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Contents

Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

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- 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 document.

1 Scope

The present document considers the network selection procedures requirements for non-3GPP access types. The network selection principles covered include both automatic and manual selection. Also considered is the operator management of network preferences for non-3GPP access types and how the device accesses networks offered through non-3GPP access.

Non-3GPP access includes any method by which the UE is connected either to a core network or to a server other than by using the radio bearers standardised by 3GPP. Examples are: BlueTooth, WLAN and fixed (wired connections).

UEs considered in this study are UEs able to connect to a non-3GPP network in addition to its 3GPP capabilities (i.e. dual mode, multi-mode UEs).

This work in this TR is applicable to GSM and UMTS and there are no additional considerations of EPS (Evolved Packet System).

Roaming and handover conditions between 3GPP and non-3GPP networks is not under the scope of this document and will not be treated here. They may be referred to, however, for the consistency of use cases and access description consistency.

Connection to a 3GPP operator's core network by WLAN is out of scope where this is I-WLAN. This is covered in [2].

Use of the Generic Access Network is out of scope.

Considerations of tariffing are out of scope.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
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- 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] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS22.234: "Requirements on 3GPP system to Wireless Local Area Network (WLAN) interworking"

[3] 3GPP TS22.011: 'Service Accessibility'

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

Primary NO:The Network Operator which has the commercial relationship with the subscriber and is responsible for billing the subscriber.

Secondary NO: A Network Operator that has a commercial relationship with the PNO, by which the SNO provides services to subscribers of the PNO. The relationship could support the seamless handover of services to and from the PNO.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

PNO	Primary Network Operator
SNO	Secondary Network Operator

4 Introduction

Currently, all UEs have 3GPP access capability (e.g. GSM, GPRS, UMTS); an increasing number of UEs also have WLAN capability. In the future, other types of access may be incorporated into UEs (e.g. WiMax). The network selection procedure for 3GPP access is defined in 3GPP specifications; the procedure for Interworked WLAN (I-WLAN) is also defined. There are no specifications for how the UE should choose non-3GPP access types, however.

In some cases, it may be required for the UE to choose a non-3GPP access type either initiated by the HPLMN or the end user or automatically by the UE. The mechanism for doing this has not been defined and so this study will consider what mechanisms should be in place to cover this.

Also, how the UE should behave when there is no preference expressed should be considered.

5 Example Use Cases

5.1 Use Case 1

An operator has a commercial relationship with a 3rd party content provider that has its own WLAN network that gives access to a server containing specialised content and services (e.g. music download). The operator arranges with the 3rd party that its subscribers can access the 3rd party over its WLAN network to complement its own products and services available over GSM/3G. Authentication and authorisation in the WLAN network is independent of authentication and authorisation in the 3GPP network.

