

Source: **T2**

Agenda item: **7.3**

Presentation of Specification to TSG or WG

Presentation to: TSG T Meeting #6

Document for presentation: TR21.910, Version 1.3.2

Presented for: Information

Abstract of document:

The present report deals with multi-mode UE related issues. This includes definitions of different types of multi-mode UE, scenarios for desired UE behaviour in specific situations and summary and evaluation of the work done on Multi-mode issues in other TSGs/working groups. Scenarios are described e.g. for start up, incoming connections, roaming and inter-system handover.

Changes since last presentation to TSG Meeting #5:

The name has been changed again and the report is now titled: Multi-mode UE issues.

The definition of a multi-system UE has been deleted and the word “system” has been replaced by mode or radio access technology, as recommended by SA and RAN2.

The scope has been narrowed and now only includes UMTS and GSM as possible modes for the UE. It also states a strong focus on the type 2 UE and that releases up to and until R99 should be considered.

The chapter with scenarios has been altered to reflect the changes of the scope.

Significant amount of text has been included for the work ongoing in other TSGs/working groups.

Outstanding Issues:

- Some situations in the scenarios where different operators are running the UMTS network and the GSM network, e.g. roaming and inter-system handover.
- Description of ongoing work in other WGs, i.e. SA3-SA5, TSG CN and RAN3.
- Evaluation of the work in other WGs

Completion of the above mentioned issues is expected due March 2000.

Contentious Issues:

Types of Multi-mode UEs.

The scenarios describing desired behaviour of the UE in specific situations.

| | | | | | |
|--|-------------------|---|---|-----------------------------------|------------|
| Work Area / Item: | | Multi-mode UE | | | |
| Affects: | UE/MS: Yes | CN: Yes | UTRAN: | Compatibility Issues: Yes: | No: |
| Expected Completion Date: | | March 2000 | | | |
| Services impacted: | | None | | | |
| Specifications affected: | | 3G TR 21.910, As a result/conclusion of the completed report, changes to other specifications may be required. It has still to be investigated what specifications should be altered and what the changes have to be. | | | |
| Tasks within work which are not complete: | | | Identification and evaluation of ongoing work and the completion of some scenarios. Identification of additional work to be done within 3GPP. | | |
| Consequences if not included in Release 1999: | | | The ideas for an efficient usage of multi-mode UEs, collected in the scenarios, will be delayed even longer. A summary of all work ongoing in this area will not be available which will make it even more difficult to finalise the work in time. | | |
| Accepted by TSG# | | for late inclusion in Release 1999: | | | |

3rd Generation Partnership Project (3GPP); Technical Specification Group (TSG) Terminals; Multi-mode UE issues



Reference

DTR/TSGT-0221910U

Keywords

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Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project, Technical Report Group Terminals.

The contents of the present document may be subject to continuing work within the 3GPP and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released with an identifying change of release date and an increase in version number as follows:

Version m.x.y

where:

- m indicates [major version number]
- x the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- y the third digit is incremented when editorial only changes have been incorporated into the specification.

Introduction

When UMTS is launched the coverage will be very limited in many areas while several second-generation systems will have a very wide coverage. To make UMTS useful for a wide range of users from the start, multi-mode UEs, combining e.g. second-generation radio access system with UMTS, are necessary. In the longer term, combinations with other radio access systems, such as HiperLAN or other cordless systems, could also be interesting and convenient. The present document describes all relevant issues concerning multi-mode UEs from a service and a terminal point of view.

1 Scope

The present 3GPP Technical Report identifies multi-mode User Equipments categories and describes the consequences on roaming capabilities and service availability (e.g. handover) of such multi-mode UEs while roaming in various regions implemented with various network configurations. The latter objective consists of case studies for each of the possible scenarios in reference to existing specifications. In these studies it has been important to make sure that no duplication of text has been made or that inconsistencies have been created between specifications.

The initial version of this TR is limited to UEs implementing release 99 of the various modes roaming in regions implementing specifications up to and including release 99 of the associated specifications (e.g. a rel 99 multi-mode UE in a release 97 GSM network should be covered).

In particular, the release 99 of this TR is focused on the type of UE that only can camp on one cell and be in active communication in only one mode at the same time. When the UE is in active communication in one mode it should be able to listen to the other radio access technologies and make e.g. measurements reports on this radio access technology and send them to the network, but no simultaneous active communication should be possible. This corresponds to a type 2 UE, as defined in the report in ch. 4.

The scope of this TR is the type of terminal implemented with at least the following modes:

- UTRA FDD and/or TDD mode
- GSM mode

The content of the scenarios could be used for other combinations of modes in a multi-mode UE. These are not considered in this version of this report.

Regarding the GSM mode, it encompasses the capabilities offered by the GSM technical specifications, i.e. MSC services, GPRS, EDGE. This means that the sub-categories as offered by GSM should be considered e.g. GPRS only terminals, circuit switched only terminal, dual capability terminals.

The present report is built on and references specifications/reports being produced in 3GPP or within other relevant foras e.g. ETSI SMG.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] 3G TS 22.135: "Multicall, Stage 1".

[2] 3G TS 25.303: "UE Functions and Interlayer Procedures in Connected Mode".

[3] 3G TR 23.920: "Evolution of the GSM platform towards UMTS".

[4] 3G TS 22.129: "Handover Requirements between UMTS and GSM or other Radio Systems".

[5] 3G TS 25.304: "UE Procedures in Idle Mode".

[6] 3G TS 23.121: "Architectural Requirements for Release 1999".

[7] 3G TR 25.990: "Vocabulary".

- [8] 3G TS 22.101: “Service aspects; Service principles”.
- [9] 3G TS 22.100: “UMTS phase 1 Release 99”.
- [10] 3G TR 21.904: “Terminal Capability Requirements”.
- [11] 3G TS 21.111: “USIM and IC Card Requirements”.
- [12] 3G TR 25.942: “RF System Scenarios”
- [13] 3G TS 25.103: “ RF Parameters in Support of Radio Resource Management”
- [14] 3G T1 iWD-001: “Interim Working Document; Combined testing areas for RF and Signalling;Idle mode operations, handover and measurement reporting “
- [15] 3G TS 25.201: “ Physical layer - General description”
- [16] 3G TS 25.215: “Physical layer – Measurements (FDD)”
- [17] 3G TS 25.225: “Physical layer – Measurements (TDD)”

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions apply:

Multi-call: a function that makes it possible for a UE to have several CS and PS-connections/calls in active communication at the same time. For further description, please refer to [1].

Multi mode terminal: UE that can obtain service from at least one mode of UMTS, and one or more different systems such as GSM bands or possibly other radio systems such as IMT-2000 family members. [4]

Radio Access Mode: Mode of the cell, FDD or TDD [7]

Radio Access Technology: UMTS, GSM etc [7]

Intra network handover: Handover within the same radio network. [4]

Inter network handover: Handover between different radio networks, irrespective if within or between MSC or CN. [4]

Inter system handover: Handover between networks using different radio technologies, e.g. UMTS – GSM. [4]

Active communication: a UE is in active communication when it has a CS connection established.. For PS active communication is defined by the existence of one or more Activated PDP contexts. Either one or both of the mentioned active communications may occur in the UE.

Camping on a cell: The UE is in idle mode and has completed the cell selection / reselection process and has chosen a cell. The UE monitors system information and (in most cases) paging information. Note that the services may be limited, and that the PLMN may not be aware of the existence of the UE within the chosen cell. [5]

Multi-band: when a certain type of radio technology/radio interface is used in different frequency bands (e.g. GSM for both 900 and 1800 MHz).

