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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.
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- [1] Void
- [2] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [3] 3GPP TS 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] 3GPP TS 22.043: " Support of Localised Service Area (SoLSA). Stage 1".
- [6] 3GPP TS 22.234: "Requirements on 3GPP system to wireless local area network (WLAN) interworking".

1.2 Definitions and abbreviations

In addition to those below, abbreviations used in this 3GPP TS are listed in 3GPP TR 21.905 [2].

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. (3GPP 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.

2.4 Roaming in shared networks

Mechanisms shall be specified to enable flexible allocation of visiting roamers among core network operators that have roaming agreements with the same roaming partners. The core network operators shall be able to pre-define their relative share of visiting roamers and distribute the visiting roamers that apply automatic network selection to different core networks connected to the radio access network accordingly.

When network sharing exists between different operators and a user roams into the shared network it shall be possible for that user to register with a core network operator (among the network sharing partners) that the user's home operator has a roaming agreement with, even if the operator is not operating a radio access network in that area.

The selection of a core network operator among those connected to the shared radio access network can either be manual (i.e. performed by the user after receiving a list of available core network operators) or automatic (i.e. performed by the UE according to user and operator preferred settings). For further information see subclause 3.2.

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.

As an optional feature of the ME, the user shall be able to set a preference in the ME for the mode that shall be used at switch on. If set then the ME shall select this preference rather than the default mode.

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.

In shared networks a radio access network can be part of more than one PLMN. This shall be transparent to the user, i.e. the UE shall be able to indicate those PLMNs to the user, and the UE shall support network selection among those PLMNs, as in non-shared networks.

3.2.2 Procedures

3.2.2.1 General

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

In this TS, 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., UTRAN, or GERAN associated with each entry in the PLMN Selector lists.

The UE shall utilise all the information stored in the USIM related to network selection, e.g. HPLMN, Operator controlled PLMN Selector list, User Controlled PLMN Selector list, Forbidden PLMN list.

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

The UE shall ignore those PLMN + access technology entries in the User Controlled PLMN selector and Operator Controlled PLMN selector lists where the associated Access Technology is not supported by the UE. In the case that there are multiple associated Access Technology identifiers in an entry the UE shall not ignore the entry if it includes any associated Access Technology that is supported by the UE.

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.

It shall be possible for the home network operator to identify alternative Network IDs as the HPLMN. It shall be possible for the home network operator to store in the USIM an indication to the UE that a group of PLMNs are treated as the HPLMN regarding PLMN selection. Any PLMN to be declared as an equivalent to the HPLMN shall be present within the EHPLMN list and is called an EHPLMN. The EHPLMN list replaces the HPLMN derived from the IMSI. When the EHPLMN is used it replaces the HPLMN in all the network and cell selection procedures.

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 3GPP 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 (3GPP TS 23.122 [3]).

3.2.2.2 At switch-on or recovery from lack of coverage

At switch on, when in coverage of the last registered PLMN as stored in the SIM/USIM, the UE will attach to that network.

As an option, if the UE is in automatic network selection mode and it finds that it is also in coverage of the HPLMN whilst searching for the last registered PLMN, the UE may register on the HPLMN. The operator shall be able to control the UE behaviour by USIM configuration.

As an option, if the UE is in manual network selection mode at switch-on

- if the last registered PLMN is unavailable and no equivalent PLMN is available,
- and the UE finds it is in coverage of either the HPLMN or an EHPLMN

then the UE should register on the corresponding HPLMN or EHPLMN. The UE remains in manual mode.

If the UE 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. As an alternative option to this, if the UE is in automatic network selection mode and it finds coverage of the HPLMN, the UE may register on the HPLMN and not return to the last registered PLMN. The operator shall be able to control by USIM configuration whether an UE that supports this option shall perform this alternative behaviour.

The default behaviour for a UE is to select the last registered PLMN.

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 3GPP TS 23.122 [3]), in the following order:

- i) An EHPLMN if the EHPLMN list is present or the HPLMN (derived from the IMSI) if the EHPLMN list is not present for preferred access technologies in the order specified. In the case that there are multiple EHPLMNs present then the highest priority EHPLMN shall be selected. 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 entry in the "User Controlled PLMN Selector with Access Technology" 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;
- iii) each entry in the "Operator Controlled PLMN Selector with Access Technology" 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 quality (see 3GPP 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;
- v) 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/USIM 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. The HPLMN of the user may provide on the USIM additional information on the available PLMNs that may be displayed to the user. This information, provided as free text may include:

- Preferred partner,
- roaming agreement status,
- supported services

Furthermore, the UE may indicate whether the available PLMNs are present on one of the PLMN selector lists (e.g. EHPLMN, User Controlled, Operator Controlled or Forbidden) as well as not being present on any of the lists.