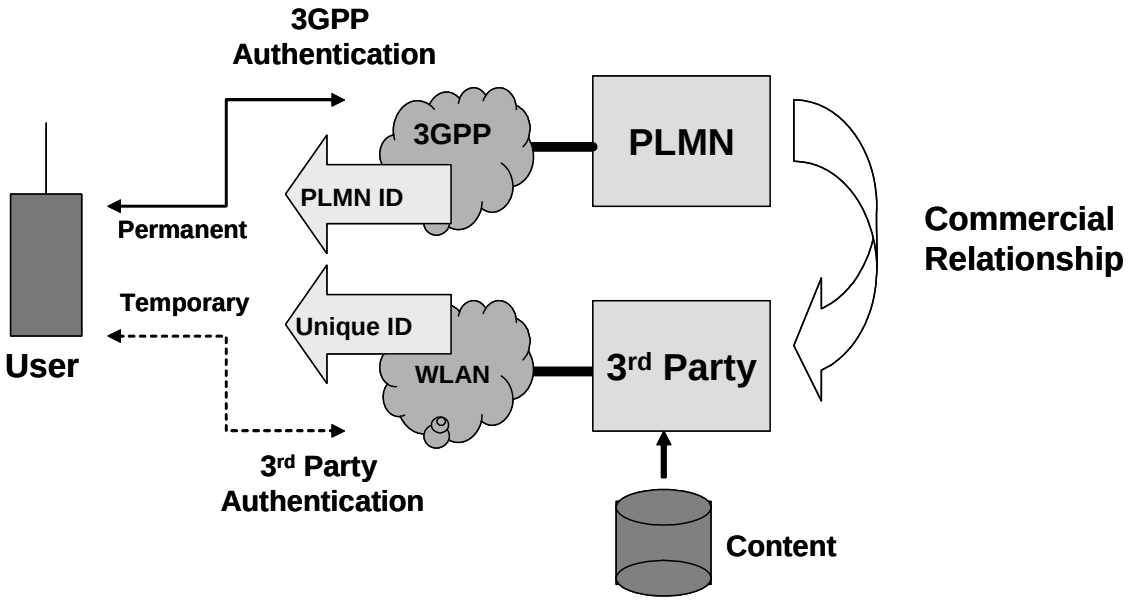

Figure 5.1: Use Case 1

The connection to the 3rd Party is temporary while the content or other service is delivered. The UE remains registered on the PLMN while also connected to the WLAN access.

The facility to set an operator (and user) defined preference for the selection of this WLAN network is required.

5.2 Use Case 2

A corporate customer needs frequent access to the company's data services. In the office it is preferred to use the company WLAN network for speed and convenience of data access; when away from the office, the customer will use 3G access to connect to the office data systems.

When in the office, there are many other WLAN hotspots in the surrounding area and they can also be seen by the user's device. The other WLAN hotspots are irrelevant to the user, therefore, an easy method of identifying, and selecting (automatically or manually) the preferred WLAN access is required where it is available and the preferred operator 3G access otherwise.

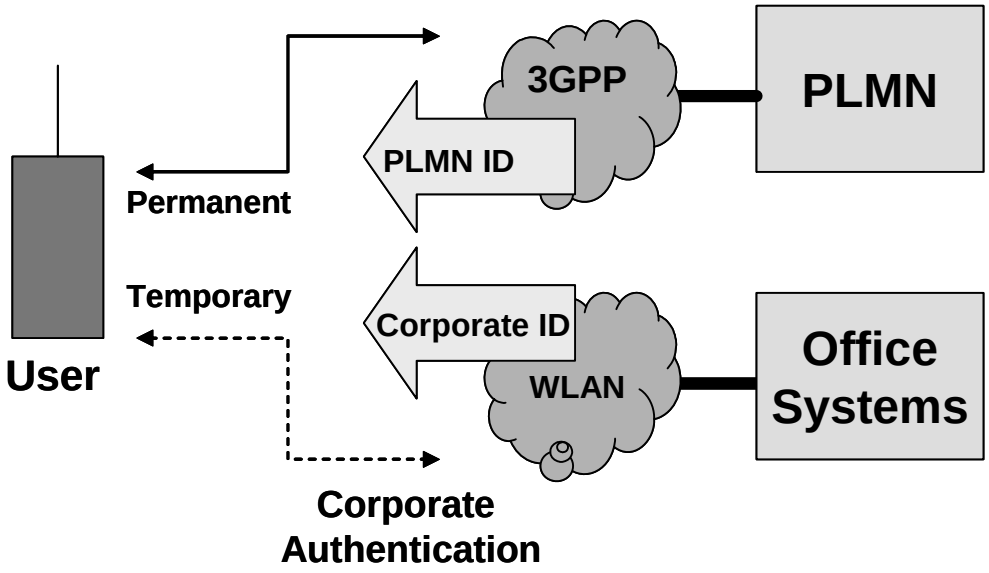

Figure 5.2: Use Case 2

The connection to the corporate systems could be maintained for a long period, however, the UE should remain registered on the PLMN while also accessing the corporate systems.

