

ETSI TS 122 011 V3.7.0 (2002-03)

Technical Specification

**Digital cellular telecommunications system (Phase 2+) (GSM);
Universal Mobile Telecommunications System (UMTS);
Service accessibility
(3GPP TS 22.011 version 3.7.0 Release 1999)**



Reference

RTS/TSGS-0122011UR6

Keywords

GSM, UMTS

ETSI

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Sous-Préfecture de Grasse (06) N° 7803/88

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Foreword

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1 Scope

The purpose of this TS is to describe the service access procedures as presented to the user.

Definitions and procedures are provided in this TS for international roaming, national roaming and regionally provided service. These are mandatory in relation to the technical realization of the Mobile Station (UE).

1.1 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. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] GSM 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".
- [2] TR 21.905: " Vocabulary for 3GPP Specifications". features".
- [3] 23.122: "Non Access Stratum functions related to Mobile Station (MS) in idle mode".
- [4] ITU-T Recommendation Q.1001: "General aspects of Public Land Mobile Networks".
- [5] TS 22.043: " Support of Localised Service Area (SoLSA). Stage 1 ".
- [6] TR 21.905: "Vocabulary for 3GPP Specifications"

1.2 Definitions and abbreviations

In addition to those below, abbreviations used in this TS are listed in GSM 01.04 [1] and TR 21.905 [6].

PLMN

A Public Land Mobile Network (PLMN) is a network established and operated by an Administration or RPOA for the specific purpose of providing land mobile communication services to the public. It provides communication possibilities for mobile users. For communications between mobile and fixed users, interworking with a fixed network is necessary.

A PLMN may provide service in one, or a combination, of frequency bands.

As a rule, a PLMN is limited by the borders of a country. Depending on national regulations there may be more than one PLMN per country.

A relationship exists between each subscriber and his home PLMN (HPLMN). If communications are handled over another PLMN, this PLMN is referred to as the visited PLMN (VPLMN).

PLMN Area

The PLMN area is the geographical area in which a PLMN provides communication services according to the specifications to mobile users. In the PLMN area, the mobile user can set up calls to a user of a terminating network. The terminating network may be a fixed network, the same PLMN, another PLMN or other types of PLMN.

Terminating network users can also set up calls to the PLMN.

The PLMN area is allocated to a PLMN. It is determined by the service and network provider in accordance with any provisions laid down under national law. In general the PLMN area is restricted to one country. It can also be determined differently, depending on the different telecommunication services, or type of UE.

If there are several PLMNs in one country, their PLMN areas may overlap. In border areas, the PLMN areas of different countries may overlap. Administrations will have to take precautions to ensure that cross border coverage is minimized in adjacent countries unless otherwise agreed.

NOTE 1: ITU-T Recommendation Q.1001 [4] does not contain a definition of the PLMN area.

System Area

The System Area is defined as the group of PLMN areas accessible by UEs.

Interworking of several PLMNs and interworking between PLMNs and fixed network(s) permit public land mobile communication services at international level.

NOTE 2: The System Area according to [4] Recommendation Q.1001 corresponds to the System Area.

Service Area

The Service Area is defined in the same way as the Service Area according to ITU-T Recommendation Q.1001 [4]. In contrast to the PLMN area it is not based on the coverage of a PLMN. Instead it is based on the area in which a fixed network user can call a mobile user without knowing his location. The Service Area can therefore change when the signalling system is being extended, for example.

Regionally Provided Service

Regionally Provided Service is defined as a service entitlement to only certain geographical part(s) of a PLMN, as controlled by the network operator.

Localised Service Area (LSA)

The localised service area concept shall give the operator a basis to offer subscribers different services (e.g. tariffs or access rights) depending on the location of the subscriber. A LSA consists of a cell or a number of cells within a PLMN. (TS 22.043 [5]).

2 Roaming

2.1 General requirements

A UE with a valid IMSI may roam and access service in the area authorized by the entitlement of the subscription.

If a communication has been established, the UE will in principle not suffer an interruption within the PLMN area (provided the entitlement of the subscription allows it). Exceptions are possible if no network resources or radio coverage are available locally.

However, if the UE leaves the PLMN area, an established communication may terminate. If the user then wants to continue, another network providing service has to be selected and a new communication has to be established (see clause 3).