3.2 Symbols

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

<symbol> <Explanation>

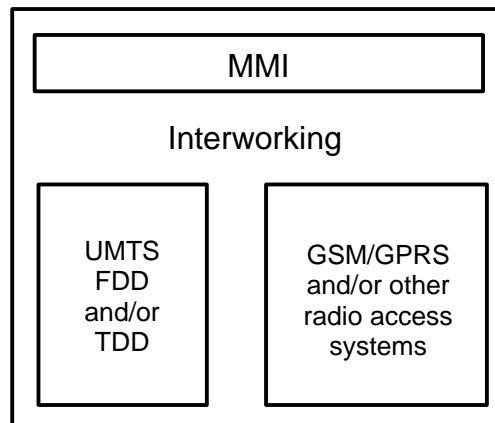
3.3 Abbreviations

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

| | |
|-----|-------------------------|
| CS | Circuit Switched |
| LA | Location Area |
| LU | Location Update |
| MM | Mobility Management |
| PS | Packet Switched |
| RR | Radio Resource |
| RRC | Radio Resource Control |
| URA | UTRAN Registration Area |

4 General Aspects

A Multi-mode UE for UMTS and GSM/GPRS or other radio systems is considered to be a UE with at least one UMTS part (FDD and/or TDD) and with one part supporting some other radio system, e.g. GSM / GPRS. This is controlled by a common Interworking Unit which also controls one common MMI (keypad, display and menu functions). A reference configuration for Multi-mode UEs is shown in figure 1.



MMI: Man-Machine Interface

Figure 1: Reference configuration for Multi-mode UEs

Some parts in the UE, such as the microphone and the loudspeaker, could be reused by both the UMTS and the other radio access technologies parts or could be implemented separately. Integration of some RF parts is also foreseen.

The present document will mainly deal with the interworking between UMTS and 2nd generation access technologies, mostly GSM/GPRS, as much standardization work considering the connection between these two radio access technologies is already done.

4.1 Types of UEs

In different situations, it is feasible to study the services considering different types of terminals. From a user and operator/service provider perspective it is also important that different types of terminals exist so that customers can be offered a great variety of services through the terminals.

NOTE: Even though four different types of UEs are described in this report, the main focus for R99 is the type 2 UE. The other types of UEs are described for possible inclusion in future releases of the 3GPP standards. For this to be possible the types of UEs have to be approved by SA and the implications of them onto the other work in 3GPP has to be studied. Some of this work has already started in chapter 7.

The type of subscription the user is having may affect the usage of types of UEs. In the present document it was decided to take this aspect into account when describing the scenarios (see clause 4.2). Table 1 is also describing some aspects of this question by mapping the registration procedure for the different types of UE.

For all types of UEs both manual and automatic switching should apply. Definitions on the different switching modes can be found below.

Manual Switching Definition

This operation is initiated by the user or defined by a user setting to allow the UE to scan for all the available radio access technologies and/or networks at predefined occurrences, e.g. when entering a new roaming area. The UE should present a list of the available networks and/or radio access technologies to the user for their selection of the network

and/or radio access technology service. Registration to the new network and/or radio access technology cannot be done without the user's consent.

Automatic Switching Definition

The automatic switching will identify when at the necessary points in time when the UE should scan for other networks and/or radio access technologies and should register onto the preferred option. This can occur without the user's knowledge and the UE does not have to request the user's permission to change, add or remove a connection to a network and/or radio access technology.

4.1.1 Type 1

This type of UE can be described as two or more single-mode UEs in the same shell. The MMI for the different modes are the same but no other functions are shared between the different modes of the UE. The UE can only camp on one cell and be in active communication in only one mode at the same time. An example of a combination of modes that could benefit from this type is a PDC/UMTS UE where the different radio access techniques are connected to different core networks. The user will then carry both UEs around but in one shell and when one mode is registered and in active communication the other is totally blocked.

No simultaneous activity is supported with this type of UE. No simultaneous mode connections are supported with this type of UE.

4.1.2 Type 2

This type of UE can be described as two or more UEs in the same shell. The MMI for the different modes are the same but no other functions are shared between the different modes of the UE. The UE can only camp on one cell and be in active communication in only one mode at the same time. When the UE is in active communication in one mode the UE should be able to listen to the other radio access technologies and make e.g. measurements reports on this radio access technology and send them to the network, but no active communication is possible. This will allow the UE to send measurement reports about another radio access technology through the active mode.

No simultaneous active communication is supported via multiple radio access technologies with this type of UE. No simultaneous mode connections are supported with this type of UE.

4.1.3 Type 3

Type 3 UEs can camp on different cells in several modes at the same time but active communication is only possible in one mode at the same time. When the UE is in active communication in one mode it can listen and respond to paging in the other mode¹. The UE can also be registered in several modes at the same time (may be applied when the modes are belonging to different operators/service providers).

The above description implies that simultaneous registration and simultaneous monitoring is supported. No simultaneous traffic is supported but the UE can initiate/receive connections in different modes sequentially.

4.1.4 Type 4

UEs of type 4 can camp on cells in several modes at the same time and also be in active communication in several modes at the same time². No switching between modes is necessary.

This implies that simultaneous registration, simultaneous activation, simultaneous monitoring and simultaneous traffic is supported.

In Table 1 the types of UEs are collected and pictured with respect to registration, paging and measurements. The table is divided into requirements for the UE and the network. In respect to the network the requirements are divided according to whether the same operator (PLMN) or different operators run the networks.

¹ The requirements for type 3 are not finalised for R99.

² The requirements for type 4 are not finalised for R99.

In the table, in the column with registration, the expression “available mode” is used and that means that the network only has to register the UE in those modes that the UE is capable of utilising.

The column with measurements means, for the UE the ability to do the measurements in other available modes/radio access technologies at the location. For the network the column means the ability to evaluate the measurements sent from the UE from different modes/radio access technologies. The operator that only runs one of the modes does not have to be able to evaluate the measurements from other radio access technologies.

Table 1: Requirements for types of UEs and networks according to registration, paging and measurements

| | | Registration | Paging | Measurements to provide handover between modes |
|--------|----------------------|----------------------------------|---|---|
| Type 1 | UE requirements | Only in one mode | Receive only in the registered mode | Measurements only in the registered mode |
| | Network requirements | Same PLMN | Transmitted only in the registered mode | Evaluate measurements from only one mode |
| | | Diff. PLMN | Only in one of the modes | Transmitted only in the registered mode |
| Type 2 | UE requirements | Only in one mode | Receive only in the camped mode | Ability to measure in several modes, even when in active communication. |
| | Network requirements | Same PLMN | One registration valid in all available modes | Evaluate measurements from several modes |
| | | Diff. PLMN | Only in one mode | Paging in the registered mode |
| Type 3 | UE requirements | One or several modes as required | Receive and answer paging in all camped modes | Measurements in all camped modes. |
| | Network requirements | Same PLMN | One registration valid in all available modes | Evaluate measurements from several modes |
| | | Diff. PLMN | One registration for each mode | Paging in the registered modes |
| Type 4 | UE requirements | One or several modes as required | Receive and answer paging in all camped modes | Measurements in all camped modes. |
| | Network requirements | Same PLMN | One registration valid in all available modes | Evaluate measurements from several modes |
| | | Diff. PLMN | One registration for each mode | Paging in the registered modes |

5 Scenarios

This clause provides some scenarios describing the usage and behaviour of multi-mode UEs in special situations from a technical and service point of view. These scenarios will then be the guideline when over-viewing the work and identifying additional work.