The facility to set an operator (and user) defined preference for the selection of the access to the corporate network is required.

5.3 Use Case 3

A customer would like to use his home WLAN while in the house to access services and content over the Internet. While away from home, the customer could use public WLAN access points and/ or 3G for access to these services.

The customer"s home operator (the PNO) could be the provider of the services available over the home WLAN or these could be offered by a 3rd party with or without a commercial agreement with the home operator..

The case where the operator offers network-based services such as voice over the home WLAN/ADSL network is out of scope of this work.

Authentication and authorisation functions in the WLAN networks are independent of authentication and authorisation in the 3GPP network.

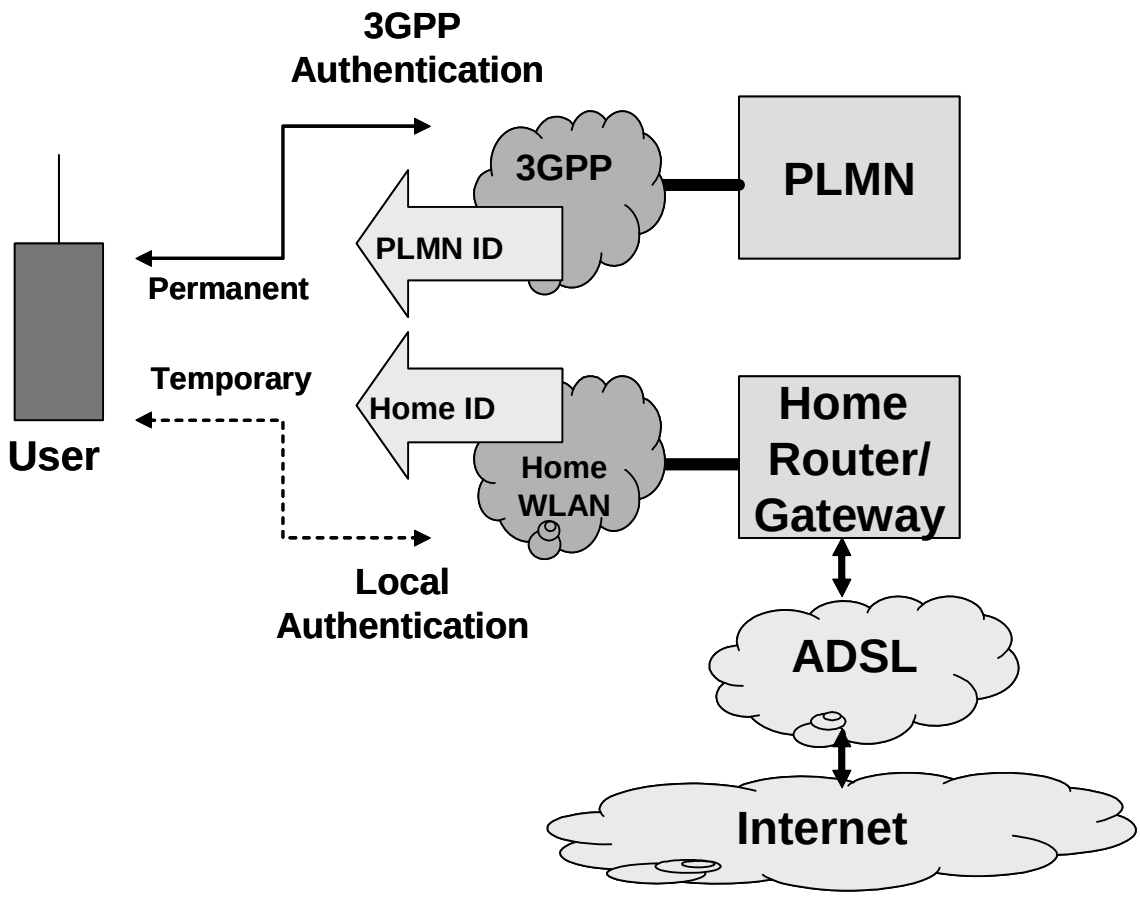

Figure 5.3: Use Case 3

An easy method of selecting (automatically or manually) the home/ public WLAN network or 3G access according to availability is required.

