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## 10 ***3GPP2 – WLAN Interworking***

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### 11 12 *Stage 1 Requirements*

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## 1 **1 INTRODUCTION AND SCOPE**

2 This document describes requirements of interworking between 3GPP2 systems  
3 and Wireless Local Area Networks (WLANs). The intent of 3GPP2 – WLAN  
4 Interworking is to extend 3GPP2 packet data services and/or capabilities to the  
5 WLAN environment.

6  
7 WLAN and cdma2000<sup>®1</sup> radio technologies provide complementary  
8 environments for mobile packet data users. The WLAN environment can in  
9 principle be any type of local area network offering wireless access, however the  
10 accepted standard for unlicensed spectrum is IEEE 802.11.

11  
12 WLAN provides high bit rate capabilities in unlicensed spectrum (e.g., IEEE  
13 802.11a, 802.11b, and 802.11g) and can be effectively used in campus or in-  
14 building environments. A 3GPP2 system provides broad coverage and mature  
15 authentication and accounting mechanisms. Thus a WLAN can provide  
16 localized coverage that complements the coverage of a 3GPP2 system.

17  
18 Since WLAN networks typically cover small geographic areas, there may be  
19 interest by WLAN providers to take advantage of certain capabilities afforded by  
20 3GPP2 systems. Conversely, the 3GPP2 system operator may off-load the traffic  
21 to users with dual-mode devices to WLANs when these users are in the WLAN  
22 coverage area. Users can benefit from increased throughput in WLANs, and  
23 improved coverage offered by the 3GPP2 system outside of WLANs.

24  
25 Potential areas of interworking between a 3GPP2 system and WLANs include  
26 but are not limited to:

- 27 • Common authentication, authorization, and accounting functions (and  
28 therefore allow for a single bill for access to both systems).
- 29 • Access to common services from both the WLAN and 3GPP2 systems.
- 30 • Creation of mechanisms for selecting and switching between the WLAN  
31 and 3GPP2 systems.
- 32 • Support for mechanisms to allow session continuity as the mobile  
33 switches access between the WLAN and 3GPP2 systems.

34  
35 These interworking areas are applicable regardless of the ownership of either  
36 3GPP2 or the WLAN systems.

37  
38 Enabling any of these interworking cases may require modifications or  
39 additions in 3GPP2 systems or WLAN systems as appropriate. However, any

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<sup>1</sup> cdma2000<sup>®</sup> is the trademark for the technical nomenclature for certain specifications and standards of the Organizational Partners (OPs) of 3GPP2. Geographically (and as of the date of publication), cdma2000<sup>®</sup> is a registered trademark of the Telecommunications Industry Association (TIA-USA) in the United States.

1 change to the 3GPP2 system and the WLAN system should be minimized and  
2 there should be no changes to IEEE 802.11 specifications.

3

4 Two types of mobile stations (MS) are foreseen for 3GPP2 - WLAN interworking:

- 5 • Single mode mobile station, which supports only the WLAN air interface.
- 6 • Dual mode mobile station, which supports both cdma2000 specifications  
7 [8-15] and WLAN air interface.

8 The following sections describe the requirements for 3GPP2-WLAN  
9 interworking. The scope of these requirements is limited to the case when a  
10 user has a subscription to a 3GPP2 system. The case when the user has its  
11 subscription outside of the 3GPP2 system is beyond the scope of these  
12 requirements.

13

## 14 **2 REFERENCES**

15

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4 Spectrum Systems.
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- 7 [11] 3GPP2 C.S0004 LAC Layer Standard for cdma2000 Spread  
8 Spectrum Systems.
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10 Spread Spectrum Systems.
- 11 [13] 3GPP2 C.S0017 Data Service Options for cdma2000 Spread  
12 Spectrum Systems.
- 13 [14] 3GPP2 C.S0024 cdma2000 High Rate Packet Data Air Interface  
14 Specification
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16

### 17 3 DEFINITIONS AND ABBREVIATIONS

18 The terms and abbreviations that are used within this document are  
19 defined as follows:

#### 20 3.1 Definitions

<b>3GPP2-Broker Interworking</b>	Interworking relationship between a 3GPP2 System and a Broker System.
<b>3GPP2 Home System</b>	A collection of 3GPP2 Home network entities, where the user's subscription information exists.
<b>3GPP2 System</b>	A 3GPP2 Home System or a 3GPP2 Visited System.
<b>3GPP2 Visited System</b>	A collection of 3GPP2 Visited network entities
<b>3GPP2-WLAN Interworking</b>	Interworking relationship between a 3GPP2 system and a WLAN system.
<b>802.11</b>	A family of standards for Wireless Networking developed by the IEEE 802.11 working group.
<b>Broker System</b>	A collection of intermediaries that facilitate 3GPP2-WLAN interworking, where there is no direct relationship between a WLAN System and a 3GPP2 Home System.