NOTE1: This clause is a collection of ideas on how to make the usage of a multi-mode UE and the interaction with the network more effective.

NOTE2: Eventhough the type 2 UE is of highest interest and priority for R99 and this report, the scenarios for the other types of UEs are still included in this clause. They are there to give more clarification about the differences of behaviour between the types of terminals.

5.1 UMTS complemented with 2nd generation or another radio access technology from the same operator

This scenario describes the case when an operator operates an UMTS-network as islands in a sea of this operator's own 2nd generation network and/or in combination with another radio access technology. The user has just one number and calls can be initiated by using this number, irrespective of in which mode the user is currently registered.

5.1.1 Power on

The network selection procedure should be based on the requirements in [8].

The procedures for power on are described in [5] and the text below is taken from that document:

“When a multi-mode UE is switched on, it attempts to make contact with a public land mobile network (PLMN) using a certain radio access system.

The particular PLMN to be contacted may be selected either automatically or manually.

The UE looks for a suitable cell of the chosen PLMN and chooses that cell to provide available services, and tunes to its control channel. This choosing is known as "camping on the cell". The UE will then register its presence in the registration area of the chosen cell if necessary, by means of a location registration procedure.”

The above description is only dealing with the PLMN selection. For selection of radio access technology the following procedure is suggested.

The UE should first search for networks in the radio access technology last used. If the last radio access technology is not present or no network is available within this radio access technology, the UE should search for other radio access technologies for suitable networks. For the choice of radio access technologies a preferred technology list should reside within the UE. This list could be changed by the user or the operator.

The UE should register through the access network chosen. This registration should also apply for the other radio access technologies belonging to the operator. When a location update is made for one radio access technology it may apply for the others as well.

It should be possible to transfer UE capability information in connected mode as well as in idle mode.

There are no differences between UE types at Power on.

5.1.2 Incoming connection

5.1.2.1 UE type 1

5.1.2.1.1 Idle mode

If the incoming connection is in the registered mode the connection can be set up.

If the incoming connection belongs to another mode than the registered the connection can not be set up.

5.1.2.1.2 Active communication mode

The UE can only be reached in the registered mode and the connection can not be set up.

5.1.2.2 UE type 2

5.1.2.2.1 Idle mode

If the UE is in the right mode for receiving the connection, the connection can be set up. If the UE is in another mode than the incoming connection (e.g. the UE is in the 2nd generation mode but the incoming connection is a videoconference) the network should page the UE through the active mode and the connection can be set up in a suitable radio access technology.

The calling party should be informed only if the set up attempt fails or a degradation in the requested QoS of the connection has taken place (e.g. a videoconference has been degraded to a speech call).

5.1.2.2.2 Active communication mode

As this type of UE is just able to receive pagings and be in active communication in one mode at the same time, it would sometimes be desirable to page the UE through the active mode about an incoming connection in another mode. This could for example be the case if the UE is in active communication in a PS-connection (e.g. web-surfing in UTRAN) and the incoming connection is a CS-connection in another mode (e.g. a speech call in GSM).

For other situations, e.g. the UE is in active communication in one mode in UTRAN and the incoming connection is incoming in this radio access technology, the normal procedure for this mode should apply. For UTRAN multicall may for example be applied. [1]

5.1.2.3 UE type 3

This type of UE is most interesting when having different operators for the modes included in the UE. As this is the case the description of these situations can be found in clause 4.2.2..

5.1.2.4 UE type 4

5.1.2.4.1 Idle mode

The incoming connection can be set up.

5.1.2.4.2 Active communication mode

In most cases the incoming connection can be set up at once, but there might be some exceptions. One of them is when the incoming connection is in the same system as the active connection and the active system not is able to deal with several active connections at the same time. The incoming connection may then be re-routed to another mode so that both connections can be active at the same time.

5.1.2.5 Clarifying tables

When a user is moving around with a UE, different areas can be entered. Either an area with just UMTS or GSM coverage can be entered or an area where both radio access technologies are available. This is depicted in Fig. 1 and the areas are denoted:

- A UMTS area with just UMTS coverage
- B Common area where both UMTS and GSM is available

C GSM area with just GSM coverage

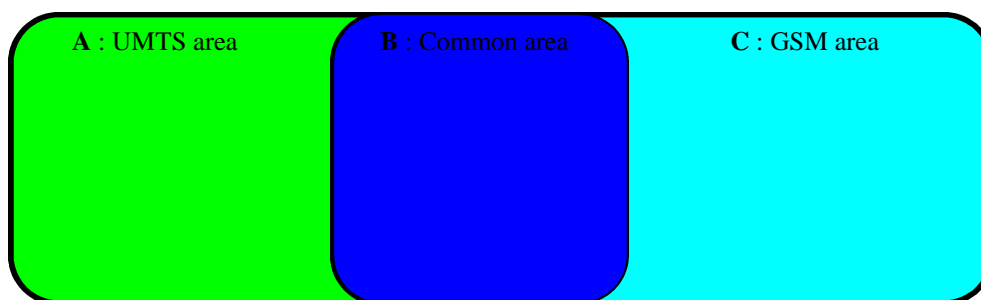


Figure 1: Service area

According to the UE types, described in section 4.1, the situation can be summarized as in Table 2. The table describes in which modes the UE can be registered and if it can be in active communication in just one, one at a time or both modes simultaneously.

Table 2: UE situation

| UE Type | Service area | Registered mode | Active communication modes |
|---------|--------------|-----------------|----------------------------|
| 1 | A | UMTS | UMTS |
| | B | UMTS or GSM | UMTS or GSM |
| | C | GSM | GSM |
| 2 | A | UMTS | UMTS |
| | B | UMTS or GSM | UMTS or GSM |
| | C | GSM | GSM |
| 3 | A | UMTS | UMTS |
| | B | UMTS and GSM | UMTS or GSM |
| | C | GSM | GSM |
| 4 | A | UMTS | UMTS |
| | B | UMTS and GSM | UMTS and GSM |
| | C | GSM | GSM |

Table 3 describes the different situations when an incoming connection is received by a UE in active communication.

Table 3: The situation for a UE in active communication when receiving an incoming connection

| UE mode | | GSM | | | | | | | | UMTS | | | | | | | |
|--------------------------|--------------|-----|---|------|---|-----|---|------|---|------|---|------|---|-----|---|------|---|
| Connected mode | | CS | | | | PS | | | | CS | | | | PS | | | |
| Add connection from mode | | GSM | | UMTS | | GSM | | UMTS | | GSM | | UMTS | | GSM | | UMTS | |
| Type | Service area | C | P | C | P | C | P | C | P | C | P | C | P | C | P | C | P |
| 1 | A (UMTS) | - | - | - | - | - | - | - | - | X | X | O | O | X | X | O | O |
| | B (Common) | - | O | - | X | O | O | X | X | X | X | O | O | X | X | O | O |
| | C (GSM) | - | O | - | X | O | O | X | X | - | - | - | - | - | - | - | - |
| 2 | A (UMTS) | - | - | - | - | - | - | - | - | X | X | O | O | X | X | O | O |
| | B (Common) | X | O | S | S | O | O | S | S | S | S | O | O | S | S | O | O |
| | C (GSM) | - | O | X | X | O | O | X | X | - | - | - | - | - | - | - | - |
| 3 | A (UMTS) | - | - | - | - | - | - | - | - | X | X | O | O | X | X | O | O |
| | B (Common) | X | O | S | S | O | O | S | S | S | S | O | O | S | S | O | O |
| | C (GSM) | - | O | X | X | O | O | X | X | - | - | - | - | - | - | - | - |
| 4 | A (UMTS) | - | - | - | - | - | - | - | - | X | X | O | O | X | X | O | O |
| | B (Common) | X | O | O | O | O | O | O | O | O | O | O | O | O | O | O | O |
| | C (GSM) | - | O | X | X | O | O | X | X | - | - | - | - | - | - | - | - |

C= circuit switched

P= packet switched

- = not possible

X= possible if direct re-direction of the connection in the CN. Applicable both for connections and signalling.

