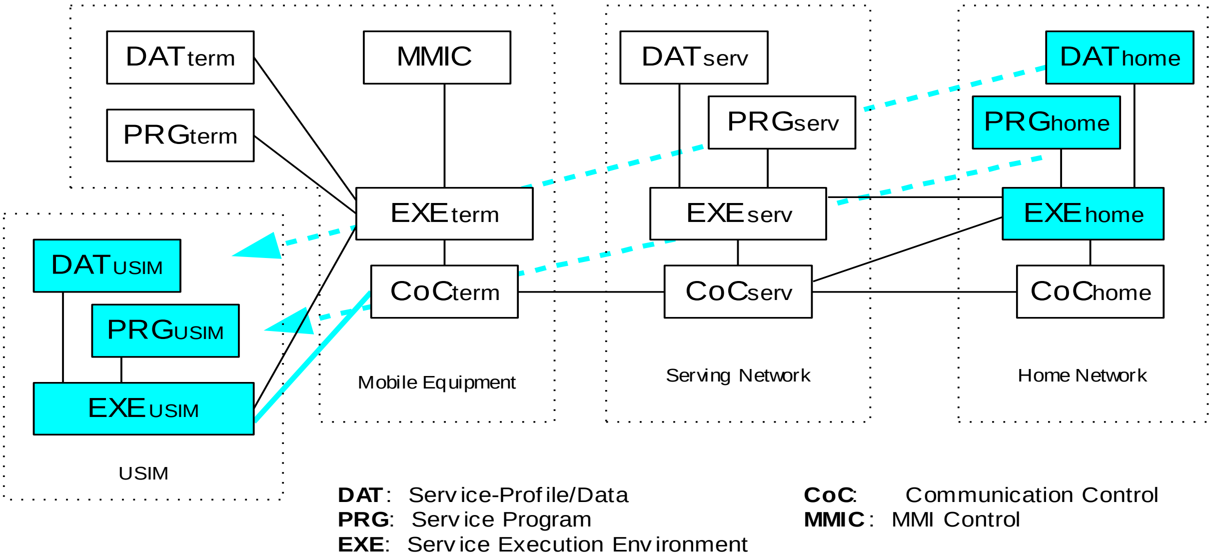


Figure 3: Involved entities (shaded) for the service execution in the USIM

The case of the SIM-toolkit is covered by the capability of the USIM to store service data and programs as well as to provide an execution environment, which interacts with the mobile terminal.

8.5.5. Service Execution within the Mobile Equipment

Similar to the mechanism for the USIM also a download of software into the mobile equipment (ME) can support the VHE. The distinction between two execution environments with different levels of security may be useful: One for the UMTS service provider with larger functionality range and one for value added service providers (VASP) with less functionality but higher security. Functionality and security is meant mainly with respect to the UMTS network and should not limit the range services of the VASP.

Possible Solutions: Remote Programming, Mobile Station Execution Environment (MExE), Wireless Application Protocol (WAP), Suns Java-Technology

Requirements: Similar to the USIM a secure and standardized execution environment and API within the terminal is needed. This requirement lead to an open terminal operating system. Also similar to the USIM requirements an electronic certification process by using hash algorithms or encryption techniques can be used to guarantee the source and the quality of the downloaded software. Also the copyright question has to be solved.

In addition one new aspect has to be considered. ME software could exist which is only operating with a specific USIM enabling adaptation and personalisation of ME functions which are related to a specific subscription and should not be available for another one. In contrast is the Non-USIM related software e.g. codec updates.

Uses: Codec update, firmware update, download of announcements, enhancements of applications in general.

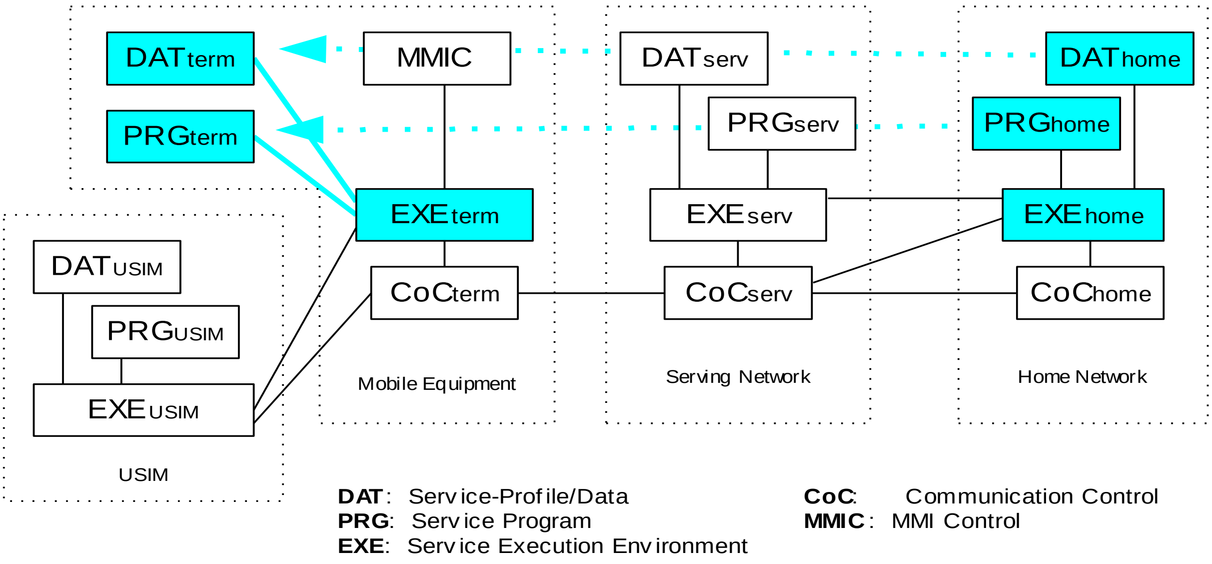


Figure 4: Involved entities (shaded) for the service execution in the Mobile Equipment

The case of a **mobile station execution environment** is covered in the following way: the execution environment in the terminal would use service programs and user specific data provided by the ME or the USIM to interact with the communication control and MMI control. The service program and data may have been downloaded from the home or even serving network.

8.5.6. Service Execution within the Serving Network

Execution of standardized GSM services or dDownload of software into the serving network.

Possible Solutions: Remote Programming

Requirements: Secure and standardized execution environment within the serving network, open system, certification of software, copyrights, secure API. But also a standardized protocol is required for the secure and efficient transfer of the relevant service data across network boundaries.

Uses: Download of announcements, Upload of user data (e.g. from the USIM) into the visited network e.g. the VLR.

8.5.6.1. Service Execution of Standardised Services

For execution of standardised 2nd generation GSM services the existing GSM roaming principles shall be used, which means MSC/VLR services are executed by the serving network.

~~It is not proposed to implement this scenario in the first phase of UMTS. This possibility to realise VHE is only included in the document for completeness and should only be investigated for further phases of UMTS.~~

8.5.6.2. Downloading from the home network to the serving network

This scenario is included for completeness only and is not considered for the first phase of UMTS.

The approach of **downloading of service programs** (e.g. Java programs) between networks would be described by a transfer of service programs and associated service data or only the service programs from the home to the serving network. The execution environment in the serving network uses these downloaded program and data to interact with the communication control. The execution environment needs to be standardised

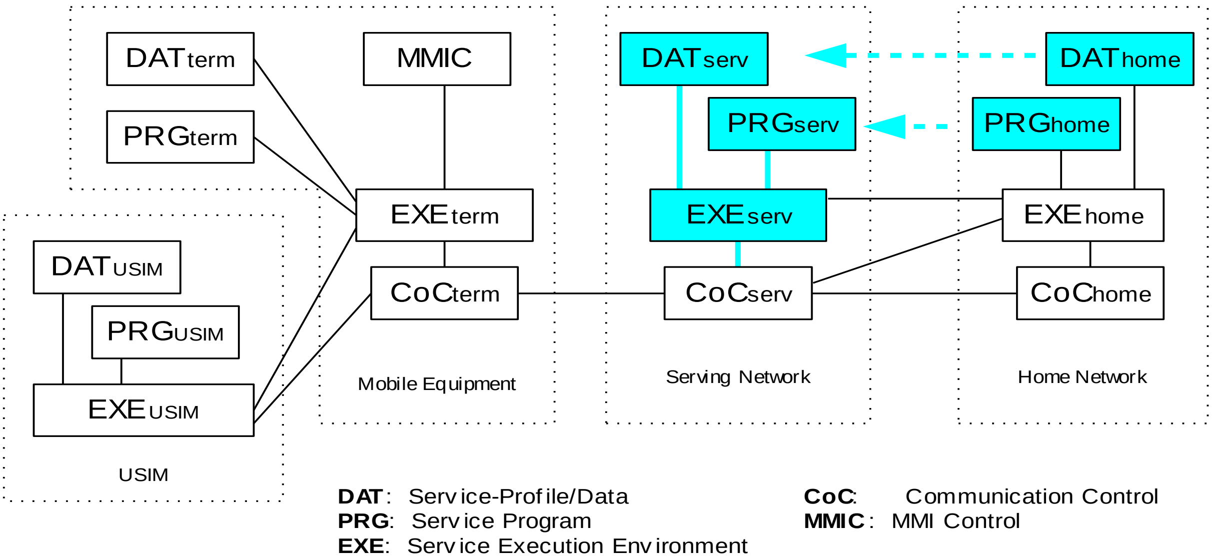


Figure 5: Involved entities (shaded) for the service execution in the serving network by downloading of service program and data from the home network

8.5.6.3. Uploading from the USIM to the serving network

This scenario is included for completeness only and is not considered for the first phase of UMTS.

As an extension of example above, the service data and programs to be run on a the execution environment in the serving network may be stored also in the USIM and **uploaded from the USIM to the serving network**. By doing so, the user may modify the service data and program according to his current needs without needing interaction with his home network.

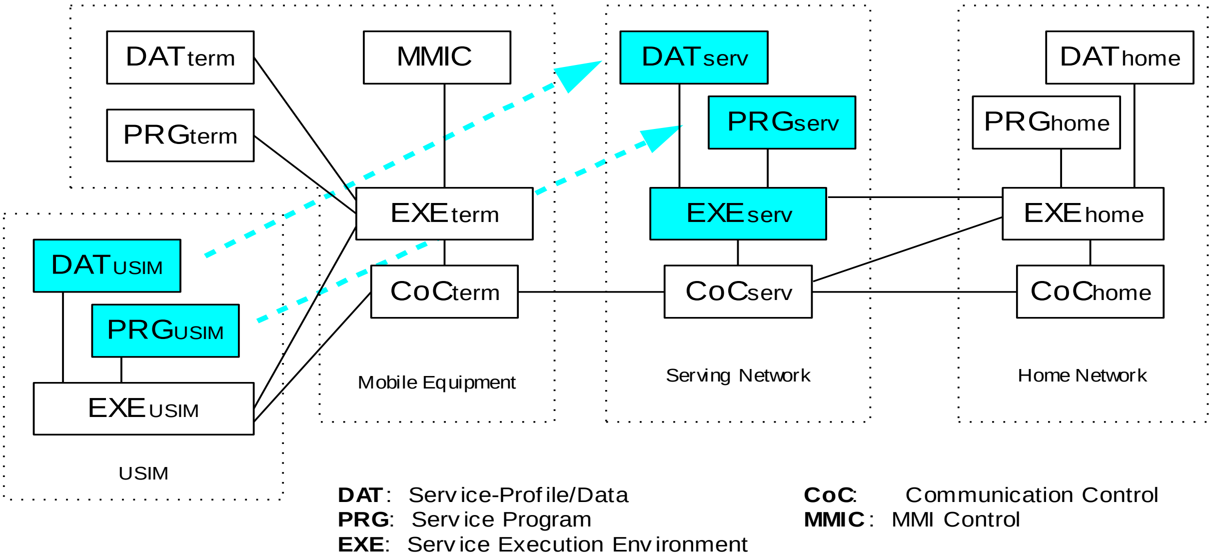


Figure 6: Involved entities (shaded) for the service execution in the serving network by downloading of service program and data from USIM

8.5.6.4. Downloading of user-specific service data from the home network to the serving network

This scenario is included for completeness only and is not considered for the first phase of UMTS.

Another mechanism relies on interaction between execution environments of home and serving network, which also may imply the download of user-specific service data from the home network to the serving network. The actual interaction with the communication control of the serving network will be carried out by the serving network. No program code is exchanged, as the behaviour and input parameters of the services are either standardised or bilaterally agreed between home and serving network.