<b>Packet data session</b>	A period of time over which an authenticated and authorized user is allowed to use resources of a network/service for the purpose of exchanging data with other entities inside or outside of the network/service provider's domain.
<b>Session continuity</b>	Continuity of a packet data session while switching of network connection takes places between the available access systems For example, between a WLAN system and a 3GPP2 system, or between WLAN systems.
<b>WLAN Access Network</b>	A local area network that provides wireless access via an 802.11 or other type of air interface.
<b>WLAN System</b>	Wireless local area network entities.

1

2 **3.2 Abbreviations**

3

<b>AAA</b>	Authentication, Authorization and Accounting
<b>AP</b>	WLAN Access Point
<b>LAN</b>	Local Area Network.
<b>MS</b>	Mobile Station
<b>NAI</b>	Network Access Identifier
<b>WLAN</b>	Wireless Local Area Network

4

5 **4 GENERAL FEATURE DESCRIPTION AND GUIDING PRINCIPLES**

6

7 **4.1 Guiding Principles**

8 The following are guiding principles and goals that are considered as a basis for  
9 the interworking requirements:

- 10 • Service interworking between 3GPP2 systems and WLAN systems should  
11 reuse the existing WLANs, i.e. transportation of IP packets, with  
12 minimum modifications for both the 3GPP2 system and the WLAN  
13 system. Any change to the WLAN system should be minimized and there  
14 should be no changes to IEEE 802.11 specifications.
- 15 • The functional split and interface(s) between 3GPP2 systems and WLAN  
16 systems shall be clearly specified.

- 1 • The evolution of 3GPP2-WLAN interworking should adopt a flexible,  
2 general, scaleable and future proof approach. The approach should be  
3 general in that there should be no limitations on the type of WLAN that  
4 can be interworked.

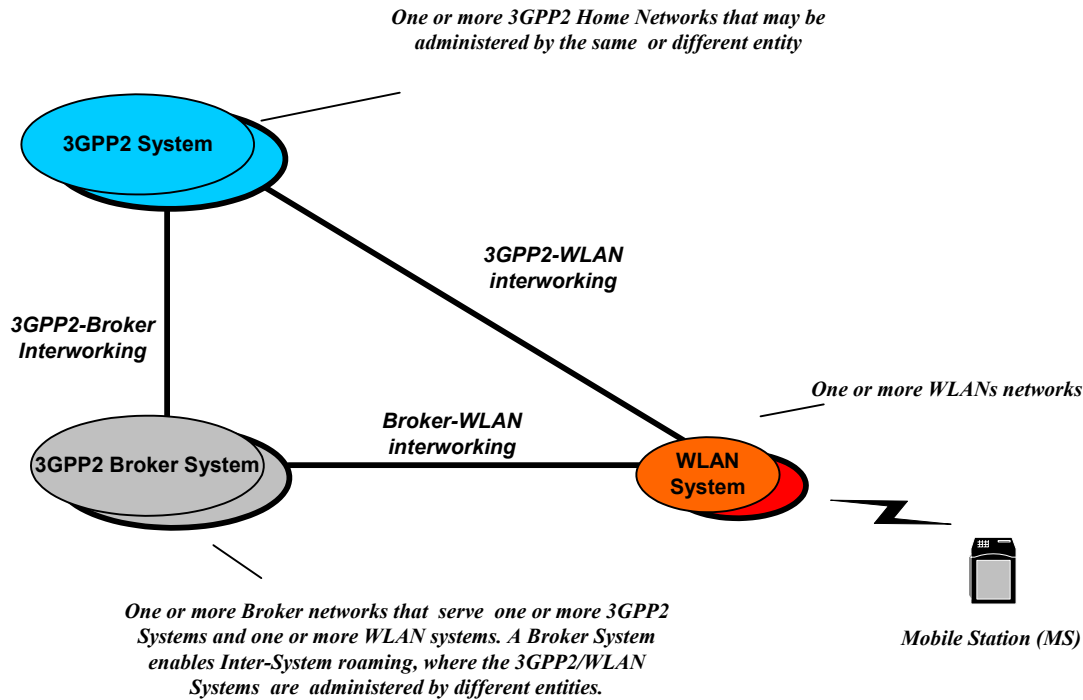
## 6 **4.2 WLAN technologies**

7 There are several different technologies that fall into the WLAN category.  
8 Despite the different radio technologies, most WLANs are commonly used for  
9 transportation of IP packets. The specific technology used in each WLAN does  
10 not impact the layers above IP.

11  
12 **Gen-01:** 3GPP2 - WLAN interworking shall not be limited to any specific  
13 WLAN technology.

