Technical Specification Group Services and System Aspects
Meeting #10, Bangkok, Thailand, 11-14 December 2000

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Source: **TSG SA1**

Title: **CRs to 22.129 on Handover requirements (R99)**

Document for: **Approval**

Agenda Item: **7.1.3**

Spec	CR	Rev	Phase	Cat	Subject	Vers	New Vers	SA1 Doc. No.
22.129	015		R99	F	Handover requirements	3.4.0	3.5.0	S1-000863
22.129	016		R4	A	Handover requirements	4.0.0	4.1.0	S1-000864

3GPP TSG-SA WG1 Meeting #10 **S1-000863**
Orlando, Fl, USA, 13-17 November 2000

CR-Form-v3

CHANGE REQUEST

22.129	CR	015	rev	-	Current version:	3.4.0

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ✍ symbols.*

Proposed change affects: ✍ (U)SIM ☐ ME/UE ☐ Radio Access Network [X] Core Network [X]

Title: ✍	Corrective CR to 22.129 for R99	
Source: ✍	SA1	
Work item code: ✍		***Date:*** ✍ 17 November 2000
Category: ✍	F	***Release:*** ✍ R99

Use one of the following categories:
F *(essential correction)*
A *(corresponds to a correction in an earlier release)*
B *(Addition of feature),*
C *(Functional modification of feature)*
D *(Editorial modification)*
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:
2 (GSM Phase 2)
R96 (Release 1996)
R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
REL-4 (Release 4)
REL-5 (Release 5)

Reason for change: ✍	Alignment of R99 Stage 1 (22.129) with R99 stage 2 and 3 specifications and clarification of requirements. Replacement of terms UMTS and GSM to be inline with other S1 specifiations.
Summary of change: ✍	Removal of requirements from the R99 stage 1 specifications which are not included in R99 stage 2 and 3 specifications. Removal of terms UMTS and GSM. Clarification of Service Continuity requirements.
Consequences if not approved: ✍	22.129 for R99 will not be aligned with other R99 specifications.

Clauses affected: ✍	All		
Other specs affected: ✍	☐ Other core specifications ☐ Test specifications ☐ O&M Specifications	✍	
Other comments: ✍			

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3GPP TS 22.129 V3.~~4~~5.0 (2000-10)

Technical Specification

3rd Generation Partnership Project;
Technical Specification Group Services and System Aspects
Service aspects;
Handover Requirements between ~~UMTS~~UTRAN and ~~GSM~~GERAN or other Radio Systems
(Release 1999)

Keywords

UMTS, GSM, handover

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Contents

Foreword

This Technical Specification has been produced by the 3GPP.

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

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the specification;

1 Scope

The scope of this document includes service requirements for ~~handover (terms are defined below) within UMTS systems and between UMTS, other IMT-2000 family members and 2nd generation systems. Particular emphasis has been placed on the description of requirements for handover between UMTS and GSM but requirements specific to other systems are incorporated as required.~~

~~UMTS is a "third generation" mobile cellular radio telecommunications system which provides telecommunication and information services to wireless terminals. Mobile cellular systems have the defining characteristic that they are capable of~~ maintaining continuity of service to a wireless terminal as it moves between the radio coverage area, or "cells", associated with different base station sites~~.~~. This functionality is called "handover". Handover can also occur due to change of radio resource providing a service without necessarily any change of the base stations involved. In particular, when the radio resources providing a service change from one of the UTRA radio access modes to the other (UTRA-FDD and UTRA-TDD), this is regarded as handover. Particular emphasis has been placed on the description of requirements for service continuity within UTRAN and between UTRAN and GERAN but requirements specific to other systems are incorporated as required.

It is a key requirement ~~of UMTS that it~~to allow~~s~~ for dual or multi-mode ~~(e.g. UMTS/GSM)~~ terminals to handover traffic from UTRAN~~MTS~~ to other radio systems such as GERAN~~SM~~ and vice versa. This document describes the service requirements for intra- and inter- system handover~~, that shall be used by other SMG STCs to guide the implementation of UMTS to (e.g.) GSM handover specifications. It defines requirements for the enhancement of the GSM specifications to allow GSM to UMTS handover.~~

The following subject areas are within the scope of these service requirements:

- User perceived performance that may be influenced by handover;
- Operational requirements relating to handover;
- Security requirements.

The requirements set forth in this document are service requirements, in that they fulfil the following:

- The requirements are independent of the implementation of the UTRAN;
- The extent to which the requirements are met are in principle verifiable using observables that are not internal to the UTRAN.

1.1 Situations in which Service Requirements apply

The service requirements in this document are as far as possible independent of the implementation ~~of the UTRA~~. They therefore apply to situations where handover would occur regardless of how the ~~UTRA~~radio access network is implemented. Situations envisaged are:

- Handover within UTRAN~~MTS~~ due to change of radio resource caused by UE movement between areas covered by different transmitters;
- Handover within ~~UMTS~~UTRAN due to change of UTRA radio access mode;
- Handover due to change of radio system ~~(e.g. UMTS to GSM).~~

It is possible that handover (i.e. change of radio resource) will occur in other situations, for example the technical implementation of the UTRAN may necessitate it or O&M procedures initiated by the operator may force it. Requirements for these situations are not within the scope of this document, with the exception of two remarks:

- Where the technical implementation of the UTRAN necessitates handover as a matter of normal operation (i.e. not related to the above situations), then services shall in no way be degraded or adversely affected;
- The service requirements for handover occurring in situations such as O&M activity are outside the scope of this document.

2 References

The following documents contain provisions that, 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] GSM 05.08: "GSM Digital cellular telecommunications system (Phase 2+); Radio subsystem link control".~~

~~[23] 3GPP TS 22.115: "Service aspects; Charging and Billing".~~

~~[4] 3GPP TS 22.120: "3G Security; Security Principles and Objectives".~~

~~[45] 3GPP TS 22.090: "Unstructured Supplementary Service Data (USSD) - Stage 1".~~

[6] TR 21.905: " Vocabulary for 3GPP Specifications ".

3 Definitions and Abbreviations

3.1 Definitions

In addition to the following, abbreviations used in the present document are listed in TR 21.905 [6].
For the purposes of the present document, the following definitions apply:
Connection mode (for a bearer service): characterises the type of association between two endpoints as required by the bearer service for the transfer of information. A bearer service is either connection-oriented or connectionless. In a connection oriented mode, a logical association called *connection* needs to be established between the source and the destination entities before information can be exchanged between them. Connection oriented bearer services lifetime is the period of time between the establishment and the release of the connection.
Connectionless (for a bearer service): In a connectionless bearer, no connection is established beforehand between the source and the destination entities; the source and destination network addresses need to be specified in each message. Transferred information cannot be guaranteed of ordered delivery. Connectionless bearer services lifetime is reduced to the transport of one message.
~~**GSM**~~**GERAN coverage**: an area where mobile cellular services are provided by a GERAN in accordance with ~~GSM~~GERAN ~~standards~~specifications.
~~**UMTS**~~**UTRAN coverage**: an area where mobile cellular services are provided by a UTRAN in accordance with ~~UMTS~~UTRAN ~~standards~~specifications.
Multi mode terminal: UE that can obtain service from at least one UTRA radio access mode, and one or more different systems such as ~~GSM~~GERAN bands or possibly other radio systems such IMT-2000 family members.
Handover: The process in which the radio access network changes the radio transmitters or radio access mode or radio system used to provide the bearer services, while maintaining a defined bearer service QoS.
Intra PLMN handover: Handover within the same network, i.e. having the same MCC-MNC regardless of radio access system. Note: this includes the case of ~~UMTS~~UTRAN <>~~GSM~~GERAN handover where MCC-MNC are the same in both cases.
Inter PLMN handover: Handover between different PLMNs, i.e. having different MCC-MNC.
Inter system handover: Handover between networks using different radio systems , e.g. ~~UMTS~~UTRAN – ~~GSM~~GERAN.
UTRA Radio access mode: the selected UTRA radio access mode i.e. UTRA-FDD; UTRA-TDD.
Radio system: the selected 2nd or 3rd generation radio access technology~~, e.g. UMTS or GSM~~.
Service Continuity: The means for maintaining active services during changes in the coverage areas or their characteristics without, as far as possible, the user noticing. Note that Service Continuity can be achieved by handover, cell re-selection or other mechanisms.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:
UE User equipment

4 General Principles governing ~~handover requirements~~service continuity

This section describes the general principles for service continuity within the UTRAN, within the GERAN and between the UTRAN and other radio systems such as GERAN. As a principle, the requirements on service continuity characteristics should be according to the target network on which the service is maintained.
~~This section describes the general principles governing the operation of UMTS when preparing for and executing handover both within UMTS and to another radio system such as GSM. It also describes the additional concepts required to be included in GSM to allow preparation for and handover to UMTS. As a principle, the requirements on~~

~~handover characteristics should be according to the network to which the handover is made.~~

4.1 Service Continuity Scenarios

Service continuity shall support the following scenarios:

1. Continuity of active CS services when moving within UTRAN, within GERAN and between UTRAN and GERAN coverage areas.

2. Continuity of active GPRS sessions when moving within UTRAN, within GERAN and between UTRAN and GERAN coverage areas.

Service continuity is not applicable for any call or session using resources specific to the source domain that cannot be maintained using resources in the target domain.

4.2 Service Continuity requirements

For all scenarios, the specifications shall cover both service continuity within the same PLMN (intra-PLMN) and between PLMNs (inter-PLMN) including the case where the PLMNs involved are operated by different network operators.