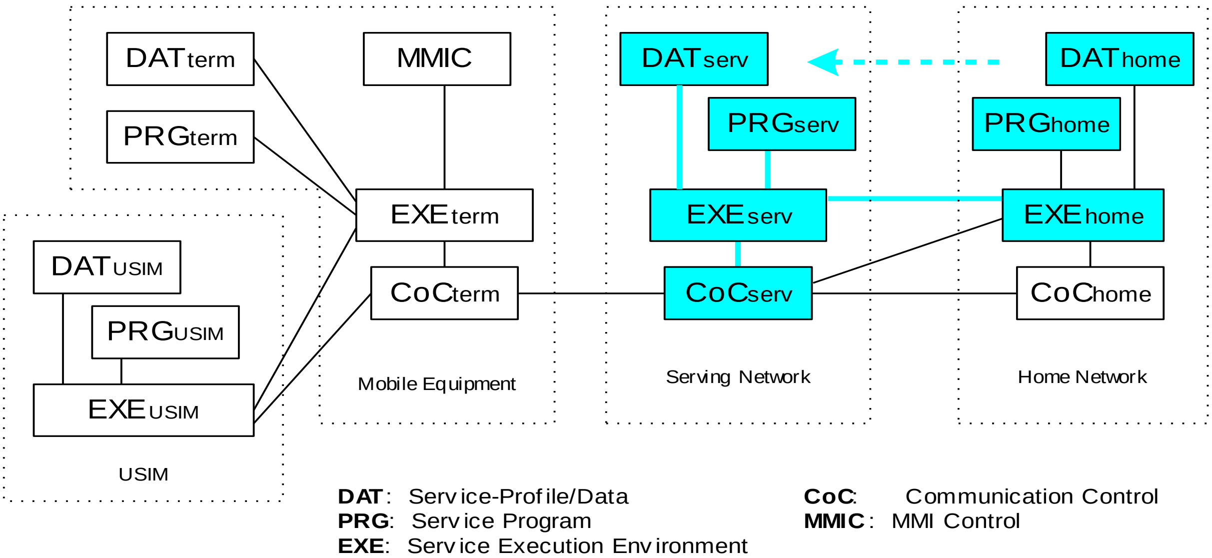


Figure 7: Involved entities (shaded) for the service execution in the serving network by downloading of only data from the home network

8.5.7. Service Differentiation

8.5.7.1. Flexible Teleservices

<< Comments are needed on the extent to which such a network could address the concepts of flexible teleservices defined in the requirements for UMTS. One question raised by this is whether the teleservices would be entirely implemented end-to-end and would therefore be transparent to the UMTS network, or whether they would be implemented in a different way over the radio interface requiring an interworking unit in the UMTS network.>>

8.5.7.2. Flexible Value Added Services and Supplementary Services

By the time of deployment of UMTS phase 1 all the existing phase 2+ GSM service capabilities (SIM toolkit, CAMEL and MS API) will have evolved considerably from today's versions. To meet the ambitious objectives of UMTS for flexible service creation a range of techniques will need to be made available. For example, any service requiring handling of the not-reachable condition will need a network-based component. Any service requiring MMI interaction with the user will require an MS-based component.

The environment for value-added and supplementary services in the phase 1 UMTS network will therefore consist of evolved versions of the existing GSM tools. These tools can be used individually, but will be most effective if they are used co-operatively (e.g. if a service implemented using CAMEL is provided with an MMI implemented using the MEXE).

The range of applicability of the various techniques is suggested below:

- SIM Toolkit: The SIM Toolkit could be extended to manipulate the call handling functions internally within the terminal, communicating with the Home Network only to update the information/service logic within the terminal. By allowing the Service Provider (who owns the Home Network and USIM card) to update the Home Network and the USIM card, more flexibility in the creation of services can be obtained. This functionality could be introduced to augment the existing GSM features, thus allowing a smooth migration of services over to the new architecture while continuing to provide existing services for older mobiles.

  This requires a robust, efficient core network on which to build. The functions provided by the network include security (authentication, encryption), charging and billing, and addressing.

- MEXE: The MEXE provides similar capabilities to those that may be available from an enhanced SIM toolkit, and the synergy between these features should be exploited. MEXE may applied in cases where the capabilities of the SIM on its own, or limitations of the SIM-ME interface mean it is not feasible to implement the service by relying on the SIM.

- CAMEL: CAMEL primarily provides support for call routing and call handling services. The CAMEL approach is required if services are to operate when a mobile station is switched-off or out of coverage. CAMEL is also beneficial when a service requires access to a large, frequently updated database (e.g. for VPN or freephone services), or if it is required to optimise the use of bandwidth on the radio interface (e.g. to avoid having to present two calls over the access interface to implement a call waiting service).

8.5.7.3. Standardised Supplementary Services

The extent to which standardised supplementary services continue to exist in a phase 1 UMTS network is an important issue. The UMTS requirements for flexible service support suggest the objective should be to eliminate standardised supplementary services. However, this would force GSM operators to migrate many existing features (e.g. voice mail) from simple standardised services to implementations based on CAMEL, SIM toolkit or MEXE. It also has impacts on the efficiency of the network.

One approach is to:

- Minimise the extent to which new standardised GSM services are created, and instead prefer solutions in GSM that implement new services though "toolkits"
- Minimise linkage between standardised services and the toolkits so that features implemented using the toolkits are self-contained and will remain useful when standardised services are removed.

8.6. Mobility Support

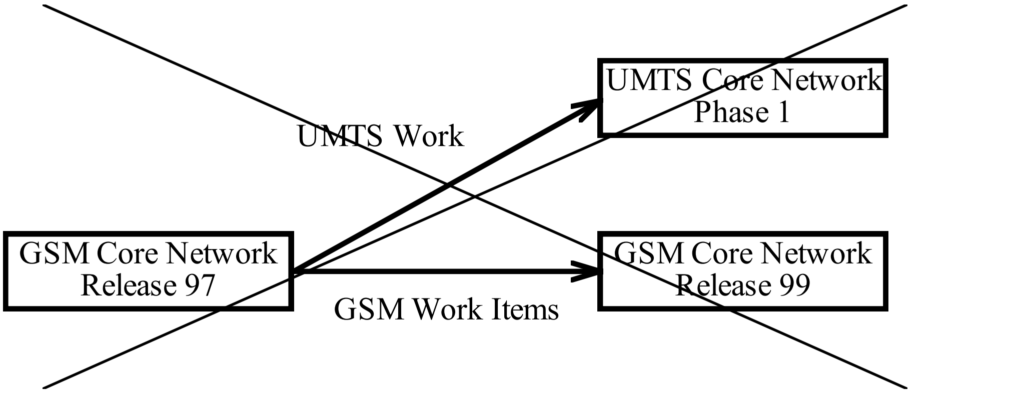
The possibility of combining different mobility handling systems should be considered. MAP, as being a widely spread protocol would form the basis for mobility handling in the evolution scenarios, but the combination of different mobility handling systems should be supported. As an example, the use of MobileIP, as a means to support discrete mobility, in combination with MAP subscriber handling, authorisation etc should be supported. In that case Mobile IP would be used to handle discrete mobility in between access networks, whereas GSM/GPRS would be used for handling of subscriber data, charging mechanisms etc. Thus, Mobile IP would handle roaming and possibly handover between radio access networks (UTRANs), whereas the GPRS SGSN node –enhanced to include also some IP functionality – would be used for mechanisms such as authorisation and handling of encryption keys.

9. Evolution Scenarios

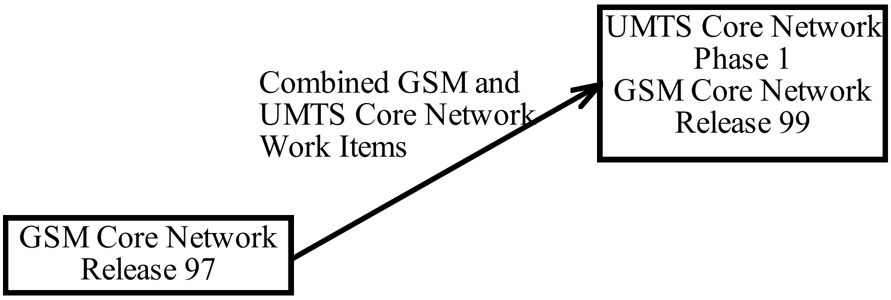
The UMTS phase 1 network is planned as a direct evolution of the GSM core network. This implies that:

- the evolution takes account of both GSM and UMTS requirements,
- the modifications to GSM to create UMTS phase 1 should be limited to changes targeted at specific service and performance objectives.

These objectives can be achieved by creating a common stream of work items for both UMTS and GSM core networks. This is illustrated in Figure 82:



Divergence between GSM Core Network and UMTS Phase 1 is to be Avoided



Common Work Items Create Convergence

Figure 8~~1~~ Common Work Items Convergence

In the following scenarios show possible evolution paths from GSM towards UMTS.

9.1. UMTS PHASE 1

9.1.1. Scenario 1

The starting point in 2002: UMTS Phase 1

When UMTS Phase 1 will be ready for operation in 2002 it is very likely that the UMTS Terrestrial Access Network (UTRAN) will be interconnected with the GSM NSS. This is at least true for a scenario where the initial deployment of UTRAN will cover isolated islands (e.g. city centres, business areas, industrial plants, etc) while the overall (international) coverage will be provided by the GSM2+ infrastructure. This situation is given in figure 9~~1~~.

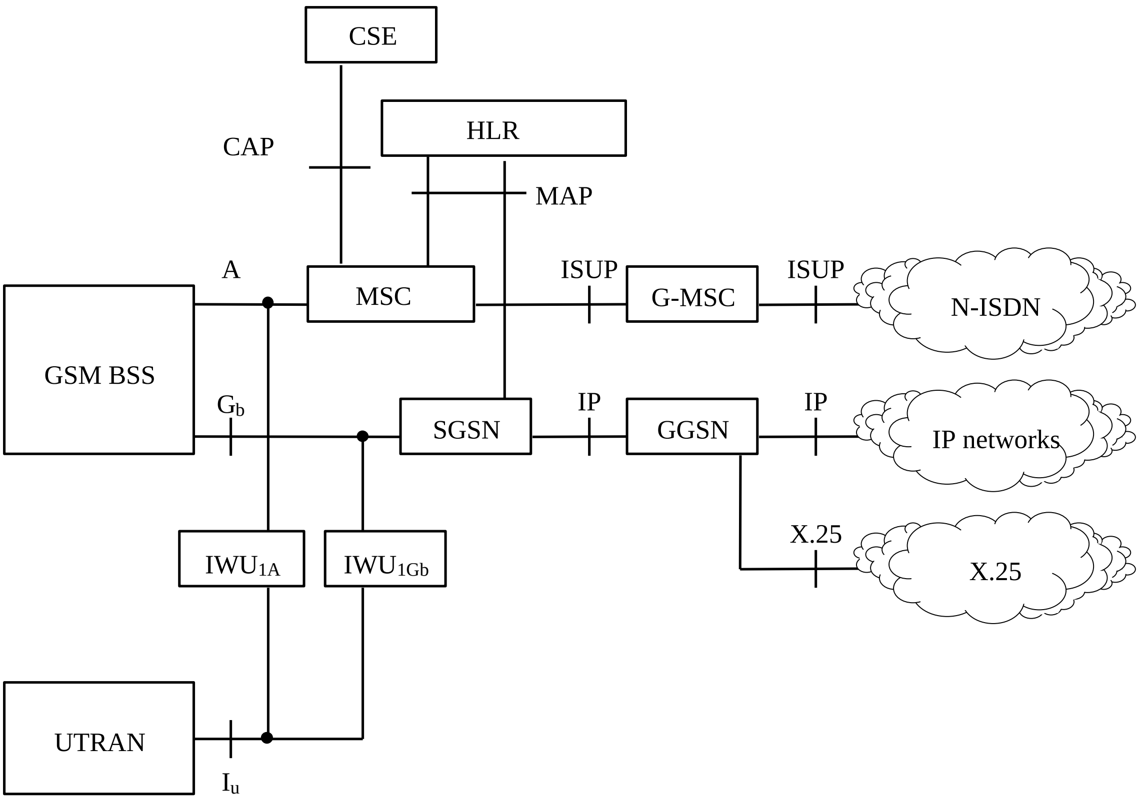


Figure 92: Interconnection of UMTS AN and GSM NSS via IWUs

9.1.1.1. Scenario 1 Opportunities

The approach depicted in figures 92 show the use of GSM and GPRS specific Interworking Units (IWU) used to connect the UTRAN to the GSM/GPRS network.