The UE should remain registered on the PLMN while also accessing the services over the home WLAN network.

5.4 Use Case 4

A customer of a 3GPP network operator (the PNO) would like to use a non-3GPP access type to access services if 3GPP access coverage is lost. A secondary, non-3GPP Network Operator (a SNO), with its own WLAN access network is available and can connect to the PNO. In this case, the services continue to be provided by the Core Network of the 3GPP Network Operator via the SNO.

A method of switching to the non-3GPP access point is needed. The method must allow return from the non-3GPP access point to 3G access. The method must take into account user and operator preferences. It must be possible to select an operator/service provider through the non-3GPP access point.

Need to consider trusted and non-trusted cases.

5.5 Use Case 5

A customer has a UE which is capable of accessing two different non-3GPP RATs. A mechanism is needed to determine which non-3GPP RAT is used when the UE is within coverage of both and wishes to access services.

Editor's Note: This Use Case may be out of scope

5.6 Use Case 6

An operator has its own WLAN network. The operator would like to give its customers access to this WLAN network to complement its own products and services available over GSM/3G.

The facility to set an operator (and user) defined preference for the selection of this WLAN network is required.

This Use Case is out of scope and is dealt with by [2]

6 Access types

6.1 Public

This is where there is an open environment where there could be potentially many different accesses on offer from many different organisations that can be detected by the UE. The accesses can be further classified into following types:

- The access provided by the service providers/ operators as a controlled public access service.
- The access which is completely freely accessible by anyone.

The UE or end-user could choose any of these accesses (if the UE is suitably capable) and therefore there are the following considerations:

- Security risks
- Identification of the accesses
- Encryption/ authentication
- Charging

6.1.1 Security risks

Where the access network belongs to a 3rd party, there is a security risk. Where the subscriber's home operator (i.e. the PNO) has a commercial agreement with the 3rd party, these risks can be managed. However, if the subscriber uses any other 3rd party then the risks of using the access are taken by the end user.

Security risks are different for trusted and non-trusted access.

6.1.2 Identification of the accesses

There is no current standard for the naming of accesses. WLANs are identified by SSID but there is no agreed convention for the format of the SSID. Where the subscriber's 3GPP and WLAN NOs have a commercial agreement, it would be possible to agree an identification that is meaningful to the user.

6.1.3 Encryption / Authentication

Where the access network belongs to a 3rd party (e.g. an SNO) with which the home operator has a commercial agreement there could be encryption and authentication applied. However, this would be separate from those of the home operator (the PNO) and would be managed by agreement between the operator and the 3rd party.

6.1.4 Charging

Any charging between the owning operator and a 3rd party is out of scope of this document. However, mechanisms exist to facilitate inter-company charging.

6.2 Corporate

This is where there is a controlled environment (e.g. in a company office) where there may be a limited number of different accesses that can be detected by the UE. In this case, the accesses are likely to be provided by a known organisation (e.g. the company WLAN). The accesses can be further classified into following types:

- Access for the corporate employees (full access to corporate systems)
- Guest access for visitors (limited or no access to corporate systems and internet access)

This gives rise to the following considerations:

- Company management
- Identification of the accesses
- Encryption/ authentication

6.2.1 Company management

Management of the enterprise access would normally be the responsibility of the Company. There could be an agreement between the subscriber's home operator and the company about how the access is managed.

6.2.2 Identification of the accesses

The identification of the access would be agreed between the subscriber's home operator and the private enterprise company.

6.2.3 Encryption / authentication

The access to a company system could be authenticated and encrypted. However, this would be separate from those of the home operator (the PNO) and would be managed by agreement between the operator and the 3rd party.