O= added connection OK if the UE can support it and the network allows it

S= the UE can be paged in the mode of active communication about the connection. For S to be possible the operators should have the different radio access technologies in their network. Changing of modes depends of the setting of the UE. (manually/automatically switched).

For idle mode the table becomes much simpler. Only two situations when the incoming connection can not be received are identified, and these are when a UE of type 1 and 2 is used and the incoming connection not is in the registered mode.

Table 4: The situation for a UE in idle mode when receiving an incoming connection

| Registered mode Incoming connection | GSM | | UMTS | |
|--|----------------|------|----------------|------|
| | GSM (CS or PS) | UMTS | GSM (CS or PS) | UMTS |
| Type of UE | | | | |
| 1 | OK | X | X | OK |
| 2 | OK | X | X | OK |
| 3 | OK | OK | OK | OK |
| 4 | OK | OK | OK | OK |

X= only possible if paged through the registered mode and re-routed to this radio access technology.

5.1.3 Outgoing connection

When initiating a connection, the chosen service may affect the choice of mode. The service may just be supported in one mode or the capabilities for the service may be better in a specific mode.

5.1.3.1 The UE in idle mode

If the appropriate mode for this connection is present, the connection can be set up. If a service is required by the user that the registered mode does not support or have limited support to, the network should hand over the UE to the radio access technology that supports the requested service. This means that the ME requests the call in the mode in which it is registered and the network hand it over to the mode that supports the service.

If the necessary mode is not present, the service may be connected with limited capabilities in the present radio access technology.

One exception from this may be with usage of UE of type 1. As the UE is not able to make measurements in other modes when registered in one mode, it is not possible for this type of UE to scan its surroundings. A handover may in this case consume a great deal of time and the user may not be positive to that. Then it might be better to set up the connection with limited capabilities, as the latter suggestion above describes.

5.1.3.2 The UE in active communication mode

5.1.3.2.1 UE type 1

No more outgoing connections, belonging to different modes, can be set up.

5.1.3.2.2 UE type 2

No more outgoing connections, belonging to different modes, can be set up.

5.1.3.2.3 UE type 3

In some cases it might be desirable to put the active connection on hold to set up another connection for a while. An example of this is when the UE is busy with a data session in one mode and the user wants to make a speech call in another mode. The data connection can then be set on hold to make the user able to perform the speech call and after that resume the data session.

5.1.3.2.4 UE type 4

The connection can be set up.

5.1.4 Inter-system handover

This is the only handover that is interesting for the present document. Other transactions such as to/from idle mode and to/from multical are not considered in the present document.

Handover may be initiated by:

- A service demanding a specific mode
- The UE losing coverage of the active mode
- The UE coming into coverage of a higher preferred mode, e.g. LSA concept
- The operator changing the mode of usage due to traffic reasons
- The preference list prioritising another than the present mode higher, e.g. GSM mode is prioritised higher than UMTS

Whether the handover should be initiated by the UE or the network is FFS. In [6], a handover between GSM and UMTS for a CS service is always network initiated whether the handover is from GSM to UMTS or not. On the other hand handover between GSM and UMTS for a PS service can be either network or UE initiated.

5.1.4.1 Inter-system handover versus service availability

The availability of services when handover between UMTS and GSM depend on the capabilities of the UE. The tables below, Table 5 and Table 6, tries to summarise several different situations for handover and what the impact on different services, such as speech and data services, are.

In the tables only a type 2 multi-mode UE is considered. The other types of UEs are FFS.

The terminal configuration describes the support of services in the available modes in the UE, e.g. the GSM CS means that the GSM part of the UE does not support PS connections.

Table 5: UMTS to GSM handover

| Multi-mode Terminal Type 2 configuration | Active communication in UMTS mode to be handed over | | |
|--|---|-------------|--|
| | CS services | PS services | CS+PS services (simultaneously) |
| UMTS CS/PS + GSM CS | X | Dropped | CS - X PS - dropped |
| UMTS CS/PS + GPRS class C | X (If CS is supported in GSM mode) | X | One of the active communications (CS or PS) will be dropped, subject to user or network preferences. |
| UMTS CS/PS + GPRS class B | X | X | One of the active communications (CS or PS) will be dropped, subject to user or network preferences. |
| UMTS CS/PS + GPRS class A | X | X | X |

X - The service and the active communication will be maintained through handover eventhough the change in e.g. service capabilities (e.g. speech codecs), data rate or QoS may be apparent to the user.

NA – not applicable

Table 6: GSM to UMTS handover

| Multi-mode Terminal Type 2 configuration | Active communication in GSM mode to be handed over | | |
|--|--|-------------|---------------------------------|
| | CS services | PS services | CS+PS services (simultaneously) |
| GSM CS + UMTS CS/PS | X | NA | NA |
| GPRS class C + UMTS CS/PS | X (If CS is supported in GSM mode) | X | NA |
| GPRS class B + UMTS CS/PS | X | X | NA |
| GPRS class A + UMTS CS/PS | X | X | X |

X - The service and the active communication will be maintained through handover eventhough the change in e.g. service capabilities, data rate or QoS may be apparent to the user.

NA – not applicable

5.1.5 For mobility management

While registered to a specific radio access technology, all MM procedures of that system should apply.

A LU from one radio access technology may be made valid for other radio access technologies as well.

Combining LU for different modes, e.g. the UE is registered in GSM and UTRA but still it is enough with one LU, is very desirable.

Combined LA or signalling between entities that makes it possible to direct a call or ask the UE/user to change mode.

5.1.6 Roaming

When roaming, mode should be chosen according to the preferred and forbidden network lists. The requirements for network selection can be found in [8].

For the procedure of radio access mode selection and reselection it is assumed that the UE frequently searches for available radio access technologies/PLMNs. The procedure may differ between types of UEs and operators.

After a registration in a desired mode (depending on the user settings for preferred mode/network), the UE should stay in this mode unless a mode selection/reselection is initiated either by the UE or the network, the network is lost or a certain service that requires a specific mode is chosen.

If the UE is set to automatic mode search and it is registered in a not preferred mode, i.e. at a low priority in the preferred mode list, the UE should switch to another mode, as soon as the more preferred mode is available.

5.1.7 Loss of coverage

When the UE is beginning to loose coverage it has to search for new networks to camp on.

To get the knowledge of other modes, two principles can be applied. Either the network tells the UE to make a scanning of the surroundings to search for another mode that is available or the UE continuously searches for other modes and tell the network when an interesting mode is becoming available.

For the first alternative, knowledge of the different modes and the locations of their cells have to reside within the network.