2.2 International roaming

International roaming is a service whereby an UE of a given PLMN is able to obtain service from a PLMN of another country.

The availability of International Roaming is subject to inter-PLMN agreements.

2.3 National roaming

National Roaming is a service whereby an UE of a given PLMN is able to obtain service from another PLMN of the same country, anywhere, or on a regional basis.

The availability of National Roaming depends on the home PLMN of the requesting UE and the visited PLMN; it does not depend on subscription arrangements.

3 Provisions for providing continuity of service

3.1 Location registration

PLMNs shall provide a location registration function with the main purpose of providing continuity of service to UEs over the whole system area. The location registration function shall be such as to allow:

- Fixed subscribers to call a UE by only using the directory number of the UE irrespective of where the UE is located in the system area at the time of the call.
- UEs to access the system irrespective of the location of the UE.
- UEs to identify when a change in location area has taken place in order to initiate automatic location updating procedures.

3.2 Network selection

3.2.1 General

The UE shall support both manual and automatic network selection mechanisms (modes). The UE shall select the last mode used, as the default mode, at every switch-on.

NOTE: By defaulting to the last mode used, e.g. manual network selection, the undesired automatic selection of an adjacent PLMN instead of the desired HPLMN in border areas, can be avoided at switch-on.

The user shall be given the opportunity to change mode at any time.

Except as defined below, the MMI shall be at the discretion of the UE manufacturer.

The UE shall contain display functions by which Available PLMNs and the Selected PLMN can be indicated.

3.2.2 Procedures

3.2.2.1 General

In the following procedures the UE selects and attempts registration on PLMNs.

In this ETS, the term "PLMN Selection" defines an UE based procedure, whereby candidate PLMNs are chosen, one at a time, for attempted registration.

A User Controlled PLMN Selector data field exists on the USIM to allow the user to indicate a preference for network selection. It shall be possible for the user to update the User Controlled PLMN Selector data field, but it shall not be possible to update this data field over the radio interface, e.g. using SIM Application Toolkit.

It shall be possible to have an Operator Controlled PLMN Selector list and a User Controlled PLMN Selector list stored on the SIM/USIM card. Both PLMN Selector lists may contain a list of preferred PLMNs in priority order. It shall be possible to have an associated Access Technology identifier e.g., UTRA, or GSM associated with each entry in the PLMN Selector lists.

NOTE 1: A PLMN in a Selector list, including HPLMN, may have multiple occurrences, with different access technology identifiers.

It shall be possible to handle cases where one network operator accepts access from access networks with different network IDs. It shall also be possible to indicate to the UE that a group of PLMNs are equivalent to the registered PLMN regarding PLMN selection, cell selection/re-selection and handover.

If registration on a PLMN is successful, the UE shall indicate this PLMN (the "registered PLMN") and be capable of making and receiving calls on it. The identity of the registered PLMN shall be stored on the SIM/USIM. However, if registration is unsuccessful, the UE shall ensure that there is no registered PLMN stored in the SIM/USIM.

If a registration is unsuccessful because the IMSI is unknown in the home network, or the UE is illegal, then the UE shall not allow any further registration attempts on any network, until the UE is next powered-up or a SIM/USIM is inserted.

If the registration is unsuccessful due to the lack to service entitlement, specific behaviour by the UE may be required, see subclause 3.2.2.4.

To avoid unnecessary registration attempts, lists of forbidden PLMNs and LAs are maintained in the UE, see subclause 3.2.2.4 and TS 23.122 [3].

Registration attempts shall not be made by UEs without a SIM/USIM inserted.

An UE/ME which has not successfully registered shall nevertheless be able to make emergency call attempts on an available PLMN(which supports the emergency call teleservice), without the need for the user to select a PLMN. An available PLMN is determined by radio characteristics (TS 23.122 [3]).

3.2.2.2 At switch-on or recovery from lack of coverage

If the UE is within coverage (at switch-on) or returns to coverage of the PLMN on which it is already registered (as indicated by the registered PLMN stored in the SIM/USIM), the UE shall perform a location update to a new location area if necessary.