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

- i) HPLMN (if the EHPLMN list is not present); or if one or more of the EHPLMNs are available then based on an optional data field on the USIM either the availability of the highest priority EHPLMN is to be presented to the user or all available EHPLMNs are presented to the user in priority order; if the data field is not present, then only the availability of the highest priority EHPLMN is presented;
- 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 3GPP 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 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 prioritizing 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 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 3GPP 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/USIM is removed; the maximum number of possible entries in this list is implementation dependent, but must be at least one entry (see 3GPP TS 23.122 [3]).

If a successful registration 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 Periodic network selection attempts

A UE in Automatic Mode shall make periodic attempts to look for a higher priority PLMN including associated Access Technology of the same country as the currently received PLMN including associated Access Technology. For the ranking of PLMNs the UE shall use the order used in subclause 3.2.2.2. In the case that there is no associated Access Technology identifier the mobile shall assume that all Access Technologies provided by a PLMN are of equal priority. Moreover, periodic network selection shall not lead to change of access technology within the registered PLMN.

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 all 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 3GPP 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.

In the case that there are multiple EHPLMNs available, the UE shall not attempt to select a higher priority EHPLMN when an EHPLMN has already been selected. The priorities of EHPLMNs are only applicable when the UE is on a VPLMN and multiple EHPLMNs are available.

The UE shall only make reselection attempts while in idle mode for circuit services. In case of GPRS terminals, the UE shall only make reselection attempts while in Idle or Stand-by mode.

The interval between attempts shall be stored in the SIM/USIM. Only the service provider shall be able to select for which of the previous situations, periodic network selection shall be attempted and to set the interval, which shall be 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 CS 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.

3.2.2.7 Confirmed Roaming

This feature is intended to prevent accidental roaming by users when the UE is in automatic mode.

It shall be possible for the HPLMN to identify a number of countries in which the UE shall request positive confirmation from the user that they intend to roam.

Once the user has confirmed that they wish to roam, this confirmation will remain valid until the user returns to the HPLMN. It shall also be possible for a users' preference to remain valid for an operator determined period, even if they return to the HPLMN, in order to prevent the user being asked for repeated confirmations in a short period.

It shall be possible for the user to change the preference at any time.

If no countries are specified by the HPLMN then no user confirmation shall be required for roaming.

3.2.2.8 Steering Of Roaming

Steering to a specific VPLMN

It shall be possible for the HPLMN at any time to direct a UE, that is in automatic mode, to search for a specific VPLMN and, if it is available, move to that VPLMN as soon as possible. This VPLMN shall then be regarded as the highest priority VPLMN as defined by the operator. This process shall be done transparently and without inconvenience to the user.

If the UE is in manual mode, the steering request shall be ignored.

If the UE is registered on a VPLMN that is present on the User Controlled PLMN List, the steering request shall be ignored.

The UE shall attempt to register on the specified VPLMN even if the specified VPLMN is present on a Forbidden List.

This mechanism shall be available to the HPLMN even if the VPLMN the UE is registered on is compliant to an earlier release of the 3GPP specifications.

VPLMN Redirection

It shall be possible for the HPLMN to request a UE, that is in automatic mode, to find and register on a different VPLMN from the one it is currently using or trying to register on, if another VPLMN, that is not in a Forbidden List, is available. The original VPLMN shall then be treated as the lowest priority VPLMN and would not be selected by the UE unless it is the only one available to the UE or has been selected in manual mode. This process shall be done transparently and without inconvenience to the user.

If the UE is in manual mode, the redirection request shall be ignored.

If the UE is registered on a VPLMN that is present on the User Controlled PLMN List, the redirection request shall be ignored.

This mechanism shall be available to the HPLMN even if the VPLMN the UE is registered on is compliant to an earlier release of the 3GPP specifications.

3.2.3 Network selection for Multi-mode terminals with 3GPP Capability

Different type's of Multi-mode terminals combining different technologies and systems in one terminal can be produced. It is not possible to foresee all possible configurations and provide a detailed technical specification for network and system selection for all possible multi-mode terminal configurations. The following provides the generic requirements for network and system selection for Multi-mode terminals with 3GPP Capability. These requirements are mandatory for a 3GPP capable multi-mode terminal, unless otherwise is explicitly specified elsewhere in the 3GPP Technical Specifications.