With the last alternative, the search may be restricted to be performed if the UE not is camping on and is registered in the highest prioritized network/mode.

If the network is lost, the UE should search for a suitable network within the same radio access technology first (presuming the user has set the UE to automatic switching with a preferred network list).

5.2 UMTS and 2nd generation or another radio access technology operated by different operators.

This scenario describes the case when the UMTS operator does not operate a 2nd generation system but has to rely on roaming agreements.

FFS

For this situation most of the things mentioned in the above chapters can be applied. Just the differences will be marked out in this chapter.

5.2.1 Power on

FFS

5.2.2 Incoming call/connection

When the user is chosen different operators for the modes in the UE, a type 3 UE might be the most interesting type of UE.

5.2.2.1 UE type 3

When this type of UE is in active communication, it can receive and answer pagings in the mode(s) that is not in active communication. This implies that an indication can be given to the user that an incoming connection exists in another mode and the user can then choose to set up this connection or resume to the connection already in active communication. During this procedure the active connection will be suspended. If the user chooses to accept the incoming connection, a hand over to the mode where the incoming connection resides should be made.

5.2.3 Outgoing connection

FFS

5.2.4 Inter-system handover

FFS

5.2.5 For mobility management

FFS

5.2.6 Roaming

When the UE comes into an area where no mode of the users own operator is present, a mode of another operator has to be chosen. The roaming agreements between operators should be the basis of the preferred network/PLMN lists.

FFS

5.2.7 Loss of coverage

FFS

5.3 Evaluation

Most work associated with handover between UMTS and GSM/GPRS is already initiated in the standardization. The work progresses but it is not sure that it will be finalized for R99.

Two independent search mechanisms are needed:

- Manual/automatic radio access technology search with a preferred radio access technology list
- Manual/automatic network search with a preferred network list / forbidden network list

A function residing within the network that gives the operator the opportunity to move the user/UE from one mode to another is desirable within the network.

An entity that keeps track of in which radio access technology the UE is camping or in active communication for the moment is also desirable.

6 Identities

For a multi-mode user it is desirable to have just one subscriber number. Eventhough the subscriber is just having one subscriber number the implementation in the network might be to have one identity for each mode that are combined in the network to only one subscriber number. How the treatment (e.g. in what entity the identities will be combined) and signalling of these multiple identities are interesting and important questions for a multi-mode UE usage. Evenso they are not treated in this version of the report.

7 Ongoing work and identified additional work

This section tries to collect all relevant documents related to multi-mode UE issues and reviews the multi-mode UE aspects in them. In some cases additional work has been identified.

The list of document may not be complete but more relevant documents might reside within the group.

7.1 TSG SA

In SA there is one document that collects all requirements for R99 that are set by the different WG:s within SA, TS 3G 22.100 [9]. The requirements on Multi-mode UE:s can be found in ch 8 and reads as follows:

“UMTS phase 1 shall support dual mode UMTS/GSM terminals. At least one Capability Class shall be standardised for mobile terminals supporting the GSM and UTRA modes. It shall support monitoring of cells belonging to the two types of access networks in idle mode (cell reselection procedure) and active mode (handover preparation procedure).”

This corresponds to a type 2 UE as defined in this report. The requirement does not exclude any other types of terminals as those defined in this report

7.1.1 SA1

7.1.1.1 Service requirements

The service requirements for release 99 is collected in TS 3G 22.101 [8]. The requirement related to Multi-mode UE:s can be found in ch. 17 (Handover requirements) and ch 18 (Network selection).

The handover requirements are very general and states that:

“Any handover required to maintain an active service while a user is mobile within the coverage area of a given network, shall be seamless from the user’s perspective. However handovers that occur between different radio environments may result in a change of the quality of service experienced by the user.

It shall be possible for users to be handed over between different UMTS networks subject to appropriate roaming/commercial agreements.

Handover between UMTS and GSM systems (in both directions) is required, even if this requires changes to GSM specifications. In addition, a generic solution may be implemented in UMTS which allows calls to be handed over between UMTS and other pre-UMTS systems in both directions.”

The initial requirements for network selection that are relevant for Multi-mode UE:s are:

“Three roles may be involved in UMTS network selection: the home environment, the serving network and the user. Services may be available to the user through a choice of several serving networks in a given location, possibly using different types of Radio Access Network. However it is expected that a user terminal will communicate with one network at a given instant (there may be exceptions such as when an inter-network handover occurs). “

Even more relevant for the UE and user is how the network selection shall be performed. For that three selection procedures are defined: a default automatic procedure, a manual procedure and a home environment specific procedure. The first two shall be implemented in all UMTS UE:s. As the multi-mode UE defined in this report shall include UMTS, these requirements is valid also for a multi-mode UE. This is also stated in this report for all types of UE:s and can be considered to be in line with the requirements.

A requirement that may affect the specified types of UE in this report is:

“If simultaneous access to more than one home environment is required (through a card with multiple USIMs or through several cards in a multi-slot terminal), manual selection shall be invoked.”

The type 3 UE should be able to camp on several cells from different radio access technologies that are belonging to different operators/PLMN:s at the same time and still an automatic switching between modes are defined for this types of terminal. This has to be considered in later releases of the report. Either the definition of this type of terminal has to be changed or the requirement has to change. The type 3 terminal is not of highest priority for R99 and therefore this is left ffs.

7.1.1.2 Handover requirements

TS 3G 22.129 [4] is a specification that only deals with handover requirements, both within UMTS and between UMTS and GSM. The requirement for handover from UMTS to GSM can be found in clause 6 and the requirements for handover from GSM to UMTS can be found in clause 7.

The requirements for handover from UMTS to GSM are divided into operational, performance and service requirements. The requirements most affecting the UE are those in the performance clause, which include Detection Time of Potential GSM Handover Candidates, Number of GSM handover candidates to detect, Probability of Connection Loss and Temporary degradation of service caused by handover. As a summary it can be said that the requirements that is set for intra-GSM handover shall be applied even when handover from UMTS to GSM. More stringent requirements than that are not set. These requirements mostly affects the radio part of the Multi-mode UE and some of the specifications for that can be found in clause 7.2 in this report.

In the clause with service requirements there are no specific requirements except for the speech, USSD and data bearer service. These services should be continued after a handover. An example of a service that may be interrupted after a handover is the facsimile service.

For the speech service it is said:

“any call based on the default UMTS speech codec shall be mapped to the FR GSM speech codec. In the case the terminal and the GSM network support AMR and /or EFR and/or HR, it shall be the operators choice to define the appropriate mapping.”

For USSD it is said:

“The technical standards shall provide means to ensure that any handover that occurs during a USSD interaction need no more affect the service than intra-GSM handover.”

For the data bearer service it is said:

“Standards shall be defined to permit the possibility of handover of a UMTS connection oriented data bearer service to GSM which shall result in an appropriate GSM/GPRS bearer service. The mapping between UMTS data bearer services and appropriate GSM/GPRS data bearer services will depend upon many factors such as

data rate, delay constraints, error rate etc. Means shall be provided for the application to indicate minimum acceptable QoS for service continuation after handover.”

In the clause with requirements for handover from GSM to UMTS mostly just requirements for services are dealt with. The services that should continue after a handover are speech, USSD, a circuit switched data service mapped onto a UMTS packet switched data service and a data switched packet service (if not the change of QoS is too big to be accepted by the user).