If there is no registered PLMN stored in the SIM/USIM, or if this PLMN is unavailable and no equivalent PLMN is available, or the attempted registration fails, the UE shall follow one of the following procedures for network selection:

A) Automatic network selection mode

The UE shall select and attempt registration on other PLMNs, if available and allowable and the location area is not in the list of "forbidden LAs for roaming" (see TS 23.122 [3]), in the following order:

- i) HPLMN for preferred access technologies in the order specified. It shall be possible to configure a voice capable UE so that it shall not attempt registration on a PLMN if all cells identified as belonging to the PLMN do not support the corresponding voice service;
- ii) each PLMN in the " User Controlled PLMN Selector" data field in the USIM (in priority order) . It shall be possible to configure a voice capable UE so that it shall not attempt registration on a PLMN if all cells identified as belonging to the PLMN do not support the corresponding voice service;
- iii) each PLMN in the "Operator Controlled PLMN Selector" data field in the SIM/USIM (in priority order). It shall be possible to configure a voice capable UE so that it shall not attempt registration on a PLMN if all cells identified as belonging to the PLMN do not support the corresponding voice service;
- iv) other PLMN/access technology combinations with sufficient received signal level (see TS 23.122 [3]) in random order;
- v) other PLMN/access technology combinations with sufficient received signal quality (see TS 23.122 [3]) in random order. It shall be possible to configure a voice capable UE so that it shall not attempt registration on a PLMN if all cells identified as belonging to the PLMN do not support the corresponding voice service;
- vi) all other PLMN/access technology combinations in order of decreasing signal quality. It shall be possible to configure a voice capable UE so that it shall not attempt registration on a PLMN if all cells identified as belonging to the PLMN do not support the corresponding voice service.

In the case of a UE operating in UE operation mode A or B, an allowable PLMN is one which is not in the "Forbidden PLMN" data field in the SIM/USIM. This data field may be extended in the ME memory. (see subclause 3.2.2.4). In the case of a UE operating in UE operation mode C, an allowable PLMN is one which is not in the "Forbidden PLMN" data field in the SIM or in the list of "forbidden PLMNs for GPRS service" in the ME.

If successful registration is achieved, the UE shall indicate the selected PLMN.

If registration cannot be achieved on any PLMN, the UE shall indicate "no service" to the user, wait until a new PLMN is detected, or new location areas of an allowed PLMN are found which are not in the forbidden LA list(s), and then repeat the procedure. When registration cannot be achieved, different (discontinuous) PLMN search schemes may be used in order to minimize the access time while maintaining battery life, e.g. by prioritising the search in favour of BCCH carriers which have a high probability of belonging to an available and allowable PLMN.

B) Manual network selection mode

The UE shall indicate PLMNs, including "Forbidden PLMNs", which are available. If there are none, this shall also be indicated.

Any available PLMN's shall be presented in the following order:

- i) HPLMN;
- ii) PLMNs contained in the "User Controlled PLMN Selector" data field in the SIM/USIM (in priority order);
- iii) PLMNs contained in the "Operator Controlled PLMN Selector" data field in the SIM/USIM (in priority order);
- iv) other PLMN/access technology combinations with sufficient received signal level (see TS 23.122 [3]) in random order;
- v) all other PLMN/access technology combinations in order of decreasing signal strength.

If a PLMN does not support voice services then this shall be indicated to the user.

The user may select his desired PLMN and the UE shall attempt registration on this PLMN. (This may take place at any time during the presentation of PLMNs.)

If the registration cannot be achieved on the selected PLMN, the UE shall indicate "No Service". The user may then select and attempt to register on another or the same PLMN following the above procedure. The UE shall not attempt to register on a PLMN which has not been selected by the user.

Once the UE has registered on a PLMN selected by the user, the UE shall not automatically register on a different PLMN unless:

- i) The new PLMN is declared as an equivalent PLMN by the registered PLMN;

or,

- ii) The user selects automatic mode.

If a PLMN is selected but the UE cannot register on it because registration is rejected with the cause "PLMN not allowed", the UE shall add the PLMN to the "Forbidden PLMN" list (subclause 3.2.2.4.1). The UE shall not re-attempt to register on that network unless the same PLMN is selected again by the user.

If a PLMN is selected but the UE cannot register for PS services on it because registration is rejected with the cause "GPRS services not allowed in this PLMN", the UE shall not re-attempt to register for PS services on that network. The PLMN is added to the list "Forbidden PLMN's for GPRS services". The UE shall not re-attempt to register for PS on that network unless the same PLMN is selected again by the user. The reception of the cause "GPRS services not allowed in this PLMN", does not affect the CS service.