The use of the UTRAN enables access to the broadband UMTS radio interface and offers a step towards network support of the full UMTS variable bit rate, asymmetric, multimedia capability.

As illustrated in figures 91, UMTS users have broadband radio access to the IP-world for both the Internet and intranets via the GPRS nodes but will be limited to contemporary and developing GSM core network delivered capabilities.

9.1.1.1.1. Scenario 1 Multimedia Support

The ability to provide real multimedia including different logical bearer for different media components, dynamic bearer release/re-negotiation etc may be supported in a limited fashion by the existing circuit switched GSM NSS or packet based GPRS nodes but developments are expected to realise the full potential.

9.1.1.1.1.1. Multimedia Over Circuit Switched GSM NSS

The GSM MSC would need significant development to support the 'real time' variable bit rate multi-media UMTS requirements but limited support is possible, it should be noted that although the circuit switched side of GSM NSS does not currently provide multiple bearers for different multimedia components, single bearer multimedia where different multimedia components are multiplexed to one bearer can be used in GSM NSS. An example of such specification is ITU-T recommendation H.324, which has been enhanced according to requirements of Mobile Networks. The recommendation specifies terminals which may carry real-time voice, data, and video, or any combination, including videotelephony and is also capable for multipoint configurations and dynamic addition and deletion of media components inside the bearer.

The single bearer would have fixed bit rate. Voice and data would have the priority and video would get what is left of the bandwidth. However, it could be possible to upgrade and downgrade the bearer depending on the required bandwidth and the radio conditions. The efficiency of the channel coding in single bearer multimedia is still for further study.

The effect of multiple bearers might be possible to get by using multiple calls from the same terminal. This could be used for media components which do not have any timing dependency or requirement for synchronisation.

9.1.1.1.1.2. Multimedia Over GPRS

The combination of UTRAN and GPRS offers a broadband radio access to the IP-world for both the Internet and intranets. The UTRAN can offer bearers fulfilling the multimedia requirements. It could be possible to evolve GPRS to be able to utilise the QoS levels provided by UTRAN. It could also be possible to use e.g. RSVP to guarantee the QoS inside the GPRS network and IP network to enable end-to-end high quality connection.

The access to internet makes it possible to use wide range of IP based multimedia applications. For example videotelephony over internet would be possible by using applications conforming to ITU-T recommendation H.323.

As stated there are a number of possibilities to ensure that GPRS meets the requirements of UMTS. The service and capability limitations created by the use of the Gbu to Iu interworking function need to be identified.

9.1.1.1.2. Multimedia support - Open Issues

There is still the problem how to handle multimedia including different logical bearer for different media components, dynamic bearer release/re-negotiation etc.

9.1.1.1.3. Scenario 1 Mobility support

When considering the opportunities and limitations applied to interfacing a UMTS UTRAN to the GSM NSS then serious considerations should also be given to the mobility requirements as well name:

- Location updating (routing area update GPRS)
- Paging
- Attach/Detach
- Handover

These requirements span the boundary between the UTRAN and GSM NSS with developments in one side impacting on the other. A good example is handover. For the GPRS part, this seems not to be an issue as handover is more a form of re-registration rather than an interface change. For the GSM circuit switched interconnect to the UTRAN then it is a very different matter. The forms of handover for the UMTS have not yet been finalised but factors such as forwards, backwards, soft handovers are all options.

Interconnection of the UTRAN to the GSM NSS would severely limit the applicability of these, unless dramatic changes were made to the GSM MSC as well.

It is imperative therefore that both service and mobility requirements that span the core and the access are considered when developing the UTRAN to GSM NSS evolution aspects.

9.1.1.2. Scenario 1 Related Actions

For the interconnections shown in figures 91 and 2, the necessary modifications to the A and G_b interfaces needs to be identified and specified as does the developments needed to provide the required functionality of the IWUs to make operations in 2002 happen. The Gbu developments and differences to the Iu also need to be identified. These developments are completely in line with the UMTS Phase 1 as described in the UMTS Baseline document [UMTS 30.01v3.0.0].

It is still to decide whether it is desirable to upgrade the A/Gb interfaces inside GSM so that the GSM NSS-BSS interconnection could also benefit from the modifications needed for these interfaces when UTRAN is deployed.

Note: It needs to be checked whether G_b can provide at least services as proposed/requested by MPEG [SMG3 97S161] to efficiently provide multimedia services.

9.1.2. Scenario 2

The Gb interface has been tailored to transparently transport IP datagrams in efficient way to a GSM BSS and subsequently to a GSM terminal making a particular use of the GSM air interface.

It is possible that UTRAN, which needs to support packet oriented services in efficient way, couldn't easily be adapted to the Gb interface.

It is likely that the UMTS BSS could include IP routing functionalities, being able to directly use the networking capabilities offered by the IP protocol (or its evolution) in order to perform packet routing inside the Access Network.

For these reasons, it could be reasonable to consider an alternative approach, opening a new interface (a Gbu interface using IP as network layer) in the SGSN in order to allow an IP-based dialogue with the UTRAN.

Fig.103 shows the network architecture corresponding to the second approach.

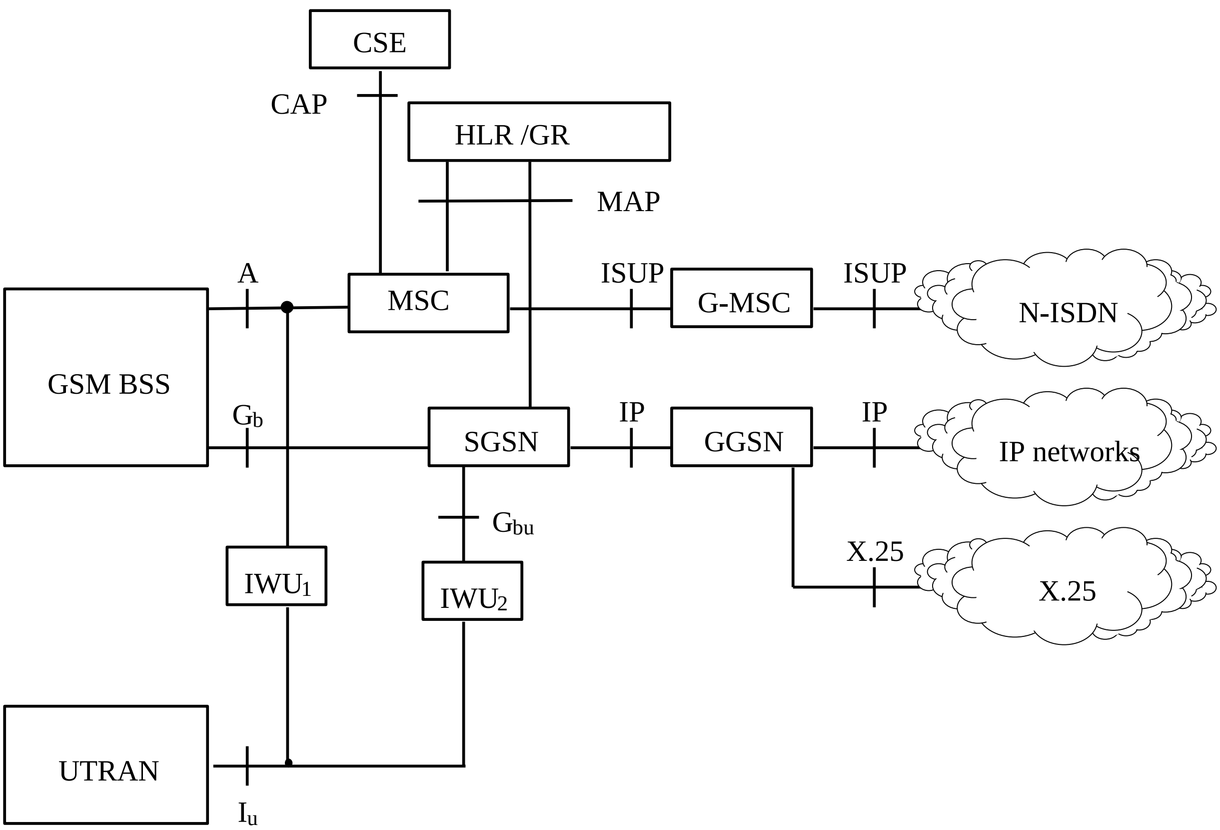


Figure 103: Interconnection of UMTS AN and GSM NSS via IWUs using the Gbu interface

9.1.2.1. Scenario 2 Opportunities

9.2. UMTS Network Evolution

9.2.1. Scenario 3:

Introduction of a UMTS Core Network

In order to provide real multimedia opportunities for the UMTS customers, the UMTS CN will be deployed (see figure 114). It will provide the separation of transport (e.g. transmission and switching) and services (e.g. mobility, service intelligence). Additionally it will offer advanced and integrated service control and management by service intelligence which will then be available in both the telecommunication's (e.g. using developments of MAP, INAP, ISUP) and the information technology's world (e.g. using developments of CORBA, TINA).

However, the UTRAN remain connected to the GSM NSS via IWUs. It is reminded that these IWUs do not serve as interconnection units between the GSM BSS and the UMTS CN.

The URAN and the UMTS core network will provide a number of bearers that differ in flexibility and offer different capabilities. The bearers provided by UMTS core network will be independent of radio environments, radio interface technology and fixed wire transmission systems. Further, UMTS core networks shall be capable of providing a specified core set of service capabilities.

The core set of capabilities of the UMTS core network are accessed through a service platform that provides interfaces (to network operators and service providers) appropriate for the support, creation and control of supplementary services, teleservices and user applications. The service platform will also provide interfaces enabling subscribers to control supplementary services, teleservices and user applications.

It is seen sufficient to rely on the mobility services already provided by GSM2+ and to expand them as necessary. This will give customers easy access to the worldwide mobility offered by GSM's roaming mechanisms and exploit fully the capabilities of UMTS services based on the same mobility management.

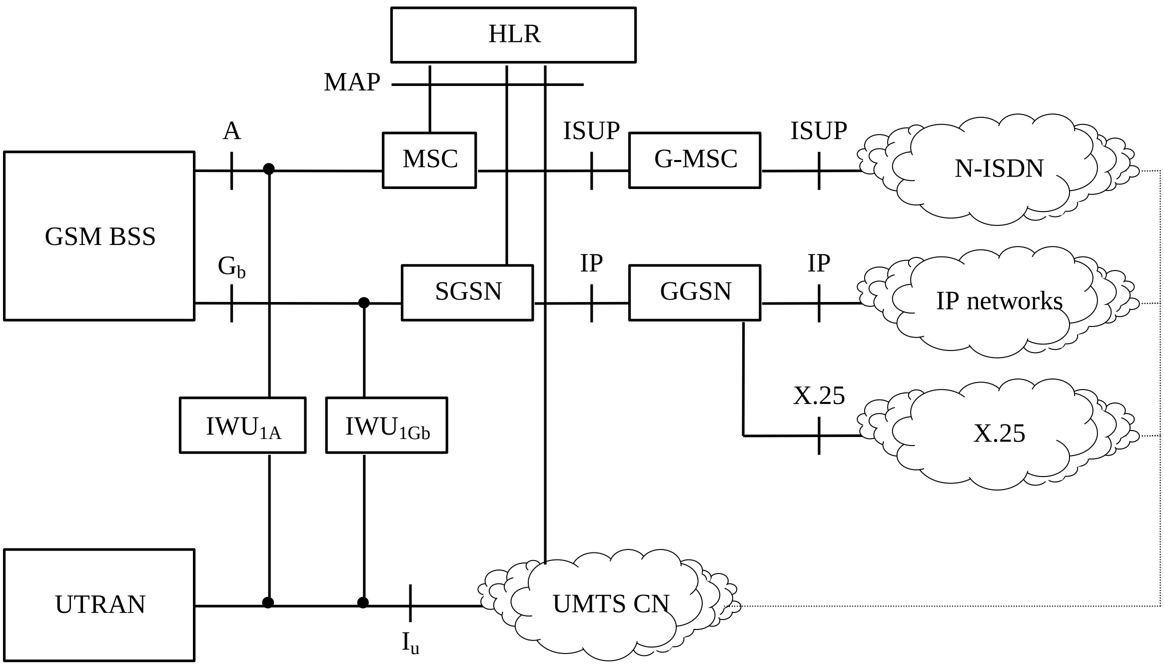


Figure 114: Introduction of a UMTS Core Network

Editors note: A variation on this theme (introduced in TDOC 98S133 is shown below), the minutes specify a new scenario