6.3 Private home

This is where there is a controlled environment (e.g. at home) where there may be a limited number of different accesses that can be detected by the UE. In this case, the accesses are likely to be provided by the end-user (e.g. home WLAN). The accesses can be further classified into following types:

- Access for the home user
- Guest access for visitors

This gives rise to the following considerations:

- User management
- Identification of the accesses
- Encryption/ authentication

6.3.1 User management

The user would be responsible for the management of the home access point. If this is offered by the subscriber's PNO there might need to be some agreement on management.

6.3.2 Identification of the accesses

The user would be responsible for the identification of the home access unless there is agreement between the subscriber and the PNO concerning identification.

6.3.3 Encryption / authentication

Any encryption and authentication relating to the use of the home access point would be separate from those required for access to the 3GPP network. It may also be separate from that used to access public WLAN hotspots using the same handheld UE.

7 Requirements for automatic selection

7.1 General requirements

The automatic network selection shall be supported for following purposes:

- To provide users with better user experiences by selecting the preferable network (e.g. higher bandwidth, cheaper tariff, loss of signal etc.) without letting users operate manually.
- To allow UEs to select the suitable network for the applications running on the UEs from QoS and/ or IP connectivity (e.g. reachability to corporate network, The Internet, etc.) perspective.
- To allow UEs negotiating a connection with a network to search for other preferable networks.
- To allow operators to control the policy (e.g. priority of the network) of the automatic network selection from network capability/ optimization perspective, etc.

The high level requirements for the automatic network selection are as follows:

- It shall be possible for the UE to select the network based on the capability of the network such as QoS, connectivity, signal strength etc.
- It shall be possible for the UE to detect and switch to the preferred network (when not in an active communication state with the current network).
- It shall be possible for the home operator (the PNO) to configure the list of the preferred non-3GPP access networks that can be used for automatic selection.
- It shall be possible for the user to configure the list of the preferred non-3GPP access networks that can be used for automatic selection. Whether a remote update (e.g. OTA) should over-ride the user's configuration is for further study and may be dependent on application and regulatory considerations.
- It shall be possible for the home operator (the PNO) to configure the policy of the automatic network selection.
- It shall be possible for the user and the home operator (the PNO) to enable/ disable the automatic network selection.
- It shall be possible to prevent a 3rd party (e.g. a SNO) and the user from modifying the network selection criteria that are provisioned and controlled by the home operator (the PNO).

7.2 Behaviour of the UE

Where a UE has both 3GPP and non-3GPP access types, the behaviour of the UE in selecting 3GPP access shall follow the existing network selection mechanism. A similar but separate mechanism shall be defined to manage the non-3GPP access.

It should be possible for the home operator (the PNO) and the end-user to set the condition in the UE so that it will use either the 3GPP access or the non-3GPP access mechanism as the default.

The use of the alternative access mechanism to the default one should be determined by the criteria listed in section 7.4, below.

7.3 Network identification

Network access types that the UE can use need to be identifiable. PLMNs are already identifiable by an agreed standard (Mobile Country Code + Mobile Network Code). There is no agreed standard for other types of access (e.g. WLAN) and these access types can take any name (e.g. SSID for WLAN). It would be preferable to have some rules in place that govern the identity of these access types but this is probably impractical at least in the short term. It would be preferable for at least those non-3GPP accesses that offer commercial services to end users and that have an agreement with a 3GPP NO to have a standard form of identification. The forms of identification may depend on whether the network is Public, Private, Corporate, Home etc. There may be a need to consider if the network identifier should also indicate the capability of the access, e.g. QoS, service capability etc.

Any agreed form of identification for non-3GPP access types should have the following characteristics:

- Uniqueness – it should be possible to identify the access unambiguously;
- Secure – any access identification should be unfeasible to spoof or otherwise copy or emulate by any unauthorised party. It should be at least as secure as the PLMN identification.
- Access Provider identification – it should be possible for the provider of the access to be easily identified;
- HPLMN and User preference – it should be possible for the UE to know if a particular access is preferred by the HPLMN or the user;

Any agreed form of identification for non-3GPP access types could also have the following characteristics:

- Type of access, e.g. Public, Private, Corporate, Home
- Capability of the access e.g. QoS provided, services available etc.