When using multiple bearer services in GSM/GPRS it is said that:

“Consideration must be given to multimedia services which may involve the use of multiple bearer services. For example Class A GPRS terminals will be capable of simultaneously supporting more than one data bearer services. The mapping between GSM/GPRS data bearer services and UMTS bearer services will depend upon many factors such as data rate, delay constraints, error rate etc. Means shall be provided to allow handover of several data bearer services from GSM to UMTS. Means shall be provided for the application(s) to indicate minimum acceptable QoS for services continuation after handover.”

These service requirements shall apply for all multi-mode UE:s that supports these kind of services.

6.1.2 SA2

6.1.2.1 Architectural requirements on UMTS for release 99

3G TS 23.121 [6] describes the architectural requirements on UMTS for release 99.

This specification divides connections into if they are in the CS or in the PS domain. The division between GSM and UMTS radio access technology is not so obvious for the core network. From an architectural point of view the division between the CS and PS domain are more important.

Data retrieval between UMTS and GPRS is dealt with in ch. 4.2.2.1. There is even a proposed solution how it shall be done.

The MM procedures for UMTS are described in section 4.3. In section 4.3.1.1 there is a requirement for the R99 UE to support both combined and separate update mechanisms between CS and PS services. The background is that in GSM/GPRS combined updates between RA and LA can be made via the Gs interface between MSC/VLR and SGSN. This possibility is facilitated to optimise the radio resources. As said before, in UMTS it is suggested to use both separate and combined updates for R99 UE:s.

In ch 4.3.14.3 there is a small comparison between MM for UMTS and GSM. The reason for the comparison is to see if the same signalling can be used and how the MM messages should be transferred when handover. If a combined update between GSM and UMTS can be done is in a way studied in [3] as described further down.

Chapter 6 is totally devoted to the questions on interoperability between GSM and UMTS. In the beginning a recommendation of combined updates if a UE is supporting simultaneous ISDN/PSTN and packet services is made. Otherwise the chapter deals with the signalling procedures for handover between UMTS and GSM. The only thing that is affecting the terminal is where the decision of the handover is performed. For CS services the decision is taken in RNS for UMTS to GSM handover and in BSS for GSM to UMTS handover. For PS services the decision can be made in either the UE, the BSS or in the SRNS. This applies for both directions of handover. In this case the details for how the decision shall be made is FFS.

6.1.2.2 Additional architectural requirements

3G TR 23.920 [3] collects architectural requirements that are not yet accepted or stable enough to be included in the other architectural specification, 23.121.

A small section on the procedures for ciphering keys is included in ch. 5.5.2 and deals with the case of UMTS-GSM handover. The actual interoperation in the case of different ciphering keys for UMTS and GSM are for further study. This does not directly affect the UE but rather the USIM.

Dual-mode operation between UMTS and GSM when the GSM part of the UE is a MS of GPRS class A is handled in chapter 5.8. The section deals with questions of MM procedures and availability of PS services after a handover of a CS service from one of the radio access technologies to the other. The suggestions include letting the UMTS MM to do

distinction between CS and PS services in the registration related procedure. The requirements on the MS/UE are that it must be capable of handling the GSM-UMTS dualism, i.e. to be a multi-mode UE.

The UMTS Mobility Management (UMM) for R99 shall use packet anchoring at the GGSN. This implies that some changes have to be introduced in GPRS. In section 5.9.5.4 the affects the requirements of QoS when using the anchor concept and the UE/MS described above (a dual-mode UE with a UMTS part that supports simultaneous CS and PS services combined with a GPRS class A MS) is described. There are no specific requirements on the multi-mode UE and all suggested changes reside in the network.

A definition on simultaneous mode has been made in chapter 5.17. It is defined as:

“Simultaneous mode is defined as the support of active parallel CS and PS communications.

The UE has simultaneous PS MM Connected and CS MM Connected states when in UE simultaneous mode.”

In this section it is also stated that it is important that from day one of UMTS launch supply terminals that supports simultaneous active communication with both the CS and the PS domain. This requirement only applies for and within UMTS but puts special requirements on the UE in respect to terminal capabilities.

Chapter 5.18 deals with the question on GSM and UMTS cells in the same registration area. This could save a lot of signalling when changing between UMTS and GSM, as also described and asked for in the scenarios (chapter 5.1.5). One reason for introducing this is, as stated in [3], that:

“Third generation needs to offer higher quality (eg higher MT call success rate) than second generation. Hence the capability to have GSM and UMTS cells in the same Registration Area is needed for at least CS traffic.”

Some open issues still reside for implementing GSM and UMTS in the same registration area and these are questions on security, network service capabilities, terminal capabilities, idle mode control and the capacity of paging channels, as described in [3].

7.1.3 SA3

TBD

7.1.4 SA4

TBD

7.1.5 SA5

TBD

7.2 TSG RAN

7.2.1 RAN1

7.2.1.1 Physical layer – general description

The specification 25.201 [15] is the general description of the physical layer in UTRAN.

In chapter 4.2.5, Physical layer measurements, it is stated that the UE shall be able to perform:

“(2) The measurement procedures for preparation for handover to GSM900/GSM1800;”

It also gives an overview of all the other documents produced within RAN1. The documents described below are the most relevant from a multi-mode UE perspective.

7.2.1.2 Physical layer – Measurements (FDD)

TS 25.215 [16] describes the measurements on the physical layer for the FDD mode.

The scope is to establish the characteristics of the physical layer measurements in the FDD mode, and to specify:

- the measurements that Layer 1 is to perform;
- reporting of measurements to higher layers and network;
- handover measurements, idle-mode measurements etc.

Chapter 5.1 describes the measurement abilities for the UE. Among them we have the GSM carrier RSSI which is defined as:

“Received Signal Strength Indicator, the wide-band received power within the relevant channel bandwidth. Measurement shall be performed on a GSM BCCH carrier. The reference point for the RSSI is the antenna connector at the UE”

UTRAN carrier RSSI is also described in a similar way to the GSM carrier RSSI, as the specification is made for the UTRAN.

The compressed mode, making it possible for the UE camping or in active communication in UMTS, to make measurements in other radio access modes/technologies is described in chapter 6.

These measurements are in line with the, in the present report, definition of a type 2 UE.

7.2.1.3 TS 25.225: Physical layer – Measurements (TDD)

TS 25.225 [17] describes the measurements on the physical layer for the TDD mode.

The scope is to establish the characteristics of the physical layer measurements in the TDD mode, and to specify:

- the measurements that Layer 1 is to perform;
- reporting of measurements to higher layers and network;
- handover measurements, idle-mode measurements etc.

The general measurements concept can be found in chapter 4.1. Chapter 4.2 is describing the measurements for cell selection/re-selection and chapter 4.3 is describing the measurements for handover.

The UE measurement ability is described also in chapter 5.1, including the GSM carrier RSSI. In this chapter an Observed time difference to GSM cell is also defined as:

“Time difference between the Primary CCPCH of the current cell and the timing of the GSM cell”

These measurements are in line with the, in the present report, definition of a type 2 UE.

7.2.2 RAN2

7.2.2.1 UE functions and Interlayer procedures in Connected Mode

In 3G TS 25.303 [2] the functions and Interlayer procedures for a UE in connected mode are described. It starts with defining the UE states and states transitions. The states and states transitions are divided according to if a the UE is utilising the CS GSM domain (PSTN/ISDN only) or the GSM/GPRS domain (IP only).