4.2.1 Service continuity for CS

The scenario numbers in this table refer to the scenarios in section 4.1.

		To CS services	
		UTRAN	**GERAN**
From CS services	**UTRAN**	Yes - Scenario 1	Yes - Scenario 1
	GERAN	Yes – Scenario 1	Yes – Scenario 1

4.2.2 Service continuity for GPRS

Service continuity of GPRS sessions (conversation, streaming, interactive and background) is required within the GERAN, within the UTRAN, and between the UTRAN and GERAN (scenario 2 in section 4.1 above).

Note: Service continuity for conversational, streaming and interactive GPRS sessions is not applicable to and from GERAN Release 99, due to the lack of support for the conversational, streaming and interactive GPRS within GERAN Release 99. In the case of continuity to GERAN R99, although the QoS required may not be available in the target, the bearer shall be maintained as long as possible. If the QoS supported by GERAN R99 is not acceptable, the user/application may terminate the session.

~~**The handover matrix**~~

~~**handover possible?**~~	~~**to UMTS**~~	~~**to GSM cs**~~	~~**to GSM GPRS**~~	~~**to IMT2000 ? UMTS**~~
~~From UMTS~~	~~1~~	~~1~~	~~1~~	~~x~~
~~From GSM cs~~	~~1~~	~~oos~~	~~oos~~	~~oos~~
~~From GSM GPRS~~	~~1~~	~~oos~~	~~oos~~	~~oos~~
~~From IMT2000 ? UMTS~~	~~x~~	~~oos~~	~~oos~~	~~oos~~

~~oos = out of scope of UMTS specifications~~

~~1= supporting standards required for UMTS release 99.~~

~~x= supporting standards required, not necessarily for release 99.~~

~~GSM GPRS in the table refers to R97, R98 and R99 GPRS.~~

~~For UMTS release 99 means shall be defined which:~~

~~1) Enable handover to a GSM network from a UMTS network;~~

~~2) Enable handover to a UMTS network from a GSM network.~~

~~In both the cases above the GSM network may be operated by either the same network operator as the UMTS network or a different network operator.~~

~~Handover of real time PS services between UMTS and GPRS R99 is out of the scope of UMTS R99 phase 1 and shall be considered in subsequent phases. Service continuity of best effort packet services between UMTS and GPRS is required.~~

~~4.1 Requirements for Service Capabilities~~

~~UMTS standardises service capabilities, not services. As part of the service capabilities it is envisaged that applications may wish to respond to events related to handover that either has occurred, is about to occur or could potentially occur. The service capabilities described in this section should be available at least to UE hosted applications.~~
~~The following list of uses is provided as an example and is not intended to be exhaustive:~~

- ~~An application may wish to accept or reject offered QoS;~~
- ~~An application may wish to cope to the effect that handover has on a service, for example facsimile retransmission;~~
- ~~An application may wish to preferentially choose radio resources, for purposes such as SoLSA.~~

~~It is therefore required that the service capability set available to an application be able to provide an indication that handover has occurred or could occur with information about the type of handover and radio resources involved. The service capabilities should support QoS negotiation.~~

4.32 General Operational Considerations

4.32.1 Coverage environment

Mechanisms defined to support ~~handover~~ service continuity between ~~UMTS and other~~different radio systems ~~(such as other IMT 2000 family members, or GSM)~~ or ~~UTRA~~ radio access modes should effectively cope with a number of coverage scenarios:

- Limited ~~UMTS~~ coverage in a 'sea' of coverage provided by another radio system or ~~UTRA~~ radio access mode~~, or, vice versa~~;
- Selective operation at a geographical boundary, with extensive UTRAN~~MTS~~ coverage on one side and extensive coverage from another radio system on the other side;
- Geographically co-located areas of ~~UMTS~~ UTRAN coverage and another radio system.

However the ~~standards~~ specifications should impose no restrictions or assumptions on how an operator might deploy or operate the network in both GERAN~~GSM~~ and ~~UMTS~~UTRAN.

4.32.2 Inter PLMN Handover Issues

Handovers to support service continuity between PLMNs should remain an optional feature to implement. It is envisaged that handover would take place due to changing radio conditions caused e.g. by movement of the terminal causing it to leave the coverage area of a PLMN.
The following networks may be involved with an inter-PLMN handover procedure. These concepts are illustrated in Annex A:

- The user's *home network*, i.e. the operator where the user's subscription may be found;
- The user's *visited network* where the subscriber user is currently registered, i.e. the network where the subscriber user has performed the last successful update location procedure. As long as the subscriber user is roaming within the home network, home and visited network are identical;
- The user's *serving network* covering the cell that serves the subscriber. After successful completion of the update location update procedure, the serving network is identical with the visited network. After an inter-PLMN handover, the visited network is different from the serving network until a location update procedure has been successfully completed (excepted the case that the subscriber returns into the visited network);
- The *target network* covering candidate target cell(s) for inter-PLMN handover. The target network has overlapping radio coverage with the serving network but not necessarily with the visited network.

The minimum requirements for inter-PLMN HO are:

- Continuity of an *active call* across the handover procedure, where this would be possible for intra-PLMN handover;

- ~~Charging, billing and accounting for inter-PLMN handover should be according to the principles defined in [3]. For R'99 the mechanisms currently used in GSM should be provided as a minimum (charging for handover leg is based on visitited network tariff, etc., settlement between operators is based on bulk metering, etc.)~~ Settlement between operators is based on bulk metering, etc. and is outside of scope of this TS;

- ~~The ability to check with the home network whether the user is permitted to handover from the visited network to a target network;~~

- The decision whether the handover request is accepted must be taken by the target network;

- ~~Invocation of the handover procedure only occurs if the target network provides the radio channel type required for the respective call;~~

- ~~The avoidance of "network hopping", i.e. successive handover procedures between neighbouring networks for the same call;~~

- ~~The possibility of user notification of inter-PLMN HO (e.g. possible tariff change) when it occurs.~~

~~For R99 t~~There can only be one target PLMN for HO in addition to the serving PLMN ~~for R99~~ in a given geographical area.

4.3~~2~~.3 Charging and Network Management

Means shall be standardised which allow charging records to record the time of handover in the case of inter-PLMN operator handover. Charging records must be able to reflect the level of UTRA radio access, operation mode and network type after handover.
A capability to provide network management information relating to frequency of occurrence and type of handover should be defined.

4.3~~2~~.4 Cost and efficiency

The UTRAN ~~standards~~ specifications shall facilitate the cost-effective implementation both on the network and on the terminal side, of multi mode operation between G~~SM~~ERAN and UTRAN~~MTS~~. Impacts on ~~GSM~~ networks based on earlier releases shall be minimised. Such handover shall not require user intervention.

4.3~~2~~.5 Security

Security requirements ~~relating to handover shall be elaborated in a separate document ([4]), but~~ should embody the principle that handover shall not compromise the security of the network providing the new radio resources; the (possibly different) network providing the original radio resources; and the terminalUE. The security mechanisms should also cater for appropriate authentication processes and meet the requirements of national administrations in terms of lawful interception.

4.4~~3~~ Performance Requirements

4.4~~3~~.1 Temporary degradation of service caused by handover

~~Any degradation of service d~~During intra ~~UMTS~~UTRAN handover or ~~in the case of~~ handover from ~~UMTS~~ UTRAN to ~~GSM~~GERAN, degradation of service shall be no ~~worse~~ greater than during intra ~~GSM~~GERAN handover.
The duration of the discontinuity experienced by PS and CS real time services should be shorter than that in the handover of ~~GSM~~ CS speech calls over GERAN.

5 Requirements for Handover ~~from UMTS to UMTS~~

5.1 Handover due to UE Movement

It should be possible to provide a technical implementation of handover such that there is no measurable impact on the quality of any service when handover due to UE movement occurs. This does not imply that all ~~UMTS~~ handovers will achieve this ideal. However, the ~~standards~~specifications shall define at least one UTRA radio access mode in which this is possible given the following:

- UE speed stays within limits for given service;
- UE stays constantly within UTRA~~MTS~~ coverage of a single UTRAN.

5.3 Handover between ~~UTRA~~ Radio Access Modes

The ~~standards~~ specifications shall permit a technical implementation of handover between radio access modes, although there may be a temporary degradation of QoS on bearer services at the time of handover.

5.3 ~~UMTS c~~Cell capacity

Consideration must be given services such as multimedia, which may involve use of multiple bearers. Due for example to cell loading, it may happen that a target cell cannot support the combination of bearer services provided by the current serving cell. ~~Means shall be provided for the application(s) to indicate minimum acceptable QoS for services continuation after handover.~~ Although all ~~UMTS~~ bearer services may not be handed over, the handover to another ~~UMTS~~ cell should not be precluded.

5.4 Handover of a Multicall

The handover event can trigger changes to individual calls in any multicall scenario.

It shall be possible to handover all the calls in a multicall configuration.. If the target cell is not able to accommodate all the calls in a multicall configuration, then the calls that are handed over shall be selected in following order:

i. The call of teleservice emergency call
ii. The call of teleservice telephony
iii. The call of any other type

Calls that cannot be handed over will be released.
If no single call can be selected according to the above criteria, handover shall be rejected.
A change in the availability of suitable radio resources may also occur for other reasons in addition to handover.

6 Requirements for Handover from UTRAN~~MTS~~ to GERAN~~SM~~

6.1 Operational Requirements

6.1.2 GERAN~~SM~~ bands

The standard shall support handover to any combination of GERAN~~SM~~ bands supported by the ~~GSM standards~~specifications.