Note: The IEEE are developing a reliable identifier (HESSID) of the operator of a WLAN network that may meet at least some of the requirements stated above. Feedback from the IEEE indicates that the HESSID should meet the requirement for uniqueness but not the security requirements. Further consideration of how security requirements can be met will therefore be needed.

7.4 Selection of a network access

The operation of the access mechanisms (3GPP or non-3GPP) needs to be based on the operator and user preferences in similar way to how PLMN selection is managed already. There needs to be, however, a method of determining how and when a non-3GPP access type will be selected either in preference to a 3GPP access type or selected and used simultaneously with a 3GPP access type. The selection of access type could be based on the following:

- Service required by the end user;
- Location of the UE (proximity of suitable accesses);
- Date, Time;
- Pre-set User preference;
- Pre-set Operator preference.
- Quality of the signal and/or QoS required for the service

8 Requirements for manual selection

8.1 General requirements

The manual network selection shall be supported for following purposes:

- To allow users to select the preferable network intentionally from tariff perspective, etc.

The high level requirements for the manual network selection are as follows:

- It should be possible for the user to initiate scanning for available non-3GPP networks
- It should be possible for the users to select the preferable access network within a list.

- It should be possible for the user to select a preferred non-3GPP network from a list without the need to scan through all available networks.

8.2 Behaviour of the UE

It is not intended to specify how a UE should allow an end user to select non-3GPP access types when in manual mode, however, some guidelines are discussed below.

8.3 Network identification

As described in section 6.2, above, non-3GPP access types do not have standardised identities. It may be possible to agree some form of standardised naming for some of these as discussed above but most will probably have arbitrary names. It is important that the end user can easily identify any of these that are recommended by the HPLMN, however.

8.4 Presentation to the user

The non-3GPP access types could be listed separately from the available PLMNs or within the PLMN list presented to the user. In this case, it is important that any non-3GPP access types are clearly identifiable.

8.5 Selection by the user

The method by which the end user will select non-3GPP access types will depend on the UE manufacturers' implementations.

9 Requirements for operator management

9.1 General requirements

The home operator (PNO) management shall be supported for following purposes:

- To limit the networks that can be automatically selected by the UEs.(e.g. using a Black List or Forbidden list).
- To control the policy of the automatic network selection (e.g. define under what circumstances selection would take place).
- To prevent the modification of the configuration of automatic network selection by the users.

The high level requirements for home operator (PNO) management are as follows:

- It shall be possible to configure the list of the networks that can be automatically selected by the UEs on the UEs remotely.
- It shall be possible to configure the policy of the automatic network selection on the UEs remotely.
- It shall be possible to limit modification of the configuration of automatic network selection on the UEs by the users.
- It shall be possible to delete the configuration of network selection on the UEs remotely.

9.2 Update of the list

It should be possible for the home operator (PNO) who is a PLMN network operator (i.e. the HPLMN) to maintain the list of preferred non-3GPP accesses in the user's UE in a similar manner to the maintenance of the PLMN lists in accordance with TS22.011.

It should be possible for the home operator (PNO) who is a non-3GPP network operator to maintain the PLMN lists in the user's UE in accordance with TS22.011

It should be possible for a list of non-3GPP accesses to be maintained separately from the list of preferred PLMNs.

It should be possible for the home operator (PNO) who is a non-3GPP network operator to maintain a list of preferred non-3GPP accesses in the user's UE in a similar manner to the maintenance of the PLMN lists.

Over The Air (OTA) updates should be allowed for the above.

9.3 Additional information

For each non-3GPP access, it should be possible for the home operator (PNO) to add a number of "reason to select" parameters. These define the conditions by which the UE will select the non-3GPP access. The conditions should also specify if 3GPP access is required simultaneously with non-3GPP access.