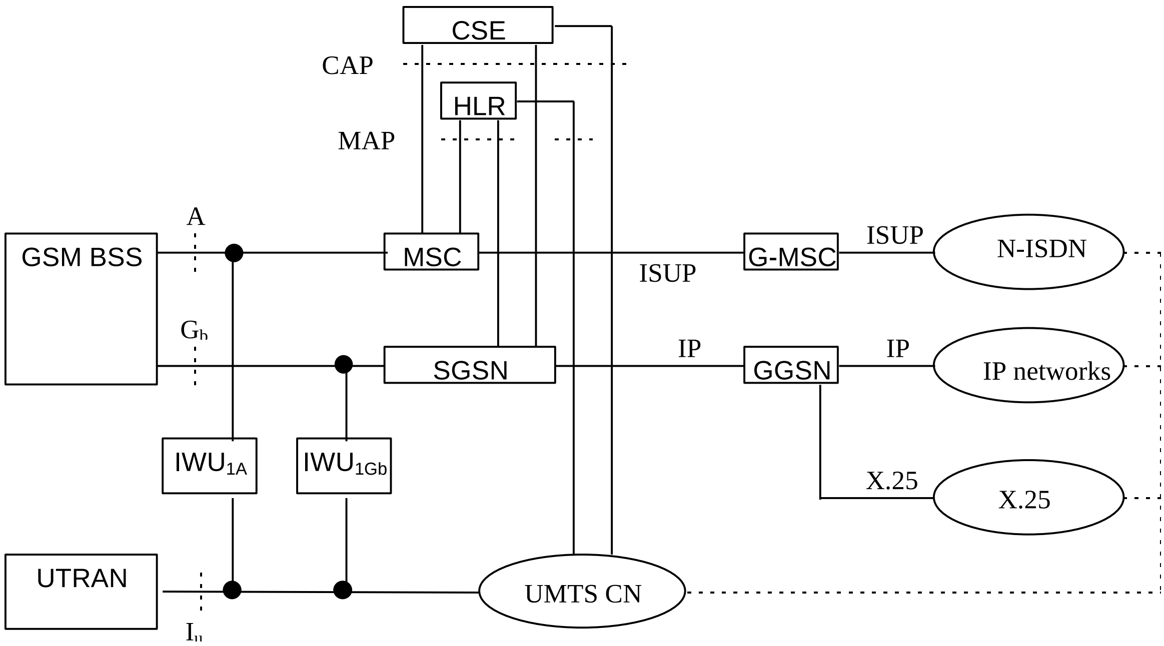


Fig 125

9.2.1.1. Scenario 3 Opportunities

The UMTS Core Network provides the complete set of UMTS services. It is connected to the UTRAN via the I_u, i.e. without an interworking unit.

The advanced Multimedia capabilities will make sure that these services will most efficiently transferred. Furthermore, the capabilities of the UMTS CN will ensure easy and flexible service creation, management, control and execution. It is highly desirable to integrate the services with TMN/O&M in order to offer operators and service providers an easy and efficient way of operations.

9.2.1.2. Scenario 3 Related Actions

The internal structure of the UMTS CN still needs to be defined. It should take into account the separation of transport (e.g. transmission and switching) and services (e.g. mobility, service intelligence) on the one hand and the integration of TMN/O&M with the service intelligence on the other hand.

Guidance from MoU GSM 3GIG should be sought [TG.3x].

9.2.1.2.1. Service Differentiation

9.2.1.2.2. Flexible Teleservices

<< Text needed>>

9.2.1.2.3. Flexible Value Added and Supplementary Services

In the UMTS phase 2 network extensive tools will exist to create value added and supplementary services. The mechanisms will reflect the prevailing technical approaches at that time. The end-systems will play a key role in service creation. Evolving the co-operative approach to service deployment described in UMTS phase 1, many applications will be distributed between the terminal and the network.

It is possible that application of tools from information technology (e.g. CORBA) will make the distribution of data and logic largely transparent from the application designer’s perspective. This implies a blurring of the distinction between network-based and terminal-based services. However, in the mobile wireless environment special techniques may be required to take account of the unreliability of the radio interface and the relatively high cost of data transmission.

Reflecting the introduction of techniques such as CORBA the key interface for CAMEL may change from the interface between the SSF and the SCF to the interface between the SCF and SDF.

9.2.1.2.4. Standardised Supplementary Services

In UMTS phase 2 it is anticipated that all standardised supplementary services and network features (e.g. ODB) are eliminated. All features are built from toolkits.

9.2.2. Scenario 4

Scenario 4: 3G MSC/VLR and 3G SGSN

~~*(Orignal source Tdoc 98s277*~~

GSM core network will evolve to meet new requirements due to UMTS. The figure below illustrates a scenario where GSM core network has evolved so that it provides Iu interface. The evolved GSM network elements are referred to as 3G MSC and 3G SGSN.

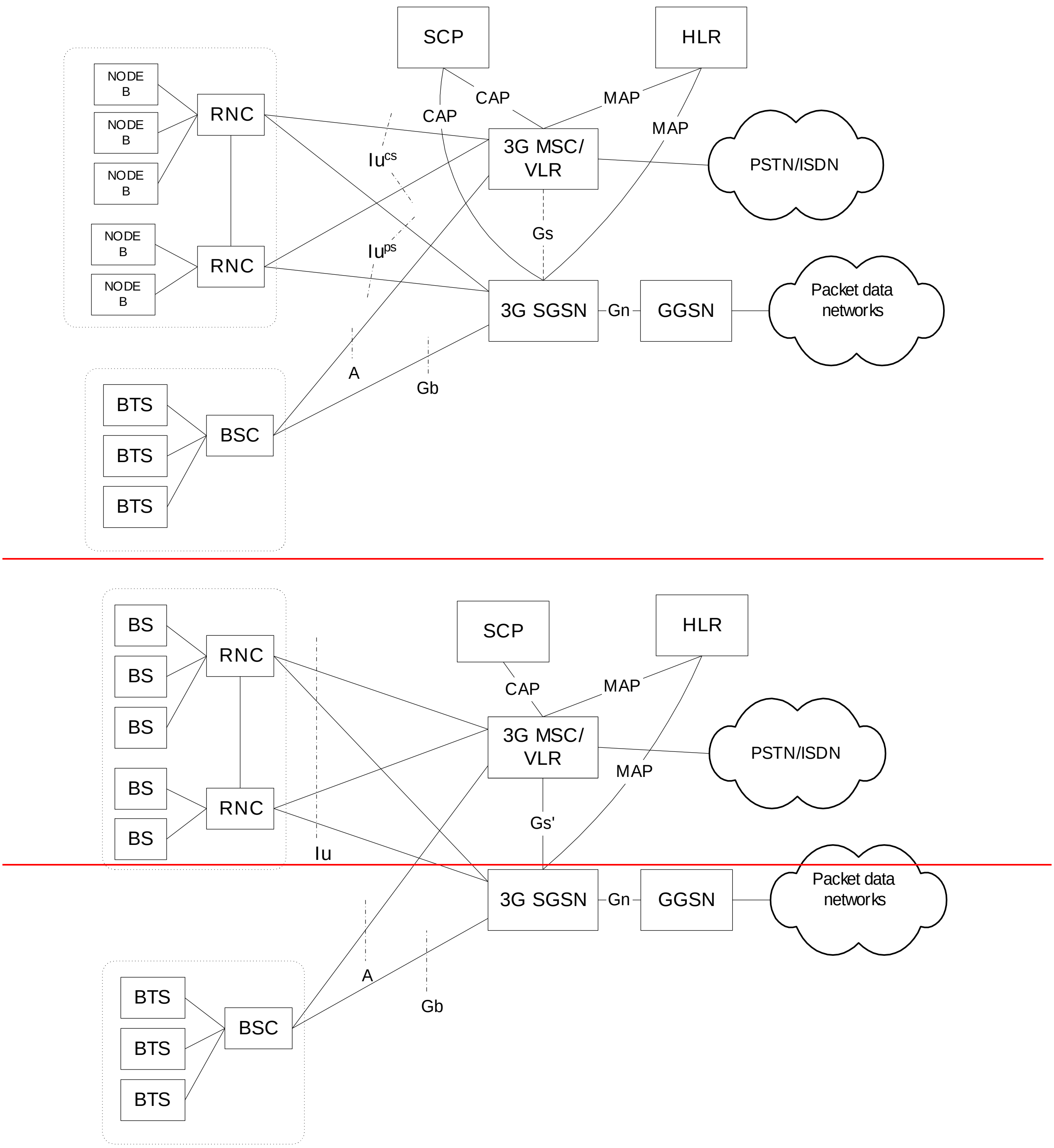


Figure 13~~6~~. One possible scenario where URAN is connected to an evolutionary GSM core network; 3G MSC/VLR and 3G SGSN provide Iu interface.

The main characteristic of this architecture is that there still exist two logically separate network elements, 3G MSC and 3G SGSN, providing interworking with circuit switched and packet switched networks, respectively. This separation shall be taken as a requirement when specifying the Iu interface, UTRAN functionalities, and mobility management. The logical separation greatly benefits backwards compatibility with 2G GSM/GPRS, including both interworking with A and Gb interfaces as well as handovers between UMTS and GSM. Moreover, it allows more flexibility in network design and dimensioning when the amounts of circuit switched (via 3G MSC) and packet switched (via 3G SGSN and GGSN) traffic change over time.

In the separated architecture the Iu interface has two embodiments: Iu^{cs} for 3G MSC and circuit switched services and Iu^{ps} for 3G SGSN and packet switched services. The lower layers and RNC - 3GMSC/3GSGSN signalling of the Iu may be identical in both variations. However, the MS - 3GMSC/3GSGSN signalling (e.g. call/session control) transferred transparently over the Iu may be different.

Of course, the logical separation does not prevent vendors from implementing 3G MSC and 3G SGSN in the same physical network element. It is for further study in the UMTS mobility management work whether procedures such as location update can be designed to provide optimization benefits in situations where the actual implementation is an integrated one.

The possibility of separated or integrated architecture implementation choice applies to both UMTS phases 1 and 2. However, any optimisation relating to e.g. mobility management is probably not achieved until in phase 2.

This architecture may be preceded by e.g. a phase 1 architecture presented in scenario 1 where interworking units convert Iu to A and Gb interfaces. The conversion to standard A and Gb restricts the services offered by the network to those provided by A and Gb interfaces, however they may evolve. The direct access to Iu interface gives access to all the capabilities of the UTRAN.

The Iu transport is likely to be ATM. For the core network transport (e.g. MSC-MSC, SGSN-GGSN connections) ATM is an option. The selection of core network transport technology is an implementation issue. For example, at first the 3G MSC can be based on hybrid ATM/TDM switching, where ATM is at Iu interface and TDM and STM at the core network.

9.2.2.1. 3G Mobility Management

Separate 3G MSC/VLR and 3G SGSN have their own independent mobility management functions. However, the packet side MM functions can be harmonised towards the GSM circuit side MM functions. For example, from CN point of view for both the circuit and packet side two MM states (idle and active) would be sufficient. The UTRAN can hide the standby mode and also cell level knowledge about the MS location during MM active state in either or both CN entities.

Either there is no Gs interface at all between 3G MSC and 3G SGSN or the functionality of the Gs interface is limited to e.g. only combined location updates. The concurrent services can be provided by the UTRAN. When

going to active mode the RNC can be given an identifier (e.g. IMSI) which is used to combine circuit and packet services in the RAN.

~~In this scenario MSC still provides interworking with ISDN, but is capable of handling multiple simultaneous calls from/to same mobile terminal. The 3G SGSN has evolved to take full advantage of the 3G RAN and Iu interface.~~

~~The interface between 3G MSC and 3G SGSN, Gs', is an evolved version of the corresponding Gs interface in GSM phase 2+.It provides improved coordination of packet switched and circuit switched services and facilitates possible implementation of 3G MSC and 3G SGSN in a same network element by equipment vendors.~~

~~GSM BSS can be connected directly to the 3G network elements through A and Gb interfaces for the access of GSM 2+ services.~~

9.2.3. Scenario 5

Scenario 5 Integration of circuit and packet switched transport in the UMTS network

{Source Tdoc98S297}

The UMTS starting architecture shown in Fig.~~2~~92 and Fig.~~3~~103 of 23.20 would allow to access a wide range of data services; in particular it ~~wouldl~~would make possible to have an efficient packet-based access to the Internet on a mobile terminal.