If a PLMN is selected but the UE cannot register on it for other reasons, the UE shall, upon detection of a new LA (not in a forbidden LA list) of the selected PLMN, attempt to register on the PLMN.

If the UE is registered on a PLMN but loses coverage, different (discontinuous) carrier search schemes may be used to minimize the time to find a new valid BCCH carrier and maintain battery life, e.g. by prioritising the search in favour of BCCH carriers of the registered PLMN.

3.2.2.3 User reselection

At any time, the user may request the UE to initiate reselection and registration onto an alternative available PLMN, according to the following procedures, dependent upon the operating mode.

A) Automatic Network Selection Mode

The UE shall follow the procedure defined in clause 3.2.2.2.A) above.

B) Manual Network Selection Mode

The procedure of 3.2.2.2 B) is followed.

3.2.2.4 Mobile Station reactions to indications of service restriction from the network

Different types of UE behaviour is required to support, for example, national roaming, regionally provided service and temporary international roaming restrictions. The behaviour to be followed by the UE is indicated by the network.

3.2.2.4.1 "Permanent" PLMN restriction

When a registration attempt by the UE is rejected by a network with an indication of "permanent" PLMN restriction, the PLMN identity shall be written to a list of "Forbidden PLMNs" stored in a data field in the SIM/USIM.

If a successful registration (whilst in manual mode) is achieved on a PLMN in the "Forbidden PLMN" list, the PLMN shall be deleted from the list.

When in automatic mode, the UE may indicate any PLMNs which will not be selected due to their presence in the "Forbidden PLMN" list.

If a UE receives an equivalent PLMN list containing a PLMN which is included in the "Forbidden PLMN" list, this PLMN shall be removed from the equivalent PLMN list before this is stored by the UE.

3.2.2.4.2 "Partial" and "temporary" PLMN restrictions

When a registration attempt by the UE is rejected by a network due to a "partial" or a "temporary" PLMN restriction, the UE shall perform one of the following procedures determined by the indication in the location update reject cause sent by the network (see TS 23.122 [3]):

- i) The UE shall store the location area identity in the list of "forbidden LAs for regional provision of service" and shall enter the limited service state and remain in that state until it moves to a cell in a location area where service is allowed.
- ii) The UE shall store the location area identity in the list of "forbidden LAs for roaming" and shall use one of the following procedures according to the PLMN selection Mode:
 - A) Automatic network selection mode:

The procedure of 3.2.2.2. A).
 - B) Manual network selection mode:

The procedure of 3.2.2.2.B).
- iii) The UE shall store the location area identity in the list of "forbidden LAs for roaming" and shall search for a suitable cell in the same PLMN. (Note: A suitable cell will belong to a different LA which is not in the "forbidden LAs for roaming").

3.2.2.4.3 PLMN restrictions for PS services

When a registration attempt for PS services by the UE is rejected by the network with the cause "GPRS services not allowed in this PLMN", the PLMN identity shall be written to a list of "forbidden PLMNs for GPRS service" in the ME. This list is deleted when the UE is switched off or when the SIM is removed; the maximum number of possible entries in this list is implementation dependent, but must be at least one entry. (see GSM 03.22 [5]).

If a successful registration (whilst in manual mode) is achieved on a PLMN in the "forbidden PLMNs for GPRS service" list, the PLMN shall be deleted from the list.

3.2.2.5 Timer for return to HPLMN

A UE in Automatic Mode shall make periodic attempts to look for a higher priority PLMN of the same country as the currently registered PLMN. For the ranking of PLMNs the UE shall use the order used in subclause 3.2.2.2. In the case that the UE has stored a list of equivalent PLMNs, the UE shall only select a PLMN if it has a higher priority than any of the PLMNs, in the list of equivalent PLMNs, which are of the same country as the currently registered PLMN

NOTE: In the context of this TS, the term country is to be interpreted not as a political entity but as a single Mobile Country Code (MCC). For instance the USA has multiple MCC. The USA case is in fact treated as an exception in the 3GPP specifications. For all other countries, multiple MCCs may be used, however the specifications have not taken this into account and there could be adverse effects such as the UE being unable to detect that multiple MCCs are within the same country.