Section 5.6 shortly describes the inter-system handover between UMTS and GSM when simultaneous services in the IP and the PSTN/ISDN domain are used. This procedure requires a terminal with GPRS class A capabilities and no other inter-system procedures for terminals not capable of simultaneous services are described. A GPRS class A MS is not thought to be produced in the nearer future and therefore procedures for other GPRS classes are also needed. Possibly these procedures can be used even if the UE is not connected to both domains at the same time.

The RRC mobility procedures are described not just for FDD and TDD but also for inter-system handover between UMTS and GSM. These procedures are just described for the PSTN/ISDN domain and the procedures for the IP domain are lacking.

7.2.2.2 UE Procedures in Idle mode

In RAN2 another specification dealing with procedures for a UE, 3G TS 25.304 “UE Procedures in Idle Mode” [5], is produced.

The specification shall, according to the scope, include examples of inter-layer procedures related to the idle mode processes and describes idle mode functionality of a dual-mode UMTS/GSM UE. Even so there is no description on how radio access technology shall be chosen. The specification only talks about PLMN selection and reselection. In the section with PLMN selection and reselection (5.1) it is stated:

“Selection of the radio access system may be part of the PLMN selection and reselection process or it may be a separate process inside NAS [FFS].

[Note: Details of the possible NAS process of the radio access system selection are out of the scope of TSG-RAN WG2.]”

The Non Access Stratum (NAS) and the Access Stratum (AS) is a functional division to serve as a basis for the work division between SMG2 UMTS L23 and other groups.

The present report recommends that a specific procedure for choice of radio access technology should be implemented. Some suggestions on how this procedure could be outlined can be found in section 5.1.1.

7.2.3 RAN3

TBD

7.2.4 RAN4

7.2.4.1 RF System Scenarios

The RAN4 report, 25.942 [12], describes the RF System Scenarios. It is/has been used when defining UTRAN and the scope states:

“During the UTRA standards development, the physical layer parameters will be decided using system scenarios, together with implementation issues, reflecting the environments that UTRA will be designed to operate in.”

No scenarios describing the effects of combined UTRAN and GSM environment is present in the report.

7.2.4.2 RF Parameters in Support of Radio Resource Management

Another document produced by RAN4 is 25.103 [13]. This specification describes the RF parameters in support of radio resource management (RRM). Section 6.1.4 in this specification treats the RRC Mobility connection for Handover from 3G to 2G. The section describes the UE requirements for performing handover from UMTS to GSM, e.g how many carriers the UE shall be able to monitor and synchronise. The opposite direction is not treated and for that direction references to GSM specifications are made.

7.3 TSG CN

7.3.1 CN1

TBD

7.3.2 CN2

TBD

7.3.3 CN3

TBD

7.4 TSG T

7.4.1 T1

T1 has at present stage an Interim Working Document called “Combined testing areas for RF and Signalling; Idle mode operations, handover and measurement reporting” [14]. The scope of the document states:

“The purpose of the present document is to be used as a permanent-working document within T1 to elaborate the combined testing areas of RF and signalling. Those areas are:

- PLMN selection/reselection
- Cell selection and reselection
- Handover, hard/soft, FDD/TDD, 2G/3G
- Location Area (LA) and Routing Area (RA) updating (MS idle mode)
- Cell and UTRAN Registration Area (URA) updating (MS connected mode)
- Measurement reporting

The present document describes the status of core requirements for conformance testing of Mobile Station idle mode operations. The present document primarily focuses on the MS idle mode operations in a pure 3G environment. However, the scope will be expanded covering also test cases for idle mode operations in the GSM/3G case as soon as possible. “

Chapter 5.1.3, MS idle mode – Inter Radio Access System selection and cell reselection, contains a table with system scenarios (e.g. Inter Radio Access System cell reselection from GSM to UTRAN; Successful cell reselection) and the appropriate core specifications for these system scenarios. The scenarios are describing both the cell re-selection from GSM to UMTS and from UMTS to other radio access technologies.

Chapter 5.2.6, MS connected mode – Inter Radio Access System Handover scenarios; describes the system scenarios for connected mode and directs to the appropriate core specifications for these system scenarios. The system scenarios are here e.g. “Reception of message XXXX by the UE”, “Reception of message INTER SYSTEM HANDOVER COMMAND by the UE” and “Abnormal case: UE fails to complete requested handover”.

This document can be considered as rather important as a reference document as it collects all relevant specifications for different procedures.

7.4.2 T2

In the report 3G TR 21.904 [10], the choice of radio access technology is introduced in a diagram in a chapter 4 where the baseline definitions for a UE are described. The diagram makes the choice of radio access technology before searching for networks to register on. If no network is found within the radio access technology chosen, a new radio access technology is chosen and the procedure is performed once again.

This procedure is the in line with what is proposed by this report.

7.4.3 T3

The requirement document for T3, 21.111 [11], collects all relevant requirements for the USIM and the IC Card. One section, section 11, is concerned with 3GPP/GSM interworking. The requirements deal with GSM subscribers in a 3GPP network and 3GPP subscribers in a GSM network.

8 Conclusions

8.1 General

A lot of work has been done to clarify the types of multi-mode UEs. When combining the different modes there will be a lot of other combinations of UEs as the GSM mode encompasses circuit switched GSM and the different types of GPRS terminals. On the other hand the UMTS mode of the terminal can encompass FDD and/or TDD and in that mode just be capable of CS or PS services or have capabilities of both.

8.2 Identified requirements

A network entity that knows the users preferences concerning choice of radio access technology. This functionality is necessary to be able to direct the user to a preferred mode and if just network originated handover is possible.

8.3 Identified work items

FFS.

Annex A: Procedures in connected mode

A.1 General description

A UE is considered to be in connected mode when at least one signalling/RRC connection is active in one or several of the modes. [2]

In the connecting state of a multi-mode UE it is important to have connections between the different states in which the UE can be active.

To enable a UE to move from the idle mode to a connected state it is important for the different modes to be connected:

- to avoid connection failures
- to allow correct call set up according to UE type
- for allocation of the correct mode for the service requested

This clause identifies the actions that affect the connected mode of a user, e.g. when they enter new radio access technology areas. The addition or modification of bearers to a call will impact the connected mode of the UE and will become more complex when handovers between modes are designed., particularly if the nature of the bearer is altered e.g. PS to CS. The figure below identifies the possible changes to the connected mode that should be discussed, they split into 3 main areas:

- Call set up and termination
- Addition, modification or lose of a bearer
- Handover to another radio access technology

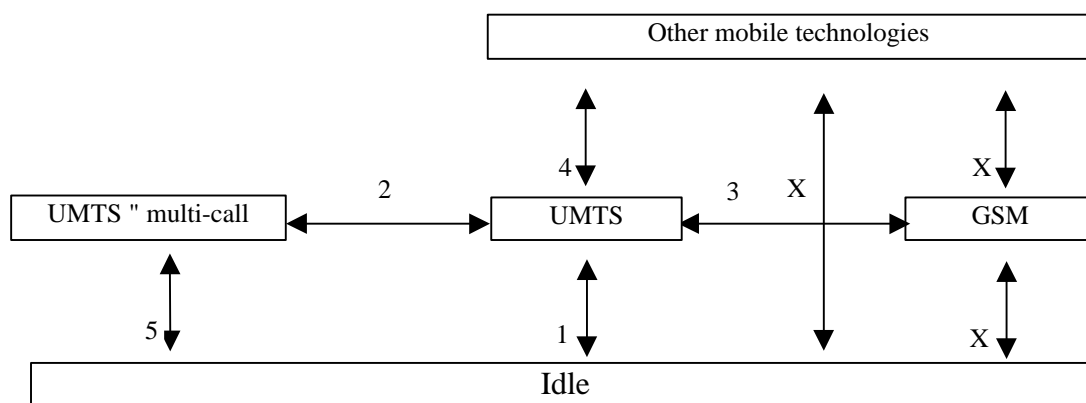


Figure A.1: Transition route between radio access technologies (the numbering system is discussed below)

Idle mode in the figure A.1 describes the idle mode for any of the radio access technologies. All other boxes identify an active call on the specified radio access technology. The UMTS Multicall box indicates that the UE may use more than one bearer, whether these bearers are related or not.