- a multi-mode terminal, when in 3GPP mode of operation shall be compliant to the 3GPP specifications, including PLMN selection, cell selection and re-selection, paging reception etc.,
- As consequence, the multi-mode terminal when entering 3GPP mode of operation shall act as if it were a 3GPP only UE which had just been switched-on. Similarly, when leaving the 3GPP mode of operation the multimode terminal shall act as if it were a 3GPP only UE which had just been switched-off

When the multimode terminal is in 3GPP mode, the switching between modes in the multi-mode terminal is considered an overlay functionality selecting mode of operation. For the design of the overlay functionality the following requirements shall be fulfilled:

- The overlay functionality shall include a mechanism to avoid ping-pong between systems, e.g., a timer or hysteresis function

- The overlay functionality shall not include network priority mechanisms, which conflict with the network priority mechanisms specified in 3GPP specifications, e.g., the Periodic network selection attempts scanning within 3GPP based systems for PLMNs of higher priority than the current serving PLMN.
- Any functionality in the overlay system, such as background scan of other systems, shall not impact the fulfilment of 3GPP protocol requirements (in particular in regards to paging, cell selection, cell re-selection and PLMN selection)
- As specified in this technical specification, the 3GPP technical specification provides the capability for the user to set their own 3GPP PLMN selection preferences; as well as the user can manually select any 3GPP PLMN. This has been done to ensure a fair competition environment. These principles shall be maintained in the design of the overlay functionality.

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 if the EHPLMN list is not present or any EHPLMN;
- Classes 12, 13, 14 - Home PLMN and visited PLMNs of home country only. For this purpose the home country is defined as the country of the MCC part of the IMSI.

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.

4.5 Control of UE Capabilities

To protect the user from the effects of a misbehaving UE (e.g causing additional charges, degraded performance) and to protect the network operator's network capacity, including radio resources and network signaling and processing, means shall be provided for the HPLMN/EHPLMN and the VPLMN to provide an indication to the UE as to which network provided services or functions it is not allowed to use.

The Selective UE Capabilities list, shall be maintained in the UE and the UE shall not request any services indicated as disabled. At registration the HPLMN/EHPLMN or VPLMN may interrogate the status of the list and provide a new list.

The Selective UE Capabilities list shall not be deleted at switch off and will remain valid until a new list is provided by the network. The Selective UE Capabilities list relates to the ME and not to the subscription.

It should be ensured that UEs are not maliciously disabled, including malicious disabling by a VPLMN, or accidentally disabled, or kept disabled, and there shall be a mechanism for restoring disabled UEs in all situations (e.g. in the case that the serving network does not support the control of UE Capabilities).

The UE should use the indications given in the Selective UE Capabilities list to inform the user of the non-availability of services or functions.

There shall be a means for the network to provide an optional customer service number(s) which can be used, by the user, to assist in determining the cause of non-availability of specific services. The specifications should also provide the capability for the network to include an optional text string that will be displayed by the UE.

The UE Capabilities list shall take precedence over subscribed services.

The services to be included in the list are:

- Call Control functions
- Supplementary Services
- Emergency Calls (including the (U)SIM-less case and subject to regional regulatory requirements, i.e. emergency calls shall not be disabled in regions where support of them is required)
- SMS, via CS and PS
- LCS, via CS and PS
- GPRS based services
- MBMS
- IMS

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. (3GPP TS 22.043 [5]). The following section is only applicable to the support of SoLSA functionality in GERAN.

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 3GPP 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.

6 Support of 3GPP - WLAN Interworking

Support of 3GPP-WLAN interworking and network selection is captured in TS 22.234 [6]

6.1 Void

6.2 Void

6.3 Void

7 Administrative restriction of subscribers' access

Means shall be standardised for an administrative restriction of subscribers' access without the need of having explicit Location/Routing Area identities in the individual subscription profiles.

To achieve this it shall be possible to indicate per subscriber, in subscription data, allowed categories of Location/Routing Areas. It shall be possible to use this subscription information to restrict subscribers' access to categories of Location/Routing Areas in serving networks accordingly.

As a minimum, the following categories shall be available:

- a) GERAN ONLY
- b) UTRAN ONLY

There might be cases where the visited network has not separated the Location/Routing area categories, in which case the administrative restriction of subscribers' access will not be possible.

This administrative restriction of subscribers' access shall be an optional feature.