6.2 Performance Requirements

The following service principles apply to performance requirements:

- When the UE performs handover to ~~GSM~~GERAN then the service requirements of ~~GSM~~GERAN that relate to handover between different cells in different location areas is taken as the benchmark. It is not the intention to set more stringent service requirements for ~~UMTS~~UTRAN to GERAN~~GSM~~ handover than are already commonly accepted for handover within ~~GSM~~GERAN.

6.2.1 Detection Time of Potential ~~GSM~~GERAN Handover Candidates

Means shall be defined which allow the UE to achieve as good detection time performance as the ~~GSM~~GERAN benchmark: i.e. to behave in such a way as to detect potential ~~GSM~~ handover candidates as quickly as a ~~GSM~~ mobile performing an intra GERAN~~SM~~ handover is required to do so.

6.2.2 Number of ~~GSM~~GERAN handover candidates to detect

Means shall be available which allow UE to detect an equal number of GERAN~~SM~~ handover candidates relative to the ~~GSM~~GERAN benchmark, i.e. to behave in such a way as to detect as many potential ~~GSM~~ handover candidates as a ~~GSM~~ mobile performing an intra ~~GSM~~GERAN handover is required to do so.

6.2.3 Probability of Connection Loss

The service requirement is that it should be possible to hand over to ~~GSM~~GERAN from UTRAN~~UMTS~~ with a probability of connection loss that fulfils the corresponding service requirement for intra GERAN~~GSM~~ handover.

6.3 Specific Requirements for Individual Services from ~~UMTS~~UTRAN to GERAN~~GSM~~

6.3.1 Speech

Handover of a CS~~UMTS~~ Speech teleservice~~channel~~ (TS11) from UTRAN to ~~GSM~~GERAN ~~shall result in a GSM speech teleservice connection~~is required. This requirement also applies to emergency calls (TS12):

- Any call based on the default UTRAN~~UMTS~~ speech codec (AMR) shall be mapped to the FR GSM speech codec. In the case the terminal and the GERAN~~SM network~~ support AMR and /or EFR and/or HR, it shall be the operators choice to define the appropriate mapping.

Means shall be defined which make it possible to limit any temporary degradation on handover so it meets the performance specified by GERANSM service requirements for speech handover.

6.3.2 Short Message Service

There are no requirements related to handover for short message service.

6.3.3 Cell Broadcast

There are no requirements related to handover for cell broadcast.

6.3.4 USSD

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

6.3.5 Facsimile

It is not required that a facsimile transmission that is active between UE and network at the time of handover from ~~UMTS~~UTRAN to GERAN~~GSM~~ completes successfully.

6.3.6 Data Bearer Services

6.3.6.1 Circuit Switched Data

~~Standards~~Specifications shall be defined to permit the possibility of handover of a ~~UMTS connection oriented~~ UTRAN data bearer service to ~~GSM~~GERAN~~, 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.~~
Means shall be defined ~~(e.g. existing GSM flow control mechanisms)~~ which make it possible to limit any temporary degradation on handover so it meets the performance specified by ~~GSM~~GERAN service requirements for ~~connection oriented~~ data bearer service handover.

6.3.6.2 Packet Switched Data

It is required to handover a user PS context between GERAN~~GPRS~~ and ~~UMTS~~UTRAN. Independently of the used air interface, the user shall stay connected to an external network (internet, intranet).

6.3.7 Supplementary Services

~~*Control* and *use* of Supplementary Services to be according to GSM or UMTS standard as applicable at the time, although close synergy between these should be encouraged to ensure that handover has no effect on their correct operation or continuity of service.~~

~~Where a GSM supplementary services is supported in UMTS then the technical standards should allow handover to GSM to have no effect, at least where the GSM and UMTS networks have the same network operator.~~
Control and use of Supplementary Services should not be effected by a handover to GERAN.

6.4 Requirements on multiple bearer services handover from ~~UMTS~~UTRAN to G~~ERAN~~ERAN~~SM~~

Consideration must be given to services that may involve multiple bearer services. The mapping between ~~UMTS~~UTRAN ~~data~~ bearer services and ~~GSM/GPRS~~GERAN bearer services will depend upon many factors such as data rate, delay constraints, error rate etc.~~. Means shall be provided for the application(s) to indicate minimum acceptable QoS for services continuation after handover.~~ In the event certain ~~UMTS~~UTRAN bearer services cannot be handed over to G~~SM/GPRS~~ERAN, the handover of some of the bearers to maintain the service should not be precluded.
In the case where user equipped with a dual mode terminal is in ~~3G~~UTRAN coverage and has multiple PDP contexts activated (for instance to support multimedia) then it is preferable to handover one PDP context, rather than dropping all of them.
As a first priority only the PDP contexts which have an associated QoS that can be supported by the ~~2G networks~~GERAN should be candidates for handover.
If there are still multiple PDP contexts as "handover candidates" then it shall be an operator choice which PDP context will be maintained. When roaming this decision shall be taken by the serving network. The operator may choose to either;
a) Drop all of the PDP contexts.
b) Choose one based upon criteria such as duration, amount of traffic transferred, etc.
In case of UTRAN~~UMTS~~ to GERAN~~GSM~~ handover of a **Multicall** only one call can be handed over.

7 Requirements for Handover from GERAN~~GSM~~ to UTRAN~~UMTS~~

7.1 Operational Requirements

7.1.2 G~~ERAN~~ERAN~~SM~~ bands

The standard shall support handover from any combination of ~~GSM~~GERAN bands supported by the G~~ERAN~~ERAN~~SM~~ ~~standards~~specifications.

7.2 Performance Requirements

~~The technical standards should ensure that it is possible to~~ During handover from G~~ERAN~~ERAN~~SM~~ to UTRAN,~~MTS in such a way that~~ temporary degradations ~~are no worse~~shall be no greater than for ~~GSM to GSM~~intra-GERAN handovers.

7.3 Specific Requirements for Individual Service Handover from ~~GSM~~GERAN to UTRAN~~UMTS~~

7.3.1 Speech

AMR, EFR, FR and HR calls shall be mapped to the default ~~UMTS~~UTRAN speech codec.

7.3.2 Short Message Service

There are no requirements related to handover for short message service.

7.3.3 Cell Broadcast

There are no requirements related to handover for cell broadcast.

7.3.4 USSD

~~In GSM, USSD is a connection mode teleservice according to the definition above: in USSD the association between endpoints is called a 'transaction' ([5]). In GSM, USSD transaction from the UE can terminate at the local MSC, the VLR or the HLR. It is not required to standardise means to handover into UMTS of transactions with the local MSC. The need to~~

~~standardise handover of transactions with the VLR and HLR is for further study.~~
The technical specifications shall provide means to ensure that any handover that occurs during a USSD interaction need no more affect the service than intra-GERAN handover.

7.3.5 Facsimile

It is not required that a facsimile transmission that is active between UE and network at the time of handover from ~~GSM~~GERAN to ~~UMTS~~UTRAN completes successfully.

7.3.6 ~~GSM~~ Data Bearer Services

7.3.6.1 Circuit Switched Data

~~Note: The requirements in this section should not delay the release 99 standardisation process and may need review.~~

~~Standards~~ Specifications shall be defined to permit the possibility of handover of a ~~GSM circuit switched~~ data bearer from GERAN to UTRAN.~~UMTS which shall result in a UMTS connection oriented data bearer service. Means shall be provided for the application to indicate minimum acceptable QoS for service continuation after handover. If this cannot be provided by theUMTS network handover will not take place (which may result in call loss once the UE moves outside GSM coverage).~~
Means shall be defined which make it possible to limit any temporary degradation on handover so it meets the performance specified by ~~GSM~~GERAN service requirements for circuit switched data handover.

7.3.6.2 Packet Switched Data

It is required to handover a user context between ~~GPRS~~GERAN and ~~UMTS~~UTRAN. Independently of the used radio interface, the user shall stay connected to an external network (internet, intranet). Any change in the QoS shall be seen at the service access points as a network initiated renegotiation of QoS. If the supported QoS is not acceptable, the ~~MS~~UE/user may terminate the connection/context.
Means shall be defined which make it possible to limit any temporary degradation on handover so it meets the performance specified by ~~GSM~~ GERAN service requirements for packet switched data handover.

7.3.7 Supplementary services

~~Where a GSM supplementary services is supported in the target UMTS network then the technical standards should allow handover from GSM to UMTS to have no effect on that service, at least where the GSM and UMTS networks have the same network operator.~~
Control and use of Supplementary Services should not be effected by a handover to UTRAN.

7.4 Requirements on multiple bearer services handover from G~~SM~~ERAN to ~~UMTS~~UTRAN

Consideration must be given to services that 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 bearer services and UMTS bearer services will depend upon many factors such as data rate, delay constraints, error rate etc.~~ Means shall be defined to allow handover of several data bearer services from ~~GSM~~ GERAN to ~~UMTS~~UTRAN.~~ Means shall be defined for the application(s) to indicate minimum acceptable QoS for services continuation after handover.~~

8 Cross Phase Compatibility for ~~R99~~this release

This section details the cross phase compatibility requirements relating to the service requirements in this document. Note: when a change is introduced which affects the ~~UMTS~~3GPP technical ~~standards~~specifications, it is said to be 'backward compatible' if existing equipment can continue to operate and perform correctly with equipment that conforms to the new implementation.