Some problems could anyway be highlighted if considering the merging of GSM and current standardisation of GPRS the target for UMTS deployment.

If market forecasts depicting for next years a tremendous increase of data transfer volume are realistic, during the next decade we will probably witness a communication environments where common people are Internet users, where the exchange of e-mails on mobile terminal is no longer a privilege of IT-skilled people and where video, pictures and graphics are a substantial part of the information we exchange, information retrieval from a remote database is the normal way to solve everyday problems.

In such a scenario where the growth of IP will probably play a substantial role, the evolution of the IP-based technology will allow an efficient support of multi-media applications (music and sounds, voice, video, electronic blackboard etc..), the Internet Protocol being no longer used for best effort services like WWW surfing, but also for different QoS, sophisticated applications.

Nevertheless, it is nowadays impossible to have an exact evaluation of how fast the Internet community will reach the goal of the efficient support of real-time services over IP; technologies like Layer 3 Switching and “band reservation” policies on links shared by different applications seem to be promising but is difficult to predict when the technology will be proven enough to allow voice transmission over a geographical IP network.

At the same time the basic telephony services will probably continue being the main source of revenues for operators during next years making the scenario where all services are migrated over the packet switched part of the mobile network quite unrealistic in a short term view.

In other words, while it is quite easy to predict a scenario where the volume of data traffic transferred in a mobile network is largely bigger than the traffic volume due to voice traffic, it is pretty difficult to predict when this overtaking will be completed during next years.

It is much more likely that circuit-oriented services and packet-oriented services will coexist at least during first years of UMTS deployment.

In the following some arguments supporting a solution where packet oriented transport and circuit oriented transport are integrated in a common transport platform are given.

- If PCM-based GSM networks and packet-based GPRS networks will be maintained separated, network operators will be called to guess what the request for packet oriented services could be and try to dimension the packet network based on future market demands. A possible way out from this undesired perspective is starting a real integration of GPRS and GSM as a target for the evolution of both networks; the realisation of a common platform supporting both packet and circuit networks is a possible way to migrate in the future the traffic load from one technology to the second one, according to market needs.

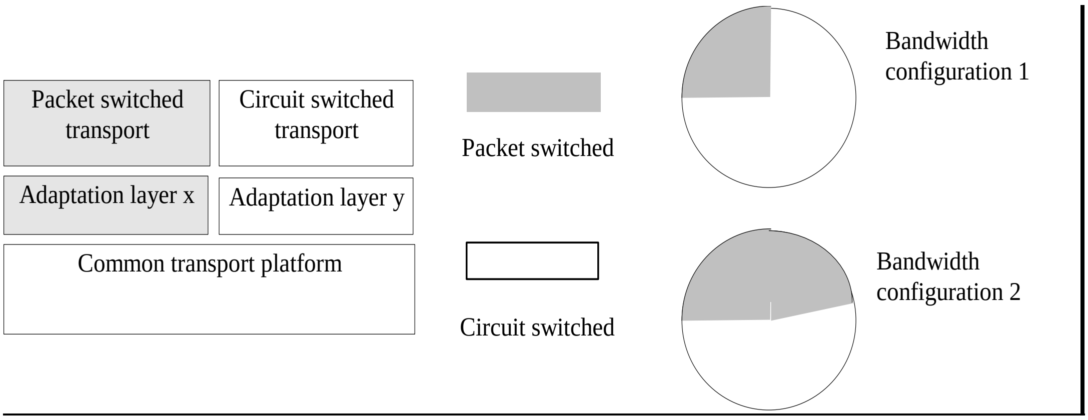


Fig 147

The presence of a common transport platform as the target for UMTS transport would allow to assign the band offered by the "common platform" on demand according to market needs; the flexible allocation of bandwidth could be used to re-assign the terrestrial resources on demand when needed or depending on peak hours on a daily basis.

- The same scenario would allow in the future to easily migrate services from the circuit-switched platform to the packet switched one (and even the opposite if needed), as soon as the evolution of packet network will offer the same performances in terms of delay and jitter. This way this integrated solution would pave the way for a scenario where all user traffic and signalling is carried by the packet network (as expected by many telecommunications gurus) allowing at same time to keep alive circuit switched services and applications as long as desired.

- An integrated circuit and packet transport is certainly a good step in the direction of GSM and GPRS services co-ordination; possible solutions in this sense could arise from:

    1. make circuit and packet data flows cross the network through the same nodes, where some flow-control and re-synchronisation could be performed
    2. make the packet-switched control acting as a slave and circuit-switchedswictched control as a master (or vice-versa) in order to co-ordinate bearers for the achievement of a common service
    3. pursue the evolutionary target of a signalling architecture common to both circuit and packet networks; the last one being probably the best candidate for the support of this particular kind of data exchange.

9.2.4. Scenario 6

Scenario 6 UMTS core network based on ATM

The UMTS core network will as evolution dictates re-use of GSM protocols where appropriate. It is likely that ATM will play an important role. The benefits of ATM include statistical multiplexing, variable bandwidth and support for different QoS requirements. In particular support of AAL2 and AAL5 by the UMTS core network will allow simultaneous handling of voice, data and signalling over flexible bearers. The use of an ATM switch fabric will require the use of protocol adaptors for connection to packet and ISDN circuit switched. Figure 8 shows a model of the UMTS core components. No physical implementation should be taken from this model. Indeed the packet handler and IP router can be considered to be similar in functionality to the SGSN and GGSN in GPRS, these could be physically mounted within a 'UMTS MSC' or external.

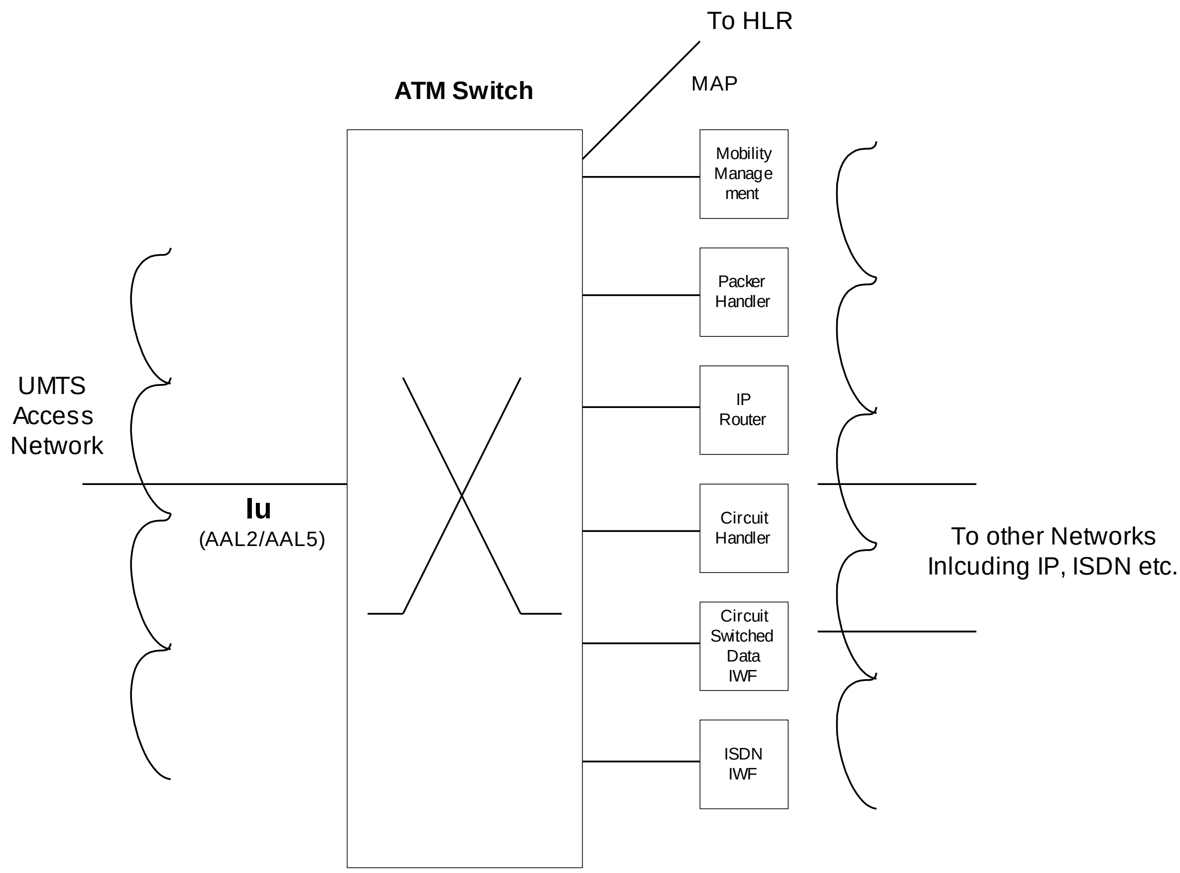


Figure 158 UMTS Core based on ATM

The present regime of attempting to evolve GPRS and GSM simultaneously or even separately could lead to divergent networks. In particular the current scheme leaves mobility handled in two different locations. Possible solutions to this are :

- The Gs interface could be used to try to integrate the mobility for both packet and circuit switched voice call, perhaps allowing a tighter coupling between SGSN and MSCs.
- A new network element UMTS MSC could be created based on both GPRS and MSC.
- Improve the QoS of GPRS such that voice could be handled by GPRS

The first solution has probably the best evolution potential but based on the fact that both GPRS and GSM MSC will eventually change to handle UMTS efficiently, the second solution has credibility as it could be implemented in such a way so as to allow complete backward compatibility with GSM. The third solution can be thought of as the packet solution paving the way for Voice over IP services. At present there are a number of issues which would need to be solved including QoS, support of supplementary services, Camel etc.

Taking into consideration the present timeline for introduction of UMTS, it is likely that the first stage of the introductio n of UMTS into an existing GSM network will be connecting the UTRAN to existing GSM core networks (GPRS is not explicitly shown as no operators at present have deployed GPRS nor will all operators necessary deploy GPRS).

In this initial scenario the UTRAN will probably be limited to the services given by an existing GSM network due to the constraints of the core network but this will depend on the service deployment by operators. But this will enable the operator to have a chance to verify the UTRAN and the third generation air interface using the GSM core as a known reference. In the longer term, evolution of the GSM core is required to realise the potential of the UTRAN. The stage 2 depicts the evolved GSM or UMTS core network

Note: the UMTS core network is also shown here as supporting GSM. Roll out of GSM equipment does not stop due to the introduction of UMTS, hence it may be interesting for an operator faced with three different core network architectures (GPRS,GSM and UMTS) to have the option of one core network. For this to be feasible th e protocols and procedures developed for UMTS should take into account backward compatibility with GSM, hence mobility management will be based on GSM map, call control will be based on 04.08 CM and session management concepts from GPRS will be re-used. IE:

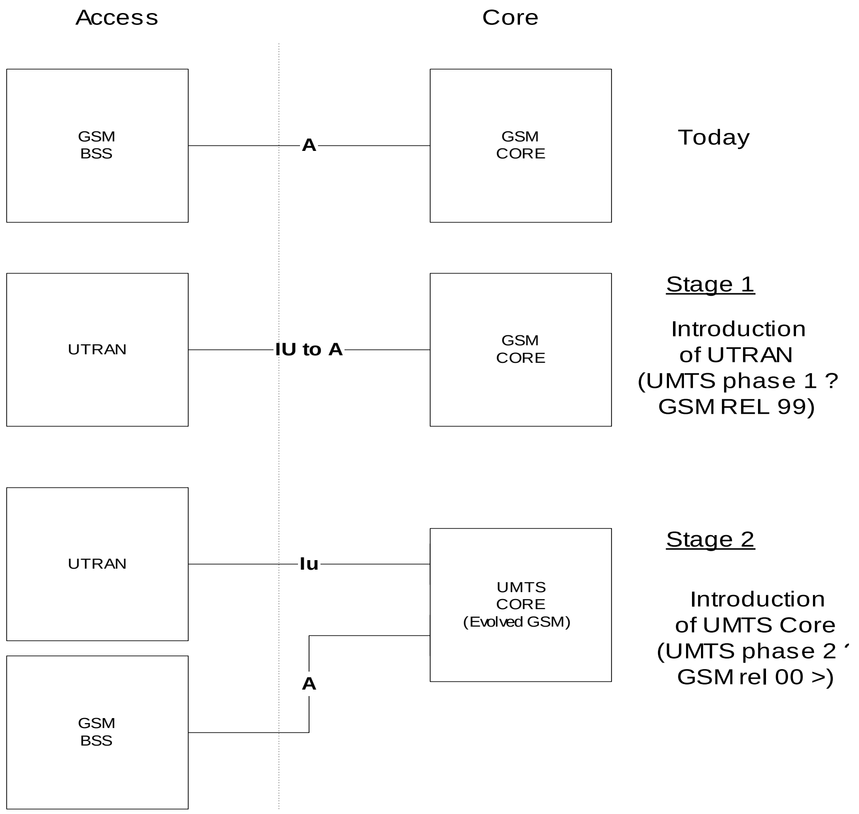


Fig 16 Introduction of UMTS to GSM network

The UMTS MSC must be capable of supporting the UTRAN in an efficient manner, it is therefore likely to use ATM as a transport mechanism. In addition the UMTS MSC must appear as a GPRS node to maintain compatibility. It therefore has the function of QoS control, packet handling and session management. The mobility would be done in such a way such that GPRS MM and GSM MM are integrated. The GPRS session management can be expanded such that everything is a session including signalling and voice calls. The act of powering up a mobile initiates a session irrespective of the eventual service or bearer required.