Annex A (informative): Change history

Change history											
TSG SA#	SA Doc.	SA1 Doc	Spec	CR	Rev	Rel	Cat	Subject/Comment	Old	New	Work Item
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	0001		R99	D	Editorial changes for alignment	3.0.0	3.0.1	
SP-06	SP-99524	S1-991032	22.011	0002		R99	B	COMPACT Cell Selection Part 2	3.0.1	3.1.0	
SP-06	SP-99606		22.011	0003	1	R99	B	Network Selection	3.0.1	3.1.0	
SP-06	SP-99607		22.011	0004	1	R99	B	Control of user preference field	3.0.1	3.1.0	
SP-07	SP-000055	S1-000138	22.011	0012		R99	F	Corrections to 22.011	3.1.0	3.2.0	
SP-07	SP-000055	S1-000139	22.011	0013		R99	C	Removal of "Home Environment Specific Network Selection Procedure"	3.1.0	3.2.0	
SP-07	SP-000071	S1-000161	22.011	0014		R00	B	Network Selection	3.1.0	4.0.0	
SP-08	SP-000211	S1-000335	22.011	0016		R00	B	Reselection attempts of GPRS terminals	4.0.0	4.1.0	
SP-09	SP-000372	S1-000549	22.011	0018		R4	F	Alignment with 23.122 on selection procedure	4.1.0	4.2.0	
SP-11	SP-010036	S1-010245	22.011	0021		Rel-4	A	CR to 02.11 on Roaming restrictions for GPRS (Release4)	4.2.0	4.3.0	GPRS
SP-11	SP-010151		22.011	0023		Rel-4	A	Equivalent handling of PLMNs with different PLMN codes	4.2.0	4.3.0	GSM / UMTS inter-working
SP-12	SP-010244	S1-010495	22.011	0025		Rel-4	A	Partial PLMN access restriction	4.3.0	4.4.0	
SP-12	SP-010244	S1-010514	22.011	0027		Rel-4	A	Periodic Network Selection Attempt improvement	4.3.0	4.4.0	
SP-12	SP-010244	S1-010517	22.011	0029		Rel-4	A	Default value for background scanning timer	4.3.0	4.4.0	
SP-14	SP-010685	S1-011341	22.011	0031		Rel-4	A	CR to 22.011 R4 'Interaction between equivalent PLMN list and periodic network selection attempts'	4.4.0	4.5.0	
SP-14	SP-010684	S1-011334	22.011	0035		Rel-4	A	CR to 22.011 R4 'Editorial improvements'	4.4.0	4.5.0	
SP-14	SP-010688	S1-011336	22.011	0037		Rel-4	A	CR to 22.011 R4 'Clarification on the UE behaviour when receiving a registration rejection'	4.4.0	4.5.0	
SP-14	SP-010687	S1-011338	22.011	0039		Rel-4	A	CR to 22.011 R4 'Simplification of the procedure for user PLMN reselection'	4.4.0	4.5.0	
SP-14	SP-010686	S1-011339	22.011	0041		Rel-4	A	CR to 22.011 R4 'Interaction between 'equivalent PLMN' list and 'Forbidden PLMN' list'	4.4.0	4.5.0	
SP-14	SP-010757	---	22.011	0042	2	Rel-4	A	Interaction between ePLMN and manual mode	4.4.0	4.5.0	
SP-15	SP-010158	---	22.011	0045	1	Rel-4	A	CR to 22.011 Rel-4: clarification of the term 'country' Note: special dispensation was given by SA #15 to allow some leeway on the position of the note.	4.5.0	4.6.0	
SP-16	SP-020238	S1-021058	22.011	0046		Rel-4	F	Editorial corrections on 22.011	4.6.0	4.7.0	CORRECT
SP-16	SP-020267	S1-021043	22.011			Rel-5		Updated from Rel-4 to Rel5	4.7.0	5.0.0	
SP-17	SP-020547	S1-021826	22.011	0049		Rel-5	A	CR to 22.011 Rel 5 - correction to periodic PLMN scan	5.0.0	5.1.0	TEI4
SP-19	SP-030035	S1-030236	22.011	0050	-	Rel-6	B	Netshare CR to TS 22.011	5.1.0	6.0.0	NTShar-CR
SP-20	SP-030249	S1-030504	22.011	0051		Rel-6	B	Network Selection requirements for WLAN Interworking	6.0.0	6.1.0	WLAN-CR
SP-20	SP-030248	S1-030532	22.011	0052		Rel-6	B	Network selection in shared	6.0.0	6.1.0	NTshar-