8.1 Compatibility with Existing ~~Standards~~Specifications

There are no earlier releases of the ~~UMTS~~ UTRAN specifications~~standards~~ for which backward compatibility is required. Where the service and operational requirements in this document relate to a ~~GSM PLMN~~GERAN, compatibility is required with ~~GSM~~ systems conforming to the R99 ~~GSM standard~~GERAN specifications.

8.2 Compatibility with Future ~~UMTS Standards~~3GPP specifications

~~It is envisaged that UMTS will evolve beyond R99, for example with the addition of new service requirements.~~ The ~~standards~~specifications that define the technical implementation of R99 should be developed in such a way that it is practical to add the requirements in this section in a backward compatible manner.

8.2.1 Requirements for Service Capabilities

3GPP standardises service capabilities, not services. As part of the service capabilities it is envisaged that applications may wish to respond to events related to handover that either has occurred, is about to occur or could potentially occur. The service capabilities described in this section should be available at least to UE hosted applications.
The following list of uses is provided as an example and is not intended to be exhaustive:

- An application may wish to accept or reject offered QoS;
- An application may wish to cope to the effect that handover has on a service, for example facsimile retransmission;
- An application may wish to preferentially choose radio resources.

It is therefore required that the service capability set available to an application be able to provide an indication that handover has occurred or could occur with information about the type of handover and radio resources involved. The service capabilities should support QoS negotiation.

8.2.2 Inter PLMN Handover Issues

The minimum requirements for inter-PLMN HO are:

- The ability to check with the home network whether the user is permitted to handover from the visited network to a target network.
- Invocation of the handover procedure only occurs if the target network provides the radio channel type required for the respective call;
- The avoidance of "network hopping", i.e. successive handover procedures between neighbouring networks for the same call;
- The possibility of user notification of inter-PLMN HO (e.g. possible tariff change) when it occurs.

8.2.3~~1~~ Handover between Environments

UMTS is expected to provide coverage in a number of environments including fixed and mobile as described in the table below. The technical ~~standards~~specifications should not preclude the possibility of implementing these requirements in a backward compatible manner.

To / From	Terrestrial Cellular	Fixed/Cordless	Satellite
Terrestrial Cellular	Yes (R99)	Yes	Yes
Fixed/Cordless	Yes	Yes	Yes
Satellite	Yes	Yes	No

8.3 Support of Multicall with Simultaneous Voice Calls

In the case where Multicall is used to support multiple voice calls a handover must be attempted for each bearer that is in use. In the case where not all bearers can be supported by the destination network the related voice calls shall be automatically put on hold. After the handover is completed, the subscriber shall be able to retrieve any held voice call by invoking the Call Hold service.
This requirement is dependent on the user subscribing to Call Hold.
This is only required if there is more than one simultaneous speech call and this is therefore not required for Release 99.

Annex A (informative):
Illustration of elements in inter-PLMN handover

Figure 1 illustrates the above definitions taking an example of European GSM networks. The subscriber's home network is France. The visited network where the subscriber is registered in a VLR is Germany. The signalling connection between HLR and VLR is indicated by dotted lines. The calls for the subscriber are controlled by the MSC collocated to the VLR where the subscriber is registered. This MSC is called "*anchor MSC*".
Handover to a different MSC may occur if the cell serving the subscriber after handover is not controlled by the anchor MSC. This MSC is called the "*serving MSC*". Even after the call has been handed over to a different MSC, the call control function remains in the anchor MSC. The signalling connection and circuit switched connection established between anchor MSC and serving MSC are indicated by a solid line.
When the French subscriber registered in a German network roams near the border to the Netherlands, inter-PLMN handover may occur. In this case a Dutch network is the *target network*. After handover, the anchor MSC located in a German network continues to control the call. The German network remains the *visited network* where the subscriber is registered. The subscriber's location information stored in the HLR remains unchanged. The signalling and circuit switched connections between the anchor MSC and the previously serving MSC in the German network will be released when the User Equipment~~Mobile Station~~ (UE~~MS~~) is served by a cell within a Dutch network. The Dutch network becomes the *serving network*. From the Dutch network the subscriber may be handed over to a Belgian network.

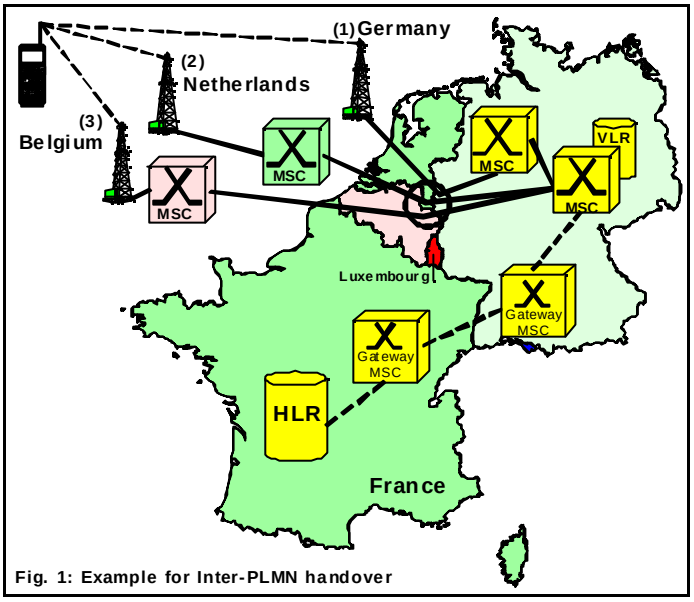

Figure 1: Example for inter-PLMN handover

Annex B (informative): Open Points on Inter-Operator Handover

The requirements outlined below are likely to need further elaboration, although these may be outside the scope of service requirements.

B.2 Selection of Target Cells for Handover

A mechanism is envisaged to support the selection of the target cell for handover. The target cell may be part of the serving network or part of another network.

B.3 Network Information Exchange

A mechanism is envisaged to support the exchange of network information between different operators. Two categories of network information are identified:

- static information, for example, neighbour cell lists, interconnecting traffic and signalling links, etc.;
- dynamic information, for example real-time signalling information related to target cell selection, etc.

B.4 Service Requirements

FFS.

[There is a need to identify which services can be maintained during handover and the interactions of services across network boundaries]

B.5 Billing, Accounting and Charging Requirements

FFS.

Annex C (informative):
Change history

Document history		
<Version>	<Date>	<Milestone>
0.0.1	29 Oct 98	First Draft for tdoc
0.0.2	5 Jan 98	Evolved from tdoc 3 then 7 of SMG 1 handover ad hoc
0.0.3	6 Jan 98	evolved from tdoc 20 of SMG1 handover ad hoc
0.0.4	7 Jan 98	evolved from tdoc 35 of SMG1 handover adhoc
0.0.5	8 Jan 98	Evolved from tdoc 45 of SMG1 handover adhoc
1.0.0	27 January	To be presented as version 1.0.0 to SMG#28 for Approval
1.1.0	5 Mar 99	- new requirment for inter-operator handover, as demanded by SMG - removes text on security requirements by referencing 33.21 - editorial revisions
1.2.0	22 Mar 99	1 Initial draft for email handover ad hoc 22-27 Mar. -
1.3.0	24 Mar 99	Clarify inter-operator handover requiremetn
1.4.0	26 Mar 99	Proposed as draft version 2.0.0
2.0.0	12 Apr 99	Draft version 2.0.0
2.0.1	12 Apr 99	Editorially equivalent 2.0.0, with editorial comments removed
2.0.2	16 April 99	Editorial review
3.0.0		
3.1.0	October 1999	Inclusion of CRs at SA#5
3.2.0	December 1999	Inclusion of CRs at SA#6
3.3.0	June 2000	Inclusion of CRs at SA#8
3.4.0	October 2000	Inclusion of CRs at SA#9

Change history										
TSG SA#	**SA Doc.**	**SA1 Doc**	**Spec**	**CR**	**Rev**	**Rel**	**Cat**	**Subject/Comment**	**Old**	**New**
SP-05	SP-99436	S1-99500	22.129	002		R99	F	SMS handover requirement clarification	3.0.0	3.1.0
SP-05	SP-99436	S1-99516	22.129	003		R99	D	Removal of out-of-date appendix	3.0.0	3.1.0
SP-05	SP-99436	S1-99533	22.129	004		R99	D	Editorial improvements of definitions and alignment of terminology	3.0.0	3.1.0
SP-05	SP-99436	S1-99540	22.129	005		R99	C	To elucidate 1-1 handover principle for R99	3.0.0	3.1.0
SP-05	SP-99436	S1-99541	22.129	006		R99	D	Clarification of the scope of mandatory requirements	3.0.0	3.1.0
SP-05	SP-99483	S1-99565	22.129	007	1	R99	C	Removes all non-R99 requirements, by changing them into Cross phase compatibility requirements which apply to R99.	3.0.0	3.1.0
SP-06	SP-99553	S1-99877	22.129	008		R99	D	Editorial CR to 22.129	3.1.0	3.2.0
SP-06	SP-99523	S1-991019	22.129	009		R99	D	3G/2G handover in the PS Domain	3.1.0	3.2.0

SP-06	SP-99523	S1-991066	22.129	010		R99	B	Handover of a Multicall	3.1.0	3.2.0
SP-06	SP-99521	S1-99868	22.129	011		R99	C	Performance requirements for real time services and requirements for handover between UMTS and GPRS	3.1.0	3.2.0
SP-08	SP-000205	S1-000349	22.129	012		R99	F	Alignment of handover requirements for Multicall	3.2.0	3.3.0
SP-09	SP-000426	S1-000574	22.129	013		R99	F	Removal of requirements for SoLSA support	3.3.0	3.4.0