Figure 17 shows an event diagram starting at the power on of a mobile terminal. One of the first reactions is that a Mobility Session is started to attach the terminal to the network (Logging on/Registration/Location Updating). After this point in time nothing necessarily happens from a users perspective until a service request occurs, (a service session starts). This service request could be mobile originated or mobile terminated. The service request could be for an IP service or a voice call, in either case the service request could indicate required QoS. For voice calls this could be default to circuit switched mode, for an IP service including VoIP, a reservation protocol could be negotiated or for non delay critical services, best effort only. The call in progress has been named the payload session.. At the end of the payload session, the Mobile terminal returns to an idle state.

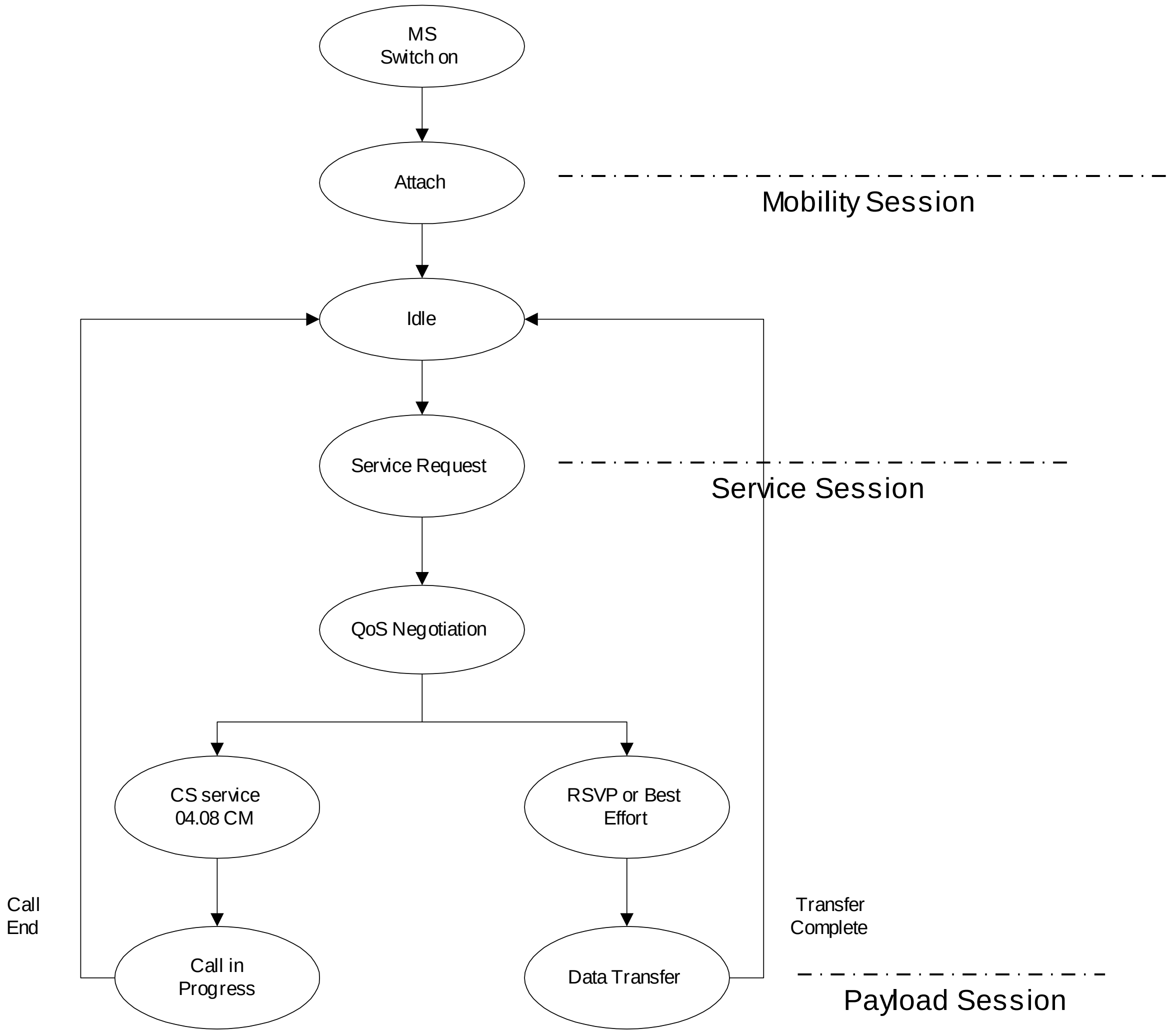


Fig 17 Event Chart - Session

9.2.4.1. UMTS Core Physical Architecture

An example of high level physical implementation is shown in Fig 18.

Key points.

- Session management extended to cover all call types
- Integrated Mobility for Voice and Packet
- Re-use or extensions to existing GSM protocols

- ATM transport for UMTS
- Optional support for GSM and GPRS basestations
- QoS management plays a prominent role
- Bearer control separated from session and call control

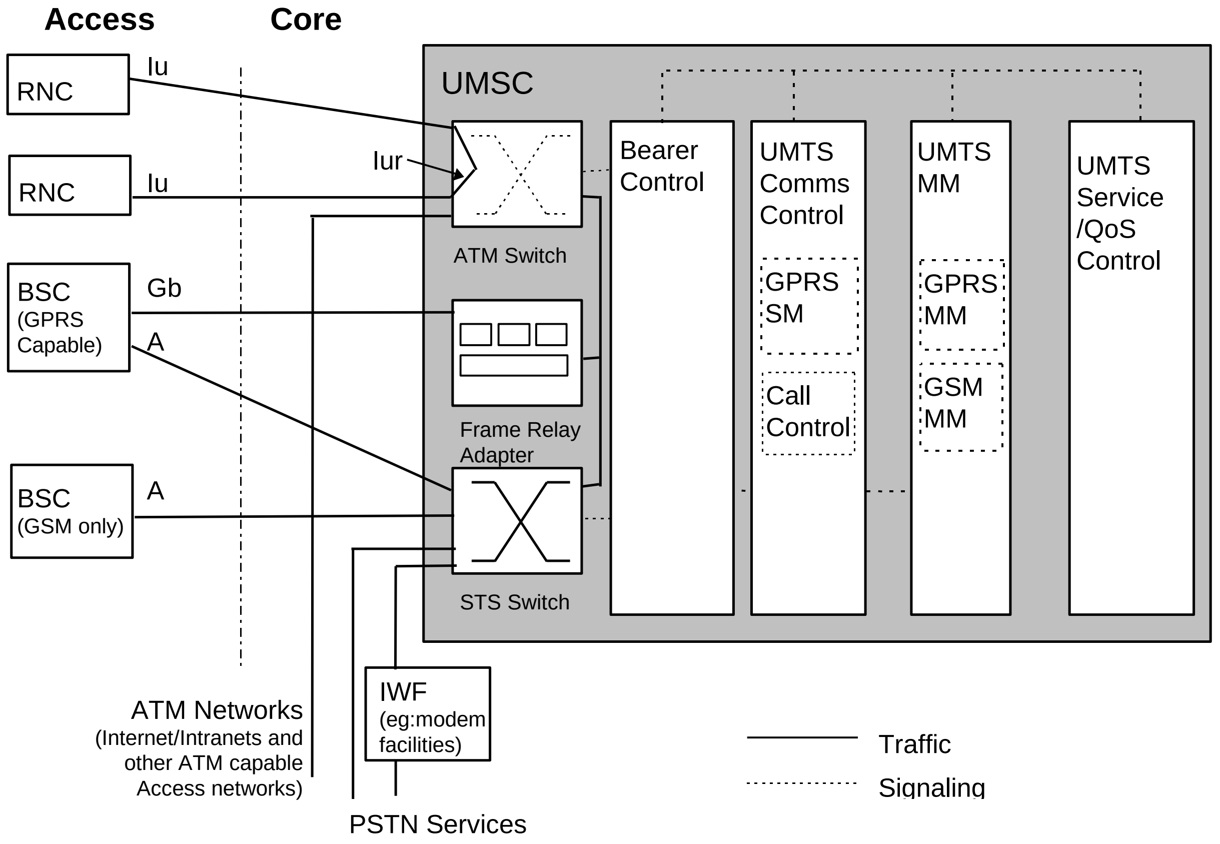


Fig 18 Example of an UMTS MSC (Integrated Solution)

Note: This is one possible implementation and should not preclude others, it is possible that the same concepts could be followed for the implementation as shown in Scenario 4 but tight co-ordination would probably be required on the Gs interface between MSC and SGSN to co-ordinate the mobility issues.

9.2.5. Scenario 7

Being similar in nature to scenario 4, this scenario emphasises on the existence of two fundamentally different and independent technology paradigms in communications: One PSTN/ISDN paradigm and one IP-paradigm. By recognising this the UMTS core network in this scenario is logically divided into two parts, one part optimised towards the PTSN/ISDN paradigm and its services and the other part optimised towards the IP-paradigm and its services. This scenario also avoids any mandatory ties between the network layers (L3) and the underlying transport layers (L1/L2) within the core network. From a services perspective this creates an optimal architecture which is open with respect to networking principles and selection of protocols and transport solutions. It also allows for deployment of non-PLMN specific standards and PLMN-external networks to be used for inter PLMN-communication in conjunction with e.g. roaming. The resemblance between this scenario and the UMTS phase 1 architecture should reasonably facilitate the migration from UMTS phase 1 networks.

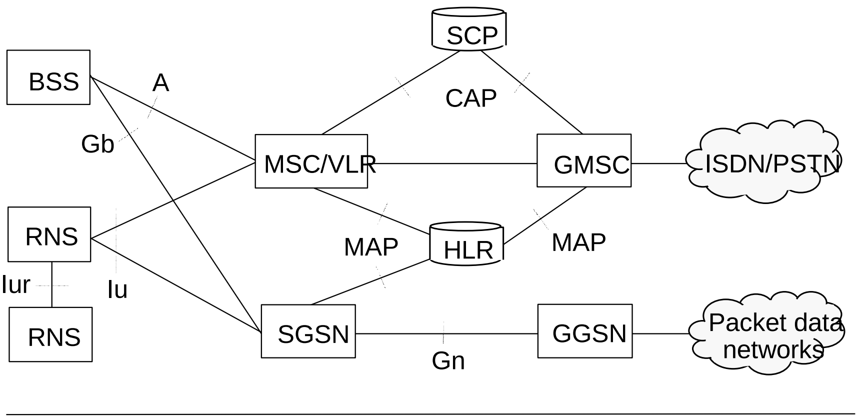


Fig 19 Simplified reference model

9.2.5.1. Network View (Layer 3)

On the network layer the GSM/UMTS core network outlined in scenario 1 and 2 is characterised by two completely different domains, one circuit mode ISDN/PSTN domain and one packet mode IP-domain, reflecting the two technology paradigms referred to above. The present scenario suggests to retain this basic network structure also for the future evolution of the UMTS core network, as illustrated in figure 20.