The interval between attempts shall be stored in the SIM/USIM. Only the service provider shall be able to set the timer value. The timer shall have a value between 6 minutes and 8 hours, with a step size of 6 minutes. One value shall be designated to indicate that no periodic attempts shall be made.

In the absence of a permitted value in the SIM/USIM, or the SIM/USIM is phase 1 and therefore does not contain the datafield, then a default value of 60 minutes, shall be used by the UE.

NOTE: Use of values less than 60 minutes may result in excessive ME battery drain.

3.2.2.6 Investigation PLMN Scan

The operator shall be able to control by SIM/USIM configuration whether an UE that is capable shall perform an investigation scan. This investigation scan shall be performed after each successful PLMN selection as well as during limited service state. The investigation scan shall search for a higher prioritised PLMN that does not offer GSM voice service. If such a PLMN is available, the user shall be informed. This enables the user to switch to such a PLMN using manual selection if the user so prefers. The investigation scan shall not be performed when no SIM/USIM is inserted.

4 Access control

4.1 Purpose

Under certain circumstances, it will be desirable to prevent UE users from making access attempts (including emergency call attempts) or responding to pages in specified areas of a PLMN. Such situations may arise during states of emergency, or where 1 of 2 or more co-located PLMNs has failed.

Broadcast messages should be available on a cell by cell basis indicating the class(es) of subscribers barred from network access.

The use of this facility allows the network operator to prevent overload of the access channel under critical conditions.

It is not intended that access control be used under normal operating conditions.

4.2 Allocation

All UEs are members of one out of ten randomly allocated mobile populations, defined as Access Classes 0 to 9. The population number is stored in the SIM/USIM. In addition, mobiles may be members of one or more out of 5 special categories (Access Classes 11 to 15), also held in the SIM/USIM. These are allocated to specific high priority users as follows. (The enumeration is not meant as a priority sequence):

Class 15 - PLMN Staff;

- "- 14 - Emergency Services;
- "- 13 - Public Utilities (e.g. water/gas suppliers);
- "- 12 - Security Services;
- "- 11 - For PLMN Use.

4.3 Operation

If the UE is a member of at least one Access Class which corresponds to the permitted classes as signalled over the air interface, and the Access Class is applicable in the serving network, access attempts are allowed. Otherwise access attempts are not allowed.

Access Classes are applicable as follows:

- Classes 0 - 9 - Home and Visited PLMNs;
- Classes 11 and 15 - Home PLMN only;
- Classes 12, 13, 14 - Home PLMN and visited PLMNs of home country only.

Any number of these classes may be barred at any one time.

4.4 Emergency Calls

An additional control bit known as "Access Class 10" is also signalled over the air interface to the UE. This indicates whether or not network access for Emergency Calls is allowed for UEs with access classes 0 to 9 or without an IMSI. For UEs with access classes 11 to 15, Emergency Calls are not allowed if both "Access class 10" and the relevant Access Class (11 to 15) are barred. Otherwise, Emergency Calls are allowed.

5 Support of Localised Service Area (SoLSA)

SoLSA consists of a set of service features that give the operator a basis to offer subscribers different services (e.g. tariffs or access rights) depending on the location of the subscriber. (TS22.043 [5]). The following section is only applicable to the support of SoLSA functionality.

5.1 Network selection

The standard automatic and manual network selection procedures will be used.

Manual network selection may be required when the PLMN providing the users SoLSA service is not the one on which the user is currently registered.

At manual network selection the UE shall provide the means to present the subscribers LSA(s) for each PLMN presented.

5.2 The Idle-mode operation

The UE shall always select a valid LSA with the highest priority.

5.2.1 Subscriber moving from a normal environment to his localised service area.

The UE shall have the ability to prioritise allowed LSA cells in reselection, making it possible to camp on a LSA cell earlier (the function shall be network controlled).

5.2.2 Subscriber moving away from his localised service area to a normal environment.

The UE shall have the ability to prioritise allowed LSA cells in reselection, making it possible to camp on a LSA cell longer (the function shall be network controlled).

5.2.3 Subscriber staying in his localised service area

The UE shall have the ability to prioritise allowed LSA cells in reselection by being more persistent (the function shall be network controlled).

NOTE: Typically in indoor environments there are occasional reflections and "disturbances" due to macro cells, e.g. near the windows. In such a case LSA cells should be favoured even though there is higher field strength available from the outdoor cells.