3GPP TSG-SA WG1 Meeting#10 **S1-000864**
Orlando, Fl, USA, 13-17 November 2000

CR-Form-v3

CHANGE REQUEST

22.129	CR	016	rev	-	Current version:	4.0.0

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ✍ symbols.*

Proposed change affects: ✍ (U)SIM ☐ ME/UE ☐ Radio Access Network [X] Core Network [X]

Title: ✍	Corrective CRs to 22.129	
Source: ✍	SA1	
Work item code: ✍	TEI4	***Date:*** ✍ 17 November 2000
Category: ✍	**A**	***Release:*** ✍ REL-4

Use one of the following categories:
F *(essential correction)*
A *(corresponds to a correction in an earlier release)*
B *(Addition of feature),*
C *(Functional modification of feature)*
D *(Editorial modification)*
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:

2	*(GSM Phase 2)*
R96	*(Release 1996)*
R97	*(Release 1997)*
R98	*(Release 1998)*
R99	*(Release 1999)*
REL-4	*(Release 4)*
REL-5	*(Release 5)*

Reason for change: ✍	Incorporation of R99 change request.
Summary of change: ✍	Removal of requirements not supported in R99. Removal of terms UMTS and GSM. Clarification of Service Continuity requirements.
Consequences if not approved: ✍	

Clauses affected: ✍	All		
Other specs affected: ✍	☐ Other core specifications ☐ Test specifications ☐ O&M Specifications	✍	
Other comments: ✍			

How to create CRs using this form:
Comprehensive information and tips about how to create CRs can be found at:
http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ✍ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://www.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2000-09 contains the specifications resulting from the September 2000 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

3G TS 22.129 V4.~~0~~1.0 (2000-10)

Technical Specification

3rd Generation Partnership Project;
Technical Specification Group Services and System Aspects
Service aspects;
Handover Requirements between ~~UMTS~~UTRAN and ~~GSM~~GERAN or other Radio Systems
(Release 4)

Keywords

UMTS, GSM, handover

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Contents

Foreword

This Technical Specification has been produced by the 3GPP.

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

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the specification;

1 Scope

The scope of this document includes service requirements for ~~handover (terms are defined below) within UMTS systems and between UMTS, other IMT-2000 family members and 2nd generation systems. Particular emphasis has been placed on the description of requirements for handover between UMTS and GSM but requirements specific to other systems are incorporated as required.~~

~~UMTS is a "third generation" mobile cellular radio telecommunications system which provides telecommunication and information services to wireless terminals. Mobile cellular systems have the defining characteristic that they are capable of~~ maintaining continuity of service to a wireless terminal as it moves between the radio coverage area, or "cells", associated with different base station sites . This functionality is called "handover". Handover can also occur due to change of radio resource providing a service without necessarily any change of the base stations involved. In particular, when the radio resources providing a service change from one of the UTRA radio access modes to the other (UTRA-FDD and UTRA-TDD), this is regarded as handover. Particular emphasis has been placed on the description of requirements for service continuity within UTRAN and between UTRAN and GERAN but requirements specific to other systems are incorporated as required.

It is a key requirement ~~of UMTS that it~~to allow~~s~~ for dual or multi-mode ~~(e.g. UMTS/GSM)~~ terminals to handover traffic from UTRAN~~MTS~~ to other radio systems such as GERAN~~SM~~ and vice versa. This document describes the service requirements for intra- and inter- system handover~~, that shall be used by other SMG STCs to guide the implementation of UMTS to (e.g.) GSM handover specifications. It defines requirements for the enhancement of the GSM specifications to allow GSM to UMTS handover.~~

The following subject areas are within the scope of these service requirements:

- User perceived performance that may be influenced by handover;
- Operational requirements relating to handover;
- Security requirements.

The requirements set forth in this document are service requirements, in that they fulfil the following:

- The requirements are independent of the implementation of the UTRAN;
- The extent to which the requirements are met are in principle verifiable using observables that are not internal to the UTRAN.

1.1 Situations in which Service Requirements apply

The service requirements in this document are as far as possible independent of the implementation ~~of the UTRA~~. They therefore apply to situations where handover would occur regardless of how the ~~UTRA~~radio access network is implemented. Situations envisaged are:

- Handover within UTRAN~~MTS~~ due to change of radio resource caused by UE movement between areas covered by different transmitters;
- Handover within ~~UMTS~~UTRAN due to change of UTRA radio access mode;
- Handover due to change of radio system ~~(e.g. UMTS to GSM).~~

It is possible that handover (i.e. change of radio resource) will occur in other situations, for example the technical implementation of the UTRAN may necessitate it or O&M procedures initiated by the operator may force it. Requirements for these situations are not within the scope of this document, with the exception of two remarks:

- Where the technical implementation of the UTRAN necessitates handover as a matter of normal operation (i.e. not related to the above situations), then services shall in no way be degraded or adversely affected;
- The service requirements for handover occurring in situations such as O&M activity are outside the scope of this document.

2 References

The following documents contain provisions that, 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] GSM 05.08: "GSM Digital cellular telecommunications system (Phase 2+); Radio subsystem link control".~~

~~[23] 3G TS 22.115: "Service aspects; Charging and Billing".~~

~~[4] 3G TS 22.120: "3G Security; Security Principles and Objectives".~~

~~[45] 3G TS 22.090: "Unstructured Supplementary Service Data (USSD) - Stage 1".~~

[6] TR 21.905: " Vocabulary for 3GPP Specifications ".

3 Definitions and Abbreviations

3.1 Definitions

In addition to the following, abbreviations used in the present document are listed in TR 21.905 [6].

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

Connection mode (for a bearer service): characterises the type of association between two endpoints as required by the bearer service for the transfer of information. A bearer service is either connection-oriented or connectionless. In a connection oriented mode, a logical association called *connection* needs to be established between the source and the destination entities before information can be exchanged between them. Connection oriented bearer services lifetime is the period of time between the establishment and the release of the connection.

Connectionless (for a bearer service): In a connectionless bearer, no connection is established beforehand between the source and the destination entities; the source and destination network addresses need to be specified in each message. Transferred information cannot be guaranteed of ordered delivery. Connectionless bearer services lifetime is reduced to the transport of one message.

~~**GSM**~~**GERAN coverage**: an area where mobile cellular services are provided by a GERAN in accordance with ~~GSM~~GERAN ~~standards~~specifications.

~~**UMTS**~~**UTRAN coverage**: an area where mobile cellular services are provided by a UTRAN in accordance with ~~UMTS~~UTRAN ~~standards~~specifications.

Multi mode terminal: UE that can obtain service from at least one UTRA radio access mode, and one or more different systems such as ~~GSM~~GERAN bands or possibly other radio systems such IMT-2000 family members.

Handover: The process in which the radio access network changes the radio transmitters or radio access mode or radio system used to provide the bearer services, while maintaining a defined bearer service QoS.

Intra PLMN handover: Handover within the same network, i.e. having the same MCC-MNC regardless of radio access system. Note: this includes the case of ~~UMTS~~UTRAN <>~~GSM~~GERAN handover where MCC-MNC are the same in both cases.

Inter PLMN handover: Handover between different PLMNs, i.e. having different MCC-MNC.

Inter system handover: Handover between networks using different radio systems , e.g. ~~UMTS~~UTRAN – ~~GSM~~GERAN.

UTRA Radio access mode: the selected UTRA radio access mode i.e. UTRA-FDD; UTRA-TDD.

Radio system: the selected 2nd or 3rd generation radio access technology~~, e.g. UMTS or GSM~~.

Service Continuity: The means for maintaining active services during changes in the coverage areas or their characteristics without, as far as possible, the user noticing. Note that Service Continuity can be achieved by handover, cell re-selection or other mechanisms.

3.2 Abbreviations

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

UE User equipment

4 General Principles governing ~~handover requirements~~service continuity

This section describes the general principles for service continuity within the UTRAN, within the GERAN and between the UTRAN and other radio systems such as GERAN. As a principle, the requirements on service continuity characteristics should be according to the target network on which the service is maintained.

~~This section describes the general principles governing the operation of UMTS when preparing for and executing handover both within UMTS and to another radio system such as GSM. It also describes the additional concepts required to be included in GSM to allow preparation for and handover to UMTS. As a principle, the requirements on~~

~~handover characteristics should be according to the network to which the handover is made.~~

4.1 Service Continuity Scenarios

Service continuity shall support the following scenarios:

1. Continuity of active CS services when moving within UTRAN, within GERAN and between UTRAN and GERAN coverage areas.

2. Continuity of active GPRS sessions when moving within UTRAN, within GERAN and between UTRAN and GERAN coverage areas.

Service continuity is not applicable for any call or session using resources specific to the source domain that cannot be maintained using resources in the target domain.

4.2 Service Continuity requirements

For all scenarios, the specifications shall cover both service continuity within the same PLMN (intra-PLMN) and between PLMNs (inter-PLMN) including the case where the PLMNs involved are operated by different network operators.

~~4.2.1~~4.2.2 Service continuity for CS

The scenario numbers in this table refer to the scenarios in section 4.1.

		To CS services	
		UTRAN	**GERAN**
From CS services	**UTRAN**	Yes - Scenario 1	Yes - Scenario 1
	GERAN	Yes – Scenario 1	Yes – Scenario 1

4.2.2 Service continuity for GPRS

Service continuity of GPRS sessions (conversation, streaming, interactive and background) is required within the GERAN, within the UTRAN, and between the UTRAN and GERAN (scenario 2 in section 4.1 above).