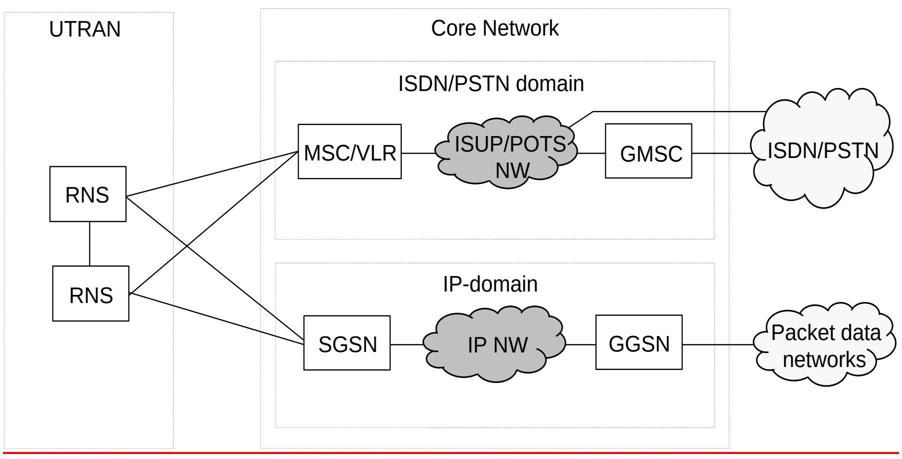


Fig 20 Simplified network layer view in the UMTS core network

Separating the two domains avoids compromises, in the standard and in the implementation, between the two fundamentally different paradigms which otherwise might increase primarily time to market but also complexity costs. Each domain can also evolve independently of the other in the future UMTS-evolution, which is of particular value since the IP-paradigm is expected to evolve extensively.

Compared to scenario 1 and 2 the core network nodes in this scenario interfaces UTRAN directly over the Iu-interface. New network capabilities are added for support of e.g. multicalls and IP-QoS.

The ISDN/PSTN core network domain provides connectivity for N-ISDN services towards ISDN/PSTN and other PLMNs. A multitude of network protocols exists which may be used in this domain but the selection of protocol is not a subject for standardization.

The IP core network domain is optimised for providing IP end-to-end services with IP QoS. Since IP is an international standard, with no national dialects, IP is the suggested network protocol for this domain.

Product wise integration of functions from the two domains, e.g. MSC and SGSN-functionality, is an implementation choice but is not a subject for standardization.

9.2.5.2. Transport View (L1/L2)

The transport technology within the core network can be selected independently of the network layer as illustrated in figure 21. Selection of the transport technology for the UMTS core network is not a subject for standardization. This makes it possible to tailor the transport networks of each PLMN individually in order to achieve the most optimal transport solution for each operators business. Decoupling the network layer from the transport layer adds flexibility to the network architecture and allows new transport technologies to be deployed as they emerge, without having to modify the network layer.

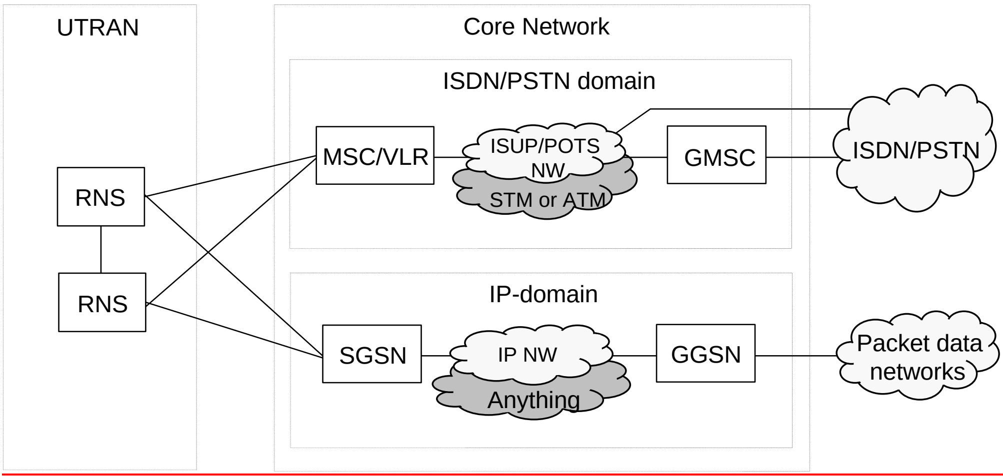


Fig 21 Simplified transport layer view in the UMTS core network

Integration of the transport network between the two core network domains on layer 1 and 2 is possible, e.g. by means of a common ATM transport network. Such integrated transport solutions may also include (parts of) UTRAN and other, non-UMTS networks of an operators business. Integrating the transport network is a matter of implementation, however, and is not a subject for standardization.

9.2.5.3. Opportunities

Optimised for both N-ISDN and IP-services

Offers support for multimedia according to main steam standards such as H.320 and H.323, as well as support for main stream multimedia solutions within the IP-world, based on Integrated Services and DiffServ as defined by the respective IETF WG.

Based on multi technology standards:
- Flexible and open with respect to networking principles and transport solutions.
- Supports mixed PLMN/non-PLMN networking solutions.
- Supports independent evolution of individual PLMNs (no 'big bang' for synchronised evolution).
- Supports integrated transport solutions.

Relies on proven and well functioning standards for support of N-ISDN services.

Results in manageable migration scenarios.

Avoids compromises between the two fundamentally different IP and ISDN/PSTN paradigms.

9.2.5.4. Related Actions

Further investigations of this scenario are needed in the following areas, among others:
- Provision of IP QoS
- Wireless specific requirements on IP QoS
- Voice over IP
- Migration. This item includes various aspects of migration such as:
  - Migration from UMTS phase 1 to this scenario
  - Co-existence of 2G and 3G systems, including roaming and handover

9.2.6. Scenario 8

BRAN Access

The evolved GPRS network should allow for various radio access networks. As stated in [UMTS 23.01], a modular approach in UMTS evolution is recommended. This is also in line with the recommendation from GMM. Thus, the infrastructure domain, which encompasses the core network domain and the access network domain, allows for different access techniques/networks to be used.

It is therefore proposed to specifically depict BRAN (HIPERLAN/2) as an alternative access method to the GSM/GPRS/UMTS CN. The standards should provide the interface adoptions needed to cater for BRANaccess to GSM/GPRS/UMTS CN (see also Tdoc 98s308 where various alternatives for BRAN GPRS interworking are presented). In Figure 22 two alternatives for BRAN/GPRS/UMTS are depicted; access via the Iu and Gbu interfaces. The possibility should be included amongst the current evolution scenarios.

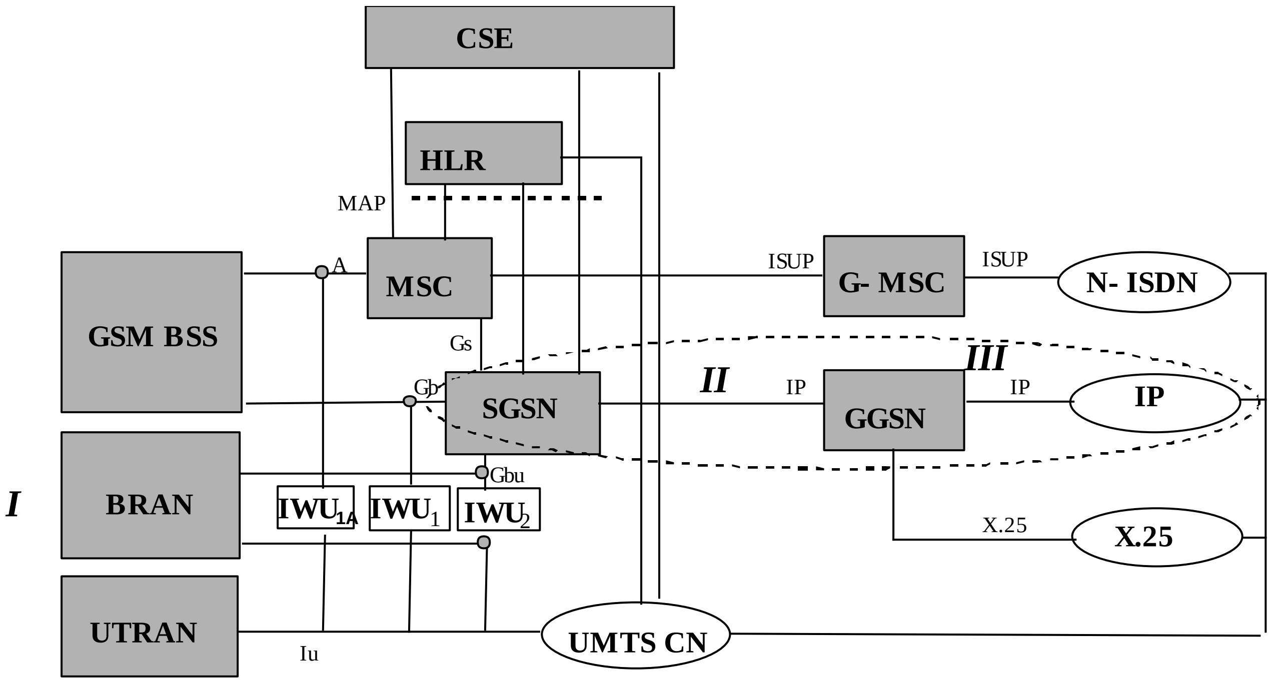


Figure 22 UMTS with BRAN access

9.2.7. Scenerio 9

1. Introduction of an ATM-based URAN

The working assumption in SMG 2 is that the URAN will be based on ATM with the RNC containing ATM switching functions. From the core network point of view the simplest deployment of ATM is to confine it to the URAN with gateways to connect to legacy GSM switching equipment. This approach is shown in figure 23.

Initially it would be likely that permanent virtual circuits (PVCs) would connect the RNCs to the GSM switches.

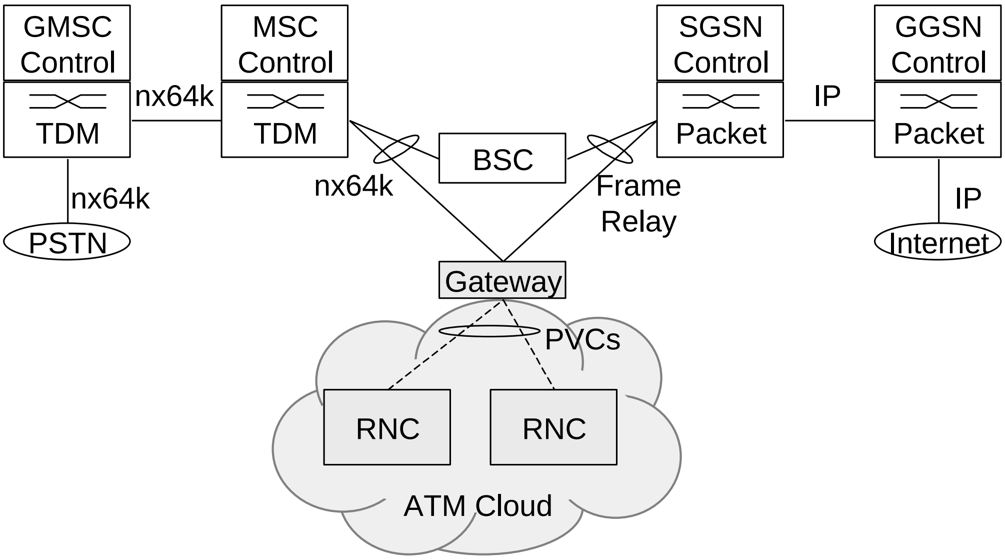


Figure 23 - Introduction of an ATM-based URAN

This approach will deliver spot-coverage of UMTS to increase coverage, capacity or radio flexibility in "hot spots". This approach could be used in a basic UMTS phase 1 implementation.

9.2.7.1. Introduction of ATM Trunking and Voice Overlay in the Core Network

ATM can be easily introduced as a transmission resource in the core network without changing the technology of the legacy GSM switches. In fact this step is so basic that once ATM is deployed to support the URAN operators may decide to immediately start to use ATM for transport in some parts of the core network. ATM can be used to replace or supplement existing transport.

Between the legacy GSM switches ATM could be used in two ways:

- Permanent Virtual Circuits (PVCs) could be used to provide simple replacement of the facilities provided by conventional trunks. If PVCs are being used the call control signalling (e.g. ISUP) is transparent to the ATM cloud.
- Switched Virtual Circuits (SVCs) could be used if the ATM network is configured to support dynamic switching. If SVCs are being used then the call control signalling (e.g. ISUP) must be processed by the ATM cloud to establish the SVCs required for the call.