Change history											
TSG SA#	SA Doc.	SA1 Doc	Spec	CR	Rev	Rel	Cat	Subject/Comment	Old	New	Work Item
								networks			CR
SP-22	SP-030774	-	22.011	0053	1	Rel-6	B	Administrative restriction of subscribers' access	6.1.0	6.2.0	TEI
SP-23	SP-040088	S1-040200	22.011	0054	-	Rel-6	C	Periodic network selection attempts enhancement	6.2.0	6.3.0	TEI
SP-23	SP-040089	S1-040257	22.011	0056	-	Rel-6	F	Priority usage of UICC parameters for I-WLAN	6.2.0	6.3.0	WLAN
SP-23	SP-040101	S1-040260	22.011	0057	-	Rel-6	D	Extraction of redundant WLAN network selection information [- now in WLAN TS22.234]	6.2.0	6.3.0	WLAN
SP-24	SP-040287	S1-040438	22.011	0058	-	Rel-6	F	Behaviour of Single Mode mobiles with regards to the use of access technology in the PLMN selector lists	6.3.0	6.4.0	TEI6
SP-24	SP-040287	S1-040442	22.011	0060	-	Rel-6	F	Use of access technology in Periodic Network Selection attempts	6.3.0	6.4.0	TEI6
SP-24	SP-040287	S1-040443	22.011	0061	-	Rel-6	F	Clarification on the use of the RAT during network selection	6.3.0	6.4.0	TEI6
SP-24	SP-040295	S1-040526	22.011	0064	-	Rel-6	F	Priority usage of UICC parameters for I-WLAN	6.3.0	6.4.0	WLAN-CR
SP-24	SP-040299	S1-040445	22.011	0062	-	Rel-7	F	Multimode terminals with 3GPP capability	6.3.0	7.0.0	TEI7
SP-24	SP-040298	S1-040448	22.011	0063	-	Rel-7	B	Support of multiple HPLMN codes	6.3.0	7.0.0	TEI7
SP-27	SP-050063	S1-050233	22.011	0066	-	Rel-7	B	Addition of "Network Control of UE Capabilities"	7.0.0	7.1.0	Network Protection
SP-27	SP-050063	S1-050245	22.011	0067	-	Rel-7	B	Reinstate CR016 for GPRS Terminal PLMN Reselection	7.0.0	7.1.0	TEI-4
SP-29	SP-050521	S1-050903	22.011	0068	-	Rel-7	C	Enhancement of the EHPLMN feature to allow load balancing	7.1.0	7.2.0	TEI7
SP-31	SP-060221	-	22.011	0069	2	Rel-7	C	The Last RPLMN	7.2.0	7.3.0	NSP-CR
SP-31	SP-060033	S1-060330	22.011	0070	-	Rel-7	B	Confirmed Roaming	7.2.0	7.3.0	NSP-CR
SP-31	SP-060033	S1-060331	22.011	0071	-	Rel-7	F	Capability of UE to read USIM information for Network Selection	7.2.0	7.3.0	NSP-CR
SP-31	SP-060033	S1-060332	22.011	0072	-	Rel-7	C	Displaying all available EHPLMNs in Manual Mode	7.2.0	7.3.0	NSP-CR
SP-31	SP-060033	S1-060333	22.011	0073	-	Rel-7	B	Requirement for presentation of additional information in manual mode	7.2.0	7.3.0	NSP-CR
SP-31	SP-060033	S1-060335	22.011	0074	-	Rel-7	B	Network selection mode at switch-on	7.2.0	7.3.0	NSP-CR
SP-31	SP-060033	S1-060352	22.011	0075	-	Rel-7	B	Steering of Roaming	7.2.0	7.3.0	NSP-CR
SP-32	SP-060311	S1-060630	22.011	0076	-	Rel-7	C	Clarification on confirmed roaming applicability	7.3.0	7.4.0	NSP-CR
SP-32	SP-060311	S1-060632	22.011	0077	-	Rel-7	C	Incomplete PLMN list for manual mode information	7.3.0	7.4.0	NSP-CR
SP-32	SP-060426	-	22.011	0078	1	Rel-7	C	Exception in Manual network selection mode when HPLMN is available at power-on	7.3.0	7.4.0	NSP-CR
SP-32	SP-060451	S1-060649	22.011	0079	3	Rel-7	C	Interaction of steering of roaming with User controlled and forbidden PLMN list	7.3.0	7.4.0	NSP-CR

History

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