Note: Service continuity for conversational, streaming and interactive GPRS sessions is not applicable to and from GERAN Release 99, due to the lack of support for the conversational, streaming and interactive GPRS within GERAN Release 99. In the case of continuity to GERAN R99, although the QoS required may not be available in the target, the bearer shall be maintained as long as possible. If the QoS supported by GERAN R99 is not acceptable, the user/application may terminate the session.

~~**The handover matrix**~~

~~**handover possible?**~~	~~**to UMTS**~~	~~**to GSM-cs**~~	~~**to GSM-GPRS**~~	~~**to IMT2000 ? UMTS**~~
~~From UMTS~~	~~1~~	~~1~~	~~1~~	~~x~~
~~From GSM-cs~~	~~1~~	~~oos~~	~~oos~~	~~oos~~
~~From GSM-GPRS~~	~~1~~	~~oos~~	~~oos~~	~~oos~~
~~From IMT2000 ? UMTS~~	~~x~~	~~oos~~	~~oos~~	~~oos~~

~~oos = out of scope of UMTS specifications~~

~~1= supporting standards required for UMTS release 99.~~

~~x= supporting standards required, not necessarily for release 99.~~

~~GSM-GPRS in the table refers to R97, R98 and R99 GPRS.~~

~~For UMTS release 99 means shall be defined which:~~

~~1) Enable handover to a GSM network from a UMTS network;~~

~~2) Enable handover to a UMTS network from a GSM network.~~

~~In both the cases above the GSM network may be operated by either the same network operator as the UMTS network or a different network operator.~~

~~Handover of real time PS services between UMTS and GPRS R99 is out of the scope of UMTS R99 phase 1 and shall be considered in subsequent phases. Service continuity of best effort packet services between UMTS and GPRS is required.~~

~~4.1 Requirements for Service Capabilities~~

~~UMTS standardises service capabilities, not services. As part of the service capabilities it is envisaged that applications may wish to respond to events related to handover that either has occurred, is about to occur or could potentially occur. The service capabilities described in this section should be available at least to UE hosted applications.~~
~~The following list of uses is provided as an example and is not intended to be exhaustive:~~

- ~~An application may wish to accept or reject offered QoS;~~
- ~~An application may wish to cope to the effect that handover has on a service, for example facsimile retransmission;~~
- ~~An application may wish to preferentially choose radio resources, for purposes such as SoLSA.~~

~~It is therefore required that the service capability set available to an application be able to provide an indication that handover has occurred or could occur with information about the type of handover and radio resources involved. The service capabilities should support QoS negotiation.~~

4.32 General Operational Considerations

4.32.1 Coverage environment

Mechanisms defined to support ~~handover~~service continuity between ~~UMTS and other~~ different radio systems ~~(such as other IMT 2000 family members, or GSM)~~ or ~~UTRA~~ radio access modes should effectively cope with a number of coverage scenarios:

- Limited ~~UMTS~~ coverage in a 'sea' of coverage provided by another radio system or ~~UTRA~~ radio access mode, or, vice-versa;
- Selective operation at a geographical boundary, with extensive UTRAN~~MTS~~ coverage on one side and extensive coverage from another radio system on the other side;
- Geographically co-located areas of ~~UMTS~~UTRAN coverage and another radio system.

However the ~~standards~~ specifications should impose no restrictions or assumptions on how an operator might deploy or operate the network in both GERAN~~GSM~~ and ~~UMTS~~UTRAN.

4.32.2 Inter PLMN Handover Issues

Handovers to support service continuity between PLMNs should remain an optional feature to implement. It is envisaged that handover would take place due to changing radio conditions caused e.g. by movement of the terminal causing it to leave the coverage area of a PLMN.
The following networks may be involved with an inter-PLMN handover procedure. These concepts are illustrated in Annex A:

- The user's *home network*, i.e. the operator where the user's subscription may be found;
- The user's *visited network* where the subscriber user is currently registered, i.e. the network where the subscriber user has performed the last successful update location procedure. As long as the subscriber user is roaming within the home network, home and visited network are identical;
- The user's *serving network* covering the cell that serves the subscriber. After successful completion of the update location update procedure, the serving network is identical with the visited network. After an inter-PLMN handover, the visited network is different from the serving network until a location update procedure has been successfully completed (excepted the case that the subscriber returns into the visited network);
- The *target network* covering candidate target cell(s) for inter-PLMN handover. The target network has overlapping radio coverage with the serving network but not necessarily with the visited network.

The minimum requirements for inter-PLMN HO are:

- Continuity of an *active call* across the handover procedure, where this would be possible for intra-PLMN handover;

- ~~Charging, billing and accounting for inter-PLMN handover should be according to the principles defined in [3]. For R'99 the mechanisms currently used in GSM should be provided as a minimum (charging for handover leg is based on vistited network tariff, etc., settlement between operators is based on bulk metering, etc.)~~ Settlement between operators is based on bulk metering, etc. and is outside of scope of this TS;

- ~~The ability to check with the home network whether the user is permitted to handover from the visited network to a target network;~~

- The decision whether the handover request is accepted must be taken by the target network;

- ~~Invocation of the handover procedure only occurs if the target network provides the radio channel type required for the respective call;~~

- ~~The avoidance of "network hopping", i.e. successive handover procedures between neighbouring networks for the same call;~~

- ~~The possibility of user notification of inter-PLMN HO (e.g. possible tariff change) when it occurs.~~

~~For R99 t~~There can only be one target PLMN for HO in addition to the serving PLMN ~~for R99~~ in a given geographical area.

4.3~~2~~.3 Charging and Network Management

Means shall be standardised which allow charging records to record the time of handover in the case of inter-PLMN operator handover. Charging records must be able to reflect the level of UTRA radio access, operation mode and network type after handover.
A capability to provide network management information relating to frequency of occurrence and type of handover should be defined.

4.3~~2~~.4 Cost and efficiency

The UTRAN ~~standards~~ specifications shall facilitate the cost-effective implementation both on the network and on the terminal side, of multi mode operation between G~~SM~~ERAN and UTRAN~~MTS~~. Impacts on ~~GSM~~ networks based on earlier releases shall be minimised. Such handover shall not require user intervention.

4.3~~2~~.5 Security

Security requirements relating to handover shall be elaborated in a separate document ([4]), but should embody the principle that handover shall not compromise the security of the network providing the new radio resources; the (possibly different) network providing the original radio resources; and the terminalUE. The security mechanisms should also cater for appropriate authentication processes and meet the requirements of national administrations in terms of lawful interception.

4.4~~3~~ Performance Requirements

4.4~~3~~.1 Temporary degradation of service caused by handover

~~Any degradation of service d~~During intra ~~UMTS~~UTRAN handover or ~~in the case of~~ handover from ~~UMTS~~UTRAN to ~~GSM~~GERAN, degradation of service shall be no ~~worse~~ greater than during intra ~~GSM~~ GERAN handover.
The duration of the discontinuity experienced by PS and CS real time services should be shorter than that in the handover of ~~GSM~~ CS speech calls over GERAN.

5 Requirements for Handover ~~from UMTS to UMTS~~

5.1 Handover due to UE Movement

It should be possible to provide a technical implementation of handover such that there is no measurable impact on the quality of any service when handover due to UE movement occurs. This does not imply that all ~~UMTS~~ handovers will achieve this ideal. However, the ~~standards~~ specifications shall define at least one UTRA radio access mode in which this is possible given the following:

- UE speed stays within limits for given service;

- UE stays constantly within UTRA~~MTS~~ coverage of a single UTRAN.

When there is handover to a new cell with different radio conditions, one of the following processes may be implemented;

- If a Multimedia call is unable to maintain the required QoS, the call may fallback to a lower bit rate Multimedia call or speech and continue communication.

- If a PS sessions is unable to maintain the required quality of service, the QoS of the sessions may be modified to lower quality to continue communication.

5.3 Handover between ~~UTRA~~ Radio Access Modes

The ~~standards~~specifications shall permit a technical implementation of handover between radio access modes, although there may be a temporary degradation of QoS on bearer services at the time of handover.

5.3 ~~UMTS c~~Cell capacity

Consideration must be given services such as multimedia, which may involve use of multiple bearers. Due for example to cell loading, it may happen that a target cell cannot support the combination of bearer services provided by the current serving cell. ~~Means shall be provided for the application(s) to indicate minimum acceptable QoS for services continuation after handover.~~ Although all ~~UMTS~~ bearer services may not be handed over, the handover to another ~~UMTS~~ cell should not be precluded.

5.4 Handover of a Multicall

The handover event can trigger changes to individual calls in any multicall scenario.

It shall be possible to handover all the calls in a multicall configuration.. If the target cell is not able to accommodate all the calls in a multicall configuration, then the calls that are handed over shall be selected in following order:

~~i.~~iv. The call of teleservice emergency call
~~ii.~~v. The call of teleservice telephony
~~iii.~~vi. The call of any other type

Calls that cannot be handed over will be released.
If no single call can be selected according to the above criteria, handover shall be rejected.
A change in the availability of suitable radio resources may also occur for other reasons in addition to handover.

6 Requirements for Handover from UTRAN~~MTS~~ to GERAN~~SM~~

6.1 Operational Requirements

6.1.2 GERAN~~SM~~ bands

The standard shall support handover to any combination of GERAN~~SM~~ bands supported by the ~~GSM standards~~specifications.