The "reasons to select" are those listed in section 6.2 along with the appropriate qualifiers (e.g. specific dates & times in the case of selection by date & time).

10 Requirements for end-user management

10.1 General requirements

The end-user management shall be supported for following purposes:

- To allow end-users to select an access network among all available networks.
- To simplify the configuration on the UEs.

The high level requirements for end-user management are as follows:

- It should be possible for the end-users to configure the settings of the network selection such as list of the networks that can be selected on the UE, policy of the network selection, activation of the automatic and manual network selection, etc.
- It should be possible for the end-users to delete entries on the user list

10.2 User entry

Users should be able to enter onto the User List specific non-3GPP accesses based on the appropriate identifier.

11 Service considerations

11.1 User experience

As users find different types of connectivity, consideration of end user expectations must be assessed. Users have high expectations of their mobile device and they expect good usability and good service.

Expectations include good battery life (could be a problem with multiple access UE); good voice quality and reliable, fast data services. Also, the use of the different access types including selection needs to be easy.

The effect on the user experience by the use of multiple access types needs to be considered, therefore, and any solutions should be tailored to maintain good user experience.

11.2 Regulatory services

Consideration needs to be given to how emergency calls would be handled where the UE is connected to a 3rd party by a non-3GPP access type where the 3rd party is not an operator or is an operator that does not have emergency call capabilities. There may be a need to reconnect to an operator to service the emergency call. A suitable algorithm may need to be provided in the UE to ensure this.

Note 1: In the scenarios it is stated that the UE could remain registered on the PLMN while accessing other services/content by WLAN therefore this may solve this problem]

Note 2: Lawful Intercept may need to be considered.

11.3 Other services

The selection of an access network is based upon a set of selection criteria which should include the service capabilities of those access networks. This could be done by the format of the access identifier as described in subclause 7.3, above.

12 Conclusions

Currently, the network selection behaviour of the UE is defined only for 3GPP access types (i.e. GERAN, UTRAN, E-UTRAN, I-WLAN). With the increasing availability of other types of access on the UE (mainly WLAN currently but could include other types in the medium term), it is desirable to define how and when these new types of access can be selected.

The reason for this is to ensure predictable behaviour and also allow the user or application to select the most appropriate type of access for the service required. The various considerations include ability to uniquely identify the access, security, the circumstances under which the non-3GPP access would be selected and the user experience.

Concerning the access identity, it will be important that an agreement is sought with the appropriate specification body (e.g. IEEE 802.11) on how to uniquely identify the access. It is also important that the security requirements are met and these may need further consideration and consultation with other groups.

It is therefore concluded that a mechanism needs to be defined to control how the UE selects non-3GPP access types and that this should complement the mechanisms already in place for the selection of 3GPP access types (GERAN, UTRAN, E-UTRAN, I-WLAN). This should include similar features to those for PLMN network selection mechanism including consideration of 'Steering of Roaming'. 'Steering of Roaming ' by the VPLMN is not envisaged for GSM or UMTS.

This study has identified potential requirements for selection of non-3GPP access and may lead to CRs to TS22.011 [3] and/or TS22.234 [2].

Annex A:
Change history

Change history											
TSG SA#	SA Doc.	SA1 Doc	Spec	CR	Rev	Rel	Cat	Subject/Comment	Old	New	WI
2008-06	SP-080313	-	22.908	0001	2	Rel-8	B	22.912 version 1.0.0 created by MCC, based on 22.812 v.8.0.0, submitted for one-step-approval	-	1.0.0	
2008-06									1.0.0	8.0.0	
-								Updated to Rel-9 by MCC	8.0.0	9.0.0	
2011-03								Update to Rel-10 version (MCC)	9.0.0	10.0.0	
2012-09								Updated to Rel-11 by MCC	10.0.0	11.0.0	
2014-10								Updated to Rel-12 by MCC	11.0.0	12.0.0	

History

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