5.3 LSA only access

It shall be possible to allow LSA user to access PLMN only within his LSAs. A LSA user is not allowed to receive and/or originate a call outside the allowed LSA area.

When UE is out of the allowed LSA area it shall be registered in PLMN but indicate subscriber/service specific "out of LSA area" notification. It shall be a network controlled function to prevent terminated or/and originated calls. Emergency calls are however always allowed.

5.4 Exclusive access

Access to exclusive access cells is restricted to defined LSA subscribers.

Non-LSA subscriber shall consider exclusive access cells as not suitable, only allowing to camp for emergency calls (limited service state TS 23.122 [3]).

5.5 Preferential access

As a network controlled function it shall be possible in LSA to allocate resources at call setup and during the active mode to LSA users compared to non-LSA users.

Annex A (informative): Change history

Change history										
TSG SA#	SA Doc.	SA1 Doc	Spec	CR	Rev	Rel	Cat	Subject/Comment	Old	New
Jun 1999			02.04					Transferred to 3GPP SA1	7.0.0	3.0.0
SA#04			02.04						3.0.0	
SP-05	SP-99479	S1-99610	22.011	001		R99	D	Editorial changes for alignment	3.0.0	3.0.1
SP-06	SP-99524	S1-991032	22.011	002		R99	B	COMPACT Cell Selection Part 2	3.0.1	3.1.0
SP-06	SP-99606		22.011	003	1	R99	B	Network Selection	3.0.1	3.1.0
SP-06	SP-99607		22.011	004	1	R99	B	Control of user preference field	3.0.1	3.1.0
SP-07	SP-000055	S1-000138	22.011	012		R99	F	Corrections to 22.011	3.1.0	3.2.0
SP-07	SP-000055	S1-000139	22.011	013		R99	C	Removal of "Home Environment Specific Network Selection Procedure"	3.1.0	3.2.0
SP-09	SP-000372	S1-000548	22.011	017		R99	F	Alignment with 23.122 on selection procedure	3.2.0	3.3.0
SP-11	SP-010036	S1-010131	22.011	020		R99	A	CR to 22.011 on Roaming restrictions for GPRS (Release '99)	3.3.0	3.4.0
SP-11	SP-010150		22.011	022		R99	F	Equivalent handling of PLMNs with different PLMN codes	3.3.0	3.4.0
SP-12	SP-010244	S1-010494	22.011	024		R99	F	Partial PLMN access restriction	3.4.0	3.5.0
SP-12	SP-010244	S1-010513	22.011	026		R99	F	Periodic Network Selection Attempt improvement	3.4.0	3.5.0
SP-12	SP-010244	S1-010516	22.011	028		R99	F	Default value for background scanning timer	3.4.0	3.5.0
SP-14	SP-010685	S1-011282	22.011	030		R99	F	CR to 22.011 R99 'Interaction between equivalent PLMN list and periodic network selection attempts'	3.5.0	3.6.0
SP-14	SP-010684	S1-011333	22.011	034		R99	F	CR to 22.011 R99 'Editorial improvements	3.5.0	3.6.0
SP-14	SP-010688	S1-011335	22.011	036		R99	F	CR to 22.011 R99 'Clarification on the UE behaviour when receiving a registration rejection'	3.5.0	3.6.0
SP-14	SP-010687	S1-011337	22.011	038		R99	F	CR to 22.011 R99 'Simplification of the procedure for user PLMN reselection'	3.5.0	3.6.0
SP-14	SP-010686	S1-011340	22.011	040		R99	F	CR to 22.011 R99 'Interaction between "equivalent PLMN" list and "Forbidden PLMN" list'	3.5.0	3.6.0
SP-14	SP-010757		22.011	043	1	R99	F	Interaction between ePLMN and manual mode	3.5.0	3.6.0
SP-15	SP-010158		22.011	044	1	R99	F	CR to 22.011 R99: clarification of the term 'country'	3.6.0	3.7.0
								Note: special dispensation was given by SA #15 to allow some leeway on the position of the note.		

History

Document history		
V3.1.0	January 2000	Publication
V3.2.0	March 2000	Publication
V3.3.0	October 2000	Publication
V3.4.0	March 2001	Publication
V3.5.0	June 2001	Publication
V3.6.0	December 2001	Publication
V3.7.0	March 2002	Publication