6.2 Performance Requirements

The following service principles apply to performance requirements:

- When the UE performs handover to ~~GSM~~GERAN then the service requirements of ~~GSM~~GERAN that relate to handover between different cells in different location areas is taken as the benchmark. It is not the intention to setmore stringent service requirements for ~~UMTS~~UTRAN to GERAN~~GSM~~ handover than are already commonly accepted for handover within ~~GSM~~GERAN.

6.2.1 Detection Time of Potential ~~GSM~~GERAN Handover Candidates

Means shall be defined which allow the UE to achieve as good detection time performance as the ~~GSM~~GERAN benchmark: i.e. to behave in such a way as to detect potential ~~GSM~~ handover candidates as quickly as a ~~GSM~~ mobile

performing an intra GERAN~~SM~~ handover is required to do so.

6.2.2 Number of ~~GSM~~GERAN handover candidates to detect

Means shall be available which allow UE to detect an equal number of GERAN~~SM~~ handover candidates relative to the ~~GSM~~GERAN benchmark, i.e. to behave in such a way as to detect as many potential ~~GSM~~ handover candidates as a ~~GSM~~ mobile performing an intra ~~GSM~~GERAN handover is required to do so.

6.2.3 Probability of Connection Loss

The service requirement is that it should be possible to hand over to ~~GSM~~GERAN from UTRAN~~UMTS~~ with a probability of connection loss that fulfils the corresponding service requirement for intra GERAN~~GSM~~ handover.

6.3 Specific Requirements for Individual Services from ~~UMTS~~UTRAN to GERAN~~GSM~~

6.3.1 Speech

Handover of a CS~~UMTS~~ Speech teleservice~~channel~~ (TS11) from UTRAN to ~~GSM~~GERAN ~~shall result in a GSM speech teleservice connection~~is required. This requirement also applies to emergency calls (TS12):

- Any call based on the default UTRAN~~UMTS~~ speech codec (AMR) shall be mapped to the FR GSM speech codec. In the case the terminal and the GERAN~~SM~~ network support AMR and /or EFR and/or HR, it shall be the operators choice to define the appropriate mapping.

Means shall be defined which make it possible to limit any temporary degradation on handover so it meets the performance specified by GERAN~~SM~~ service requirements for speech handover.

6.3.2 Short Message Service

There are no requirements related to handover for short message service.

6.3.3 Cell Broadcast

There are no requirements related to handover for cell broadcast.

6.3.4 USSD

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

6.3.5 Facsimile

It is not required that a facsimile transmission that is active between UE and network at the time of handover from ~~UMTS~~UTRAN to GERAN~~GSM~~ completes successfully.

6.3.6 Data Bearer Services

6.3.6.1 Circuit Switched Data

~~Standards~~Specifications shall be defined to permit the possibility of handover of a ~~UMTS connection oriented~~ UTRAN data bearer service to ~~GSM~~GERAN~~, 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.~~

Means shall be defined~~ (e.g. existing GSM flow control mechanisms)~~ which make it possible to limit any temporary degradation on handover so it meets the performance specified by ~~GSM~~GERAN service requirements for ~~connection oriented~~ data bearer service handover.

6.3.6.2 Packet Switched Data

It is required to handover a user PS context between GERAN~~GPRS~~ and ~~UMTS~~UTRAN. Independently of the used air

interface, the user shall stay connected to an external network (internet, intranet).

6.3.7 Supplementary Services

~~*Control* and *use* of Supplementary Services to be according to GSM or UMTS standard as applicable at the time, although close synergy between these should be encouraged to ensure that handover has no effect on their correct operation or continuity of service.~~
~~Where a GSM supplementary services is supported in UMTS then the technical standards should allow handover to GSM to have no effect, at least where the GSM and UMTS networks have the same network operator.~~
Control and use of Supplementary Services should not be effected by a handover to GERAN.

6.4 Requirements on multiple bearer services handover from ~~UMTS~~UTRAN to G~~ERAN~~SM~~

Consideration must be given to services that may involve multiple bearer services. The mapping between ~~UMTS~~UTRAN ~~data~~ bearer services and ~~GSM/GPRS~~GERAN bearer services will depend upon many factors such as data rate, delay constraints, error rate etc. ~~Means shall be provided for the application(s) to indicate minimum acceptable QoS for services continuation after handover.~~ In the event certain ~~UMTS~~UTRAN bearer services cannot be handed over to G~~ERAN~~SM~~/GPRS~~, the handover of some of the bearers to maintain the service should not be precluded.
In the case where user equipped with a dual mode terminal is in ~~3G~~UTRAN coverage and has multiple PDP contexts activated (for instance to support multimedia) then it is preferable to handover one PDP context, rather than dropping all of them.
As a first priority only the PDP contexts which have an associated QoS that can be supported by the ~~2G networks~~GERAN should be candidates for handover.
If there are still multiple PDP contexts as "handover candidates" then it shall be an operator choice which PDP context will be maintained. When roaming this decision shall be taken by the serving network. The operator may choose to either;
~~a)~~c) Drop all of the PDP contexts.
~~b)~~d) Choose one based upon criteria such as duration, amount of traffic transferred, etc.
In case of UTRAN~~UMTS~~ to GERAN~~GSM~~ handover of a **Multicall** only one call can be handed over.

7 Requirements for Handover from GERAN~~GSM~~ to UTRAN~~UMTS~~

7.1 Operational Requirements

7.1.2 G~~ERAN~~SM~~ bands

The standard shall support handover from any combination of GSM bands supported by the GSM standards.

7.2 Performance Requirements

~~The technical standards should ensure that it is possible to~~ During handover from G~~ERAN~~SM~~ to U~~TRAN~~MTS~~ in such a way that~~ temporary degradations ~~are no worse~~shall be no greater than ~~for GSM to GSM~~intra-GERAN handovers.

7.3 Specific Requirements for Individual Service Handover from ~~GSM~~GERAN to UTRAN~~UMTS~~

7.3.1 Speech

AMR, EFR, FR and HR calls shall be mapped to the default ~~UMTS~~UTRAN speech codec.

7.3.2 Short Message Service

There are no requirements related to handover for short message service.

7.3.3 Cell Broadcast

There are no requirements related to handover for cell broadcast.

7.3.4 USSD

~~In GSM, USSD is a connection mode teleservice according to the definition above: in USSD the association between endpoints is called a 'transaction' ([5]). In GSM, USSD transaction from the UE can terminate at the local MSC, the VLR or the HLR. It is not required to standardise means to handover into UMTS of transactions with the local MSC. The need to standardise handover of transactions with the VLR and HLR is for further study.~~

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

7.3.5 Facsimile

It is not required that a facsimile transmission that is active between UE and network at the time of handover from ~~GSM~~GERAN to ~~UMTS~~UTRAN completes successfully.

7.3.6 ~~GSM~~ Data Bearer Services

7.3.6.1 Circuit Switched Data

~~Note: The requirements in this section should not delay the release 99 standardisation process and may need review.~~

~~Standards~~Specifications shall be defined to permit the possibility of handover of a ~~GSM circuit switched~~ data bearer from GERAN to UTRAN.~~UMTS which shall result in a UMTS connection oriented data bearer service. Means shall be provided for the application to indicate minimum acceptable QoS for service continuation after handover. If this cannot be provided by theUMTS network handover will not take place (which may result in call loss once the UE moves outside GSM coverage).~~

Means shall be defined which make it possible to limit any temporary degradation on handover so it meets the performance specified by ~~GSM~~GERAN service requirements for circuit switched data handover.

7.3.6.2 Packet Switched Data

It is required to handover a user context between ~~GPRS~~GERAN and ~~UMTS~~UTRAN. Independently of the used radio interface, the user shall stay connected to an external network (internet, intranet). Any change in the QoS shall be seen at the service access points as a network initiated renegotiation of QoS. If the supported QoS is not acceptable, the ~~MS~~UE/user may terminate the connection/context.

Means shall be defined which make it possible to limit any temporary degradation on handover so it meets the performance specified by ~~GSM~~GERAN service requirements for packet switched data handover.

7.3.7 Supplementary services

~~Where a GSM supplementary services is supported in the target UMTS network then the technical standards should allow handover from GSM to UMTS to have no effect on that service, at least where the GSM and UMTS networks have the same network operator.~~

Control and use of Supplementary Services should not be effected by a handover to UTRAN.

7.4 Requirements on multiple bearer services handover from GERAN~~SM~~ to ~~UMTS~~UTRAN

Consideration must be given to services that 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 bearer services and UMTS bearer services will depend upon many factors such as data rate, delay constraints, error rate etc.~~ Means shall be defined to allow handover of several data bearer services from ~~GSM~~GERAN to ~~UMTS~~UTRAN.~~ Means shall be defined for the application(s) to indicate minimum acceptable QoS for services continuation after handover.~~

~~8~~9 Cross Phase Compatibility for ~~R99~~this release

This section details the cross phase compatibility requirements relating to the service requirements in this document. Note: when a change is introduced which affects the ~~UMTS~~3GPP technical ~~standards~~specifications, it is said to be 'backward compatible' if existing equipment can continue to operate and perform correctly with equipment that conforms to the new implementation.

8.1 Compatibility with Existing ~~Standards~~Specifications

There are no earlier releases of the ~~UMTS~~ UTRAN specifications~~standards~~ for which backward compatibility is required. Where the service and operational requirements in this document relate to a ~~GSM PLMN~~GERAN, compatibility is required with ~~GSM~~ systems conforming to the R99 ~~GSM standard~~GERAN specifications.