A.1.1 In Scope

A number of connecting states have been identified in the diagram above. The following connecting states shall be considered as in scope for this clause of the document:

A.1.2 Transition 3 UMTS - GSM

This interface considers the:

- Complete handover of a call to GSM from UMTS or vv
- Addition of a connected state in GSM e.g. a speech call or vv

A.1.3 Transition 4 UMTS to Other Access Technologies

This transition is important but will be left FFS.

This interface considers the:

- Complete handover of a call to other access technologies from UMTS or vv
- Addition of a connected state to other access technologies or vv

A.1.4 Out of Scope

A number of scenarios have been identified as out of scope for this clause these include:

- Idle mode to GSM or vv
- Idle mode to UMTS or vv
- Idle mode to UMTS Multicall or vv
- UMTS to Multicall or vv
- Complete or partial call handover from GSM to other access technologies or vv
- Call set up or termination from idle mode to other access technologies

A.1.5 For Further Study

The transition of the same service to another mode, the identified transitions are:

| State 1 | State 2 |
|---------|----------------------------|
| UMTS PS | UMTS CS |
| UMTS PS | GSM PS |
| UMTS CS | GSM CS |
| UMTS PS | GSM CS |
| UMTS CS | GSM PS |
| UMTS PS | other access technology PS |
| UMTS CS | other access technology CS |
| UMTS PS | other access technology CS |
| UMTS CS | other access technology PS |

These transitions can be done in either direction.

A.3 Inter system handover

A.3.1 General Issues identified to be considered for Inter-system handover

Complexity issues - signalling in the network, complexity of the UE.

Delay requirements - at handover between UMTS and GSM systems and call types i.e. more delay can be tolerated when web surfing than a speech call.

Roaming - handover becomes more complex, and these issues need to be considered.

A.3.2 UMTS to other radio access technologies

TS 23.121 [6], 7.7 – Alternate Access technologies to UTRAN (BRAN/HiperLAN)

This type of handover will mainly be used for corporate and home environments. There are 2 possible network architectures to take into account:

- both modes are managed by the same operator;
- both modes are managed by different operators.

In the first case the handover may be simple as all the mobility management and signalling is managed by a single core network, this will allow a fast handover of the call. The network will make the handover more reliable as it will be able to force the UE back to the original connection if the handover fails.

In the second scenario the handover will be slower as location information, signalling and routing of the call has to be transferred completely to another network. If the handover has failed and the first network has passed the call to the other operator there is no chance to re-establish the call.

The complexity of the call handover will vary depending on the other access technology used, e.g. DECT, BRAN, HiperLAN.

Bibliography

The following material, though not specifically referenced in the body of the present document (or not publicly available), gives supporting information.

<Publication>: "<Title>"

History

| Document history | | |
|------------------|---------|--|
| V 0.1.0 | 1999-04 | First draft (scope, definitions, structure) proposed by editor |
| V 0.2.0 | 1999-05 | Updated draft (types of terminals and scenarios) proposed by the editor |
| V 0.3.0 | 1999-07 | Updated draft, according to discussion on the last meeting in Miami. |
| V 0.4.0 | 1999-08 | Updated draft, according to discussions on the last meeting in Malmö |
| V 0.5.0 | 1999-09 | Updated draft, according to discussions on the last meeting in Helsinki. The many detailed descriptions have been excluded and instead the main points have been put in the scenarios. They should be considered as a basis for a future requirement document for multi-system terminals. |
| V 0.6.0 | 1999-10 | Updated draft, according to discussion on the T2 meeting in Kyongju. The structure of the report is now considered that stable that it can be presented for T2 to be raised to version 1.0.0 and for TSG T for information. |
| v 1.0.0 | 1999-10 | Presented to TSG-T#5 for information |
| V 1.0.1 | 1999-10 | Editorial Changes |
| V 1.1.0 | 1999-11 | <ul style="list-style-type: none"> – New scope inserted according to e-mail discussion on the SWG5-reflector in the end of October. – The scope has changed tense to describe what is in it and not what should be in it. – A reference to a type 2 terminal in the scope has also been taken away to not refer to something that comes in the report. – Definition of Multi-mode terminal and Multi-system terminal deleted. The definition from 22.129 (Hand-over requirements) inserted instead. – Definitions on “radio access system” and “radio access mode” inserted from 25.990. – Definitions on different kind of handover inserted from 21.129. – The word “system” changed to “mode” or “radio access system”, where appropriate. – The word “terminal” have been changed to UE in most places. – In ch. 4.2.1.4 (Inter-system handover) a table has been included to describe service aspects of handover between UMTS and GSM. The table only deal with a type 2 multi-mode terminal and the other types are FFS. The table is not complete yet (there are lots of aspects not covered) and comments on the table and/or inputs in this area are very welcome! – The annexes have been cleared up and some of the information has been put in the other clauses. |
| V 1.2.0 | 1999-11 | <ul style="list-style-type: none"> – The definition of “radio access system” changed to “radio access technology” according to the discussions and decisions in RAN2. – The definition of an active communication refined once again. – Through all the report it has been clarified when the UE shall be “active” or in “active communication”. – The table with the different types of UE in chapter 4 is refined and clarified with requirements and statements. – The clause with scenarios has been raised to an own chapter. |

| | | |
|---|---------|---|
| V 1.3.0 | 1999-11 | <ul style="list-style-type: none"> – The scope changed to be clearer about the included modes in a multi-mode UE described in the report, i.e. UMTS and GSM. – The definition for “active communication” refined once again – A few more references have been included. – All “shall” that explains procedures and functionality of the UE has been changed into “should” to loosen up the language to not sound as in a specification. – A note is included in the beginning of chapter 4.1 about the main focus for the report and R99 is the type 2 UE. A reference to table 1 is also included. – Clarifications included within and above table 1 to make it clear that the table deals with requirements on the different types of UE and the network. – Two clarifying notes have been included in the beginning of chapter 5, Scenarios. – Section 6, Identities, has been changed to include interesting and relevant questions in this area, but states that they are not treated in this version of the report. – Chapter 7 have been revised according to T2-990993 – Text for chapter 7 for RAN1, RAN4 and T1 has been included – Chapter 8, Conclusions, has been cleared up. <p>In addition to this some editorial changes have been made to improve the readability of the report.</p> |
| V 1.3.1 | 1999-11 | <ul style="list-style-type: none"> – The table of content updated – Some minor editorial changes |
| V 1.3.2 | 1999-11 | Editorial Changes |
| <p>Editor for 3G TR 21.910:</p> <p>Sofi Persson</p> <p>Telia Research AB</p> <p>Tel: +46 40 105125</p> <p>Fax: +46 40 307029</p> <p>Email: sofi.a.persson@telia.se</p> <p>This document is written in Microsoft Word 97.</p> | | |