As shown in the figure this step may also include use of ATM on the A-interface via gateways.

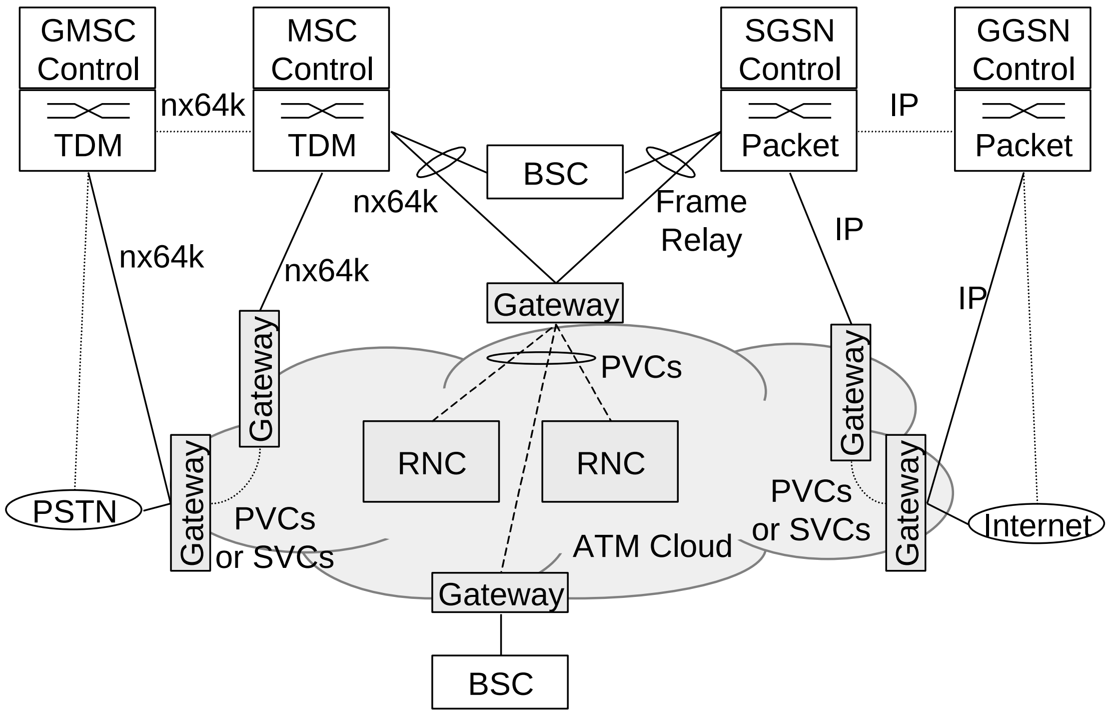


Figure 24 - Introduction of ATM Trunking and Voice Overlay in the Core Network

This stage starts to migrate traffic on to a common ATM backbone reducing the amount of duplicated transport and switching functions in the network. This approach would still be regarded as UMTS phase 1, but starts to evolve phase 1 towards phase 2.

It should be noted that repeated transitions between ATM and non-ATM formats degrades speech call quality particularly with respect to delay. Careful design of the network and the route selection algorithms will be needed to keep overall call quality within acceptable boundaries. In this scenario the GSM switching is non-ATM and therefore the most likely application of ATM will be in creating an overlay "backbone" network to provide long-distance transport of traffic. This would be particularly attractive if the interconnected PSTNs were also based on an ATM backbone.

9.2.7.2. Introduction of ATM Switching Islands in the UMTS Core Network

In this step the legacy switching matracies of the MSC and SGSN are replaced by ATM. This can be done so as to introduce islands of ATM in the core network surrounded by gateways to interconnect to legacy systems.

The islands may be as small as a single switch in which case the gateways between the ATM and non-ATM world could become the access devices of the switch. For islands of more than one switch the gateways should occur at the points of interconnect to legacy systems to avoid tandeming of adaptation functions.

The introduction of ATM switching may coincide with the introduction of separate control and switching. As shown in the diagram the control part of the switch is moved away from the switching fabric to create a call control server. An open interface between the control node and the switching matrix would allow purchase of these pieces of equipment from different vendors.

In the simplest case (shown here) each control server has a one-to-one relationship with a single physical ATM switching matrix. However this relationship will change as the network evolves.

As ATM switching is now integral to the UMTS core network functionality either PVCs or SVCs may be used depending on the network's requirements.

Note that because this paper focuses on the evolution of the transport layer the MSC and SGSN are still shown as separate nodes in this step. However, in reality other changes to the control layer may mean that these two functions have also been modified or merged.

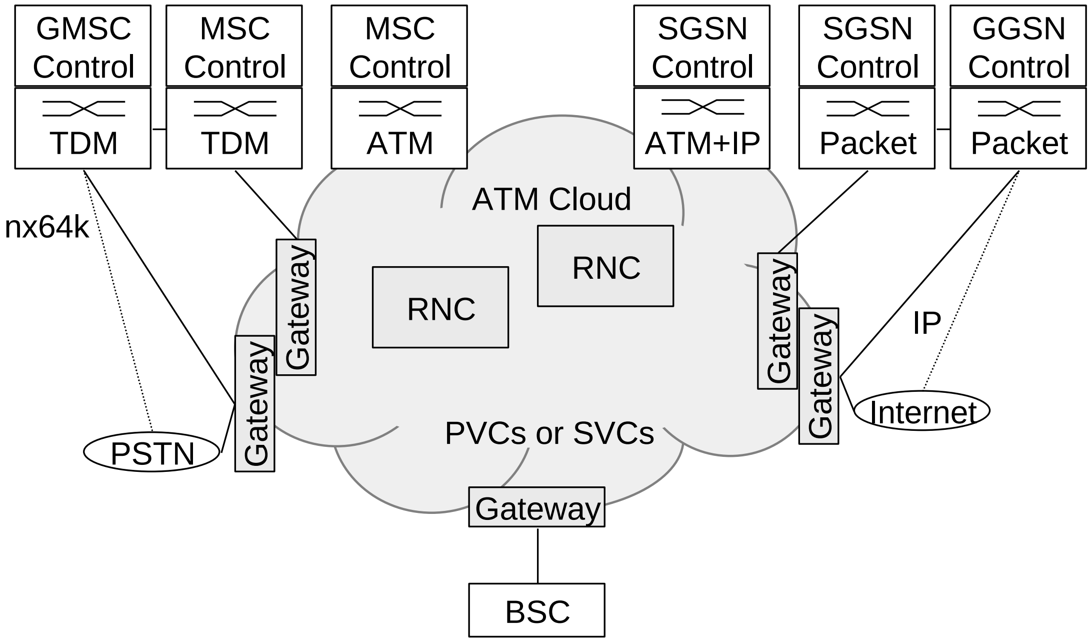


Figure 25 - Introduction of ATM Switching Islands In the UMTS Core Network

This scenario allows the full capability of ATM to be used within the islands and also enables broadband multi-media on the MSC and SGSN. This approach could represent the first introduction of UMTS phase 2 equipment.

As above the number of "hops" between ATM and non-ATM should be minimised. The network and routing algorithm design continues to be important. One approach could be to "grow" ATM switching up from the access network in to higher levels of the network. In general ATM switches should be introduced in community of interest groups with ATM inter-switch trunks.

9.2.7.3. Evolution to Distributed Switching

As the ATM switching islands grow operational benefits will be obtained if each call control or session management server is allowed to control more than one switching matrix. The switching and control aspects of the network will therefore become fully functionally and physically separated. Instead of a one-to-one mapping of matricies to control nodes each control node is connected to a "connection broker". The connection broker allows the control node to request a connection between any two points on the edge of the ATM cloud and will then configure the ATM switches to meet the control nodes requirements. The interface between the control unit and the connection broker should be an open interface to allow multi-vendor operation.

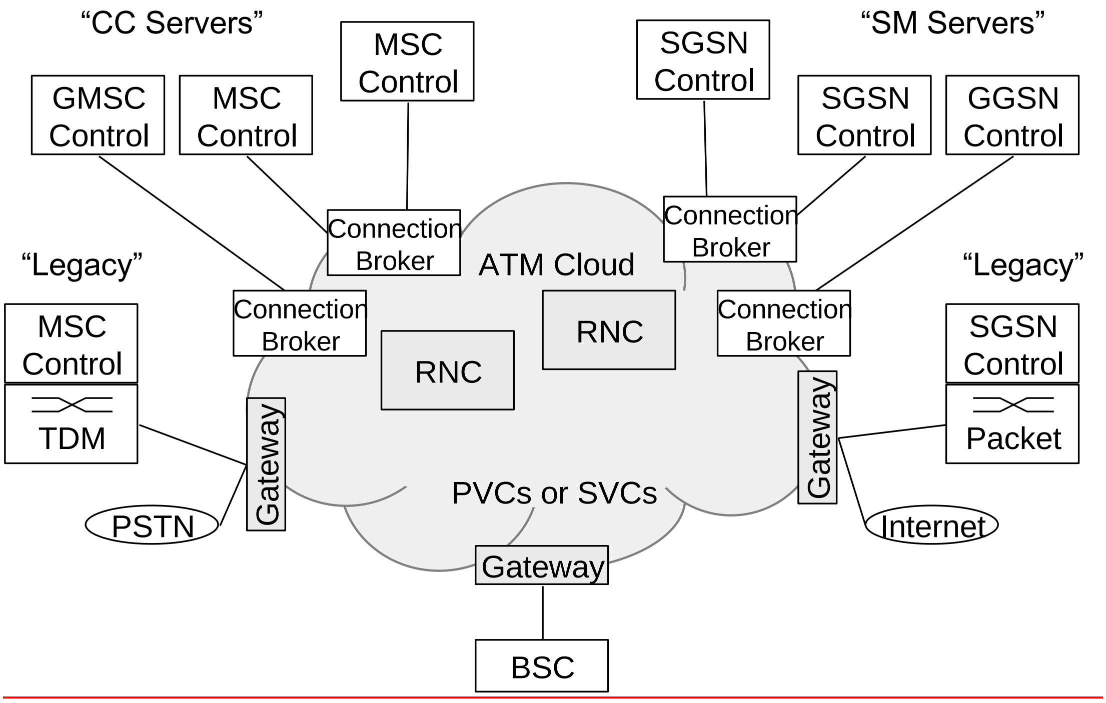


Figure 26 - Replacement of TDM by ATM

In this scenario the control functions are fully-decoupled from the transport functions. The transport requirements for a UMTS phase2 network are met.

10. Interoperability between GSM and UMTS

Handovers between GSM-UMTS and GSM

11. Roaming scenarios

How is seamless roaming between GSM and UMTS to be achieved.

History

Document history		
Date	**Status**	**Comment**
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07 July 1997	Version 0.0.2	SMG 3 SA meeting output version (Sophia Antipolis, 04.07.97)
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06 Nov 1997	Version 0.1.0	SMG3 SA meeting output version (Milan Oct 97)
21 Nov 1997	Version 0.2.0	SMG3 SA Meeting output version (Kista, Nov 97) Inclusion of Tdocs 97s380,97s385 and 97s394
09 Mar 1998	Version 0.3.0	SMG3 SA Meeting output version (Malmo Jan 98) Inclusion of Tdoc 98s080 and deletion of 2nd Bullet point of section 7.4 as agreed in the minutes re: 98s075
12 Mar 1998	Version 0.3.1	Corrected V. 0.3.0
15 April 1998	Version 0.4.0	SMG3 SA Meeting output version (Bad Aibling March 989) Inclusion of Tdoc 98S133
15 May 1998	Version 0.5.0	SMG3 SA Meeting output version (Lisbon ,May 989) Inclusion of Tdoc 98S311 and Tdoc 98S314
18 May 1998	Version 0.5.5	Preliminary restructured version without new scenaerios
26 May 1998	Version 0.5.6	New Scenarios Included
29 July 1998	Version 0.6.0	SMG12 Meeting Output Version (Chicago, June 1998 Inclusion of Tdoc 98S353, 98S325, 98S334 modified,98S368 modified, 98S354, 98S427 modified, 98S361 modified, 98S356, 98S359. (‘Modified’ implies version approved via email exploder) - Update of all figure numbers, with minor adjustments in text to take this into account.