8.2 Compatibility with Future ~~UMTS Standards~~3GPP specifications

~~It is envisaged that UMTS will evolve beyond R99, for example with the addition of new service requirements.~~ The ~~standards~~specifications that define the technical implementation of R99 should be developed in such a way that it is practical to add the requirements in this section in a backward compatible manner.

8.2.1 Requirements for Service Capabilities

3GPP standardises service capabilities, not services. As part of the service capabilities it is envisaged that applications may wish to respond to events related to handover that either has occurred, is about to occur or could potentially occur. The service capabilities described in this section should be available at least to UE hosted applications.
The following list of uses is provided as an example and is not intended to be exhaustive:

- An application may wish to accept or reject offered QoS;
- An application may wish to cope to the effect that handover has on a service, for example facsimile retransmission;
- An application may wish to preferentially choose radio resources.

It is therefore required that the service capability set available to an application be able to provide an indication that handover has occurred or could occur with information about the type of handover and radio resources involved. The service capabilities should support QoS negotiation.

8.2.2 Inter PLMN Handover Issues

The minimum requirements for inter-PLMN HO are:

- The ability to check with the home network whether the user is permitted to handover from the visited network to a target network.
- Invocation of the handover procedure only occurs if the target network provides the radio channel type required for the respective call;
- The avoidance of "network hopping", i.e. successive handover procedures between neighbouring networks for the same call;
- The possibility of user notification of inter-PLMN HO (e.g. possible tariff change) when it occurs.

8.2.3~~1~~ Handover between Environments

UMTS is expected to provide coverage in a number of environments including fixed and mobile as described in the table below. The technical ~~standards~~ specifications should not preclude the possibility of implementing these requirements in a backward compatible manner.

To / From	Terrestrial Cellular	Fixed/Cordless	Satellite
Terrestrial Cellular	Yes (R99)	Yes	Yes
Fixed/Cordless	Yes	Yes	Yes
Satellite	Yes	Yes	No

8.3 Support of Multicall with Simultaneous Voice Calls

In the case where Multicall is used to support multiple voice calls a handover must be attempted for each bearer that is in use. In the case where not all bearers can be supported by the destination network the related voice calls shall be automatically put on hold. After the handover is completed, the subscriber shall be able to retrieve any held voice call by

invoking the Call Hold service.
This requirement is dependent on the user subscribing to Call Hold.
This is only required if there is more than one simultaneous speech call and this is therefore not required for Release 99.

Annex A (informative): Illustration of elements in inter-PLMN handover

Figure 1 illustrates the above definitions taking an example of European GSM networks. The subscriber's home network is France. The visited network where the subscriber is registered in a VLR is Germany. The signalling connection between HLR and VLR is indicated by dotted lines. The calls for the subscriber are controlled by the MSC collocated to the VLR where the subscriber is registered. This MSC is called "*anchor MSC*".
Handover to a different MSC may occur if the cell serving the subscriber after handover is not controlled by the anchor MSC. This MSC is called the "*serving MSC*". Even after the call has been handed over to a different MSC, the call control function remains in the anchor MSC. The signalling connection and circuit switched connection established between anchor MSC and serving MSC are indicated by a solid line.
When the French subscriber registered in a German network roams near the border to the Netherlands, inter-PLMN handover may occur. In this case a Dutch network is the *target network*. After handover, the anchor MSC located in a German network continues to control the call. The German network remains the *visited network* where the subscriber is registered. The subscriber's location information stored in the HLR remains unchanged. The signalling and circuit switched connections between the anchor MSC and the previously serving MSC in the German network will be released when the User Equipment~~Mobile Station~~ (UE~~MS~~) is served by a cell within a Dutch network. The Dutch network becomes the *serving network*. From the Dutch network the subscriber may be handed over to a Belgian network.

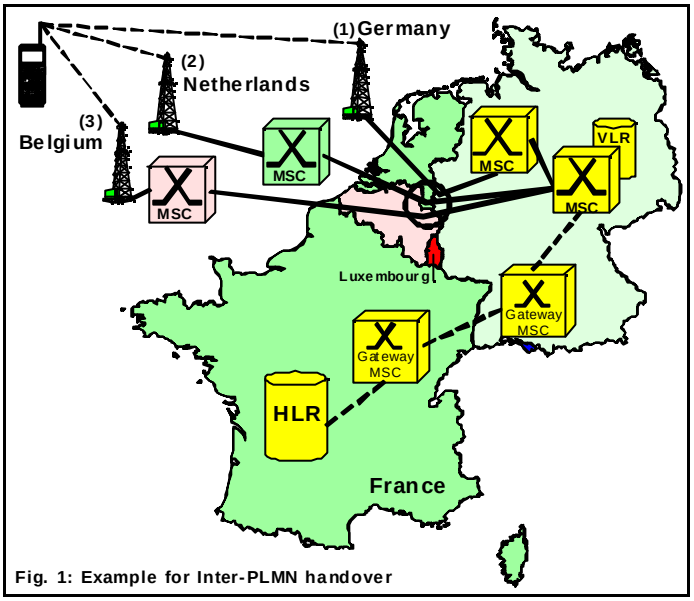

Figure 1: Example for inter-PLMN handover

Annex B (informative): Open Points on Inter-Operator Handover

The requirements outlined below are likely to need further elaboration, although these may be outside the scope of service requirements.

B.2 Selection of Target Cells for Handover

A mechanism is envisaged to support the selection of the target cell for handover. The target cell may be part of the serving network or part of another network.

B.3 Network Information Exchange

A mechanism is envisaged to support the exchange of network information between different operators. Two categories of network information are identified:

- static information, for example, neighbour cell lists, interconnecting traffic and signalling links, etc.;
- dynamic information, for example real-time signalling information related to target cell selection, etc.

B.4 Service Requirements

FFS.

[There is a need to identify which services can be maintained during handover and the interactions of services across network boundaries]

B.5 Billing, Accounting and Charging Requirements

FFS.

Annex C (informative): Change history

Document history		
<Version>	<Date>	<Milestone>
0.0.1	29 Oct 98	First Draft for tdoc
0.0.2	5 Jan 98	Evolved from tdoc 3 then 7 of SMG 1 handover ad hoc
0.0.3	6 Jan 98	evolved from tdoc 20 of SMG1 handover ad hoc
0.0.4	7 Jan 98	evolved from tdoc 35 of SMG1 handover adhoc
0.0.5	8 Jan 98	Evolved from tdoc 45 of SMG1 handover adhoc
1.0.0	27 January	To be presented as version 1.0.0 to SMG#28 for Approval
1.1.0	5 Mar 99	- new requirment for inter-operator handover, as demanded by SMG - removes text on security requirements by referencing 33.21 - editorial revisions
1.2.0	22 Mar 99	1 Initial draft for email handover ad hoc 22-27 Mar. -
1.3.0	24 Mar 99	Clarify inter-operator handover requiremetn
1.4.0	26 Mar 99	Proposed as draft version 2.0.0
2.0.0	12 Apr 99	Draft version 2.0.0
2.0.1	12 Apr 99	Editorially equivalent 2.0.0, with editorial comments removed
2.0.2	16 April 99	Editorial review
3.0.0		
3.1.0	October 1999	Inclusion of CRs at SA#5
3.2.0	December 1999	Inclusion of CRs at SA#6
3.3.0	June 2000	Inclusion of CRs at SA#8
3.4.0	October 2000	Inclusion of CRs at SA#9
4.0.0	October 2000	Inclusion of CRs at SA#9 to create version 4.0.0.

Change history										
TSG SA#	**SA Doc.**	**SA1 Doc**	**Spec**	**CR**	**Rev**	**Rel**	**Cat**	**Subject/Comment**	**Old**	**New**
SP-05	SP-99436	S1-99500	22.129	002		R99	F	SMS handover requirement clarification	3.0.0	3.1.0
SP-05	SP-99436	S1-99516	22.129	003		R99	D	Removal of out-of-date appendix	3.0.0	3.1.0
SP-05	SP-99436	S1-99533	22.129	004		R99	D	Editorial improvements of definitions and alignment of terminology	3.0.0	3.1.0
SP-05	SP-99436	S1-99540	22.129	005		R99	C	To elucidate 1-1 handover principle for R99	3.0.0	3.1.0
SP-05	SP-99436	S1-99541	22.129	006		R99	D	Clarification of the scope of mandatory requirements	3.0.0	3.1.0
SP-05	SP-99483	S1-99565	22.129	007	1	R99	C	Removes all non-R99 requirements, by changing them into Cross phase compatibility requirements which apply to R99.	3.0.0	3.1.0

SP-06	SP-99553	S1-99877	22.129	008		R99	D	Editorial CR to 22.129	3.1.0	3.2.0
SP-06	SP-99523	S1-991019	22.129	009		R99	D	3G/2G handover in the PS Domain	3.1.0	3.2.0
SP-06	SP-99523	S1-991066	22.129	010		R99	B	Handover of a Multicall	3.1.0	3.2.0
SP-06	SP-99521	S1-99868	22.129	011		R99	C	Performance requirements for real time services and requirements for handover between UMTS and GPRS	3.1.0	3.2.0
SP-08	SP-000205	S1-000349	22.129	012		R99	F	Alignment of handover requirements for Multicall	3.2.0	3.3.0
SP-09	SP-000426	S1-000574	22.129	013		R99	F	Removal of requirements for SoLSA support	3.3.0	3.4.0
SP-09	SP-000389	S1-000613	22.129	014		R4	B	Bearer Modification without pre-notification	3.3.0	4.0.0

~~History~~