## 15 **4.3 Interworking model**

16 The model for interworking between a 3GPP2 and a WLAN system is based on a  
17 defined relationship between the 3GPP2 System and the WLAN System. The  
18 relationship is characterized by specified protocols and procedures. A logical  
19 interworking model depicting the interworking relationship scenarios is shown  
20 in Figure 1. The logical model in Figure 1 shows the 3GPP2-WLAN interworking  
21 relationships, where the relationships may be either direct or indirect (i.e.  
22 through a Broker System). In the case of a direct 3GPP2-WLAN interworking  
23 relationship, the interworking relationship is defined between the 3GPP2  
24 System and the WLAN system. In the case of an indirect 3GPP2-WLAN  
25 interworking relationship, the interworking relationship is defined between a  
26 Broker System and a WLAN System, and between a Broker System and a  
27 3GPP2 System. An interworking relationship between a 3GPP2 System and a  
28 WLAN System may be a many-to-many relationship.



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**Figure 1. Interworking model**

#### 4.4 Deployment and usage

The deployment of WLAN systems is expected to continue independent of the deployment of 3GPP2 systems. The 3GPP2-WLAN interworking system is based on the logical model shown in Figure 1.

**Gen-02:** The 3GPP2-WLAN interworking solution shall support many-to-many relationships between 3GPP2 systems and WLAN systems.

One WLAN system may interwork with more than one 3GPP2 system. Also, a given 3GPP2 system may interwork with more than one WLAN system.

##### 4.4.1 Network Coverage Areas and user states

Since the 3GPP2 and WLAN systems may overlap, the access to packet-data services may be available to a mobile user via a WLAN system, a 3GPP2 system or a combination of 3GPP2 and WLAN systems. A WLAN system may have a direct, or indirect interworking relationship with one or more 3GPP2 systems in terms of providing access to a mobile user.

The high-level 3GPP2-WLAN interworking scenarios are shown in Table 1. Each scenario realizes an additional step in integrating WLAN into the 3GPP2 service offering and generally increases the level of integration. For each of these high-

1 level scenarios the impact to the 3GPP2-WLAN interworking system is  
 2 identified. There may be other impacts not yet identified.  
 3

Interworking scenario	Identification of impacts to the 3GPP2-WLAN interworking system
#1 Common Billing and Customer Care	No impact to 3GPP2 specifications.
#2 3GPP2 System based Access Control and Charging and Access to the Internet via the WLAN system	Access to the 3GPP2 Home System for authentication, authorization and accounting to the 3GPP2 Home System.
#3 Access to the 3GPP2 Packet Data Services via the WLAN system	Access to the 3GPP2 Home System for authentication, authorization, accounting, and access to the 3GPP2 Home System packet data services.
#4 Session continuity	The continuity of a packet data session while switching of network connection takes places between the available access systems. For example, between a WLAN system and a 3GPP2 system, or between WLAN systems.

4

5

**Table 1 Interworking scenarios**

6

## 7 **4.5 Ownership, Operation, Trust**

### 8 **4.5.1 Ownership**

9 Ownership of the WLAN system to be interworked with a 3GPP2 system may be  
 10 one or more of the following general classes

- 11 1) The WLAN system owner is a 3GPP2 system operator.
- 12 2) The WLAN system owner is a public network operator who is not a 3GPP2  
 13 system operator. This may include, for example, fixed network operators,  
 14 operators of mobile networks other than 3GPP2 systems or public WLAN  
 15 operators.
- 16 3) The WLAN system owner is an entity providing WLAN access in a local  
 17 area (e.g., building manager/owner or airport authority), but who is  
 18 otherwise not a public network operator. In this class it may be  
 19 considered that a primary purpose of the WLAN operations is to provide  
 20 local services and internet access as well as 3GPP2-WLAN interworking.
- 21 4) The WLAN system owner is a business entity providing a WLAN network  
 22 for its internal use that also wishes to allow interconnection, and possibly  
 23 visitor use, for some or all of their WLAN system s. The entity may have  
 24 more than one WLAN system in operation in a location of which some may  
 25 be interworked to 3GPP2 systems and some may not be interworked. In  
 26 this class it may be considered that the primary purpose of the WLAN  
 27 operations is for its own business and WLAN interworking is a secondary  
 28 consideration.

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## **4.5.2 Operations**

In addition to supporting billing functions, accounting records are used by the 3GPP2 Home System operator for operational functions. These operational functions include usage and performance analysis of the network and services, fraud detection, general record keeping, and settlement. To meet the demands of these operational functions, accounting records should be mediated across all of the operator's WLAN partners in a timely manner.

## **4.5.3 Internetworking trust**

3GPP2 systems interworking with WLAN systems must consider the possibility of security weaknesses within the WLAN. The level of trust of communication between the WLAN system and the 3GPP2 system may be considered to have three levels:

- 1) The WLAN system may be completely untrusted by the MS and the 3GPP2 system.
- 2) The WLAN system contains elements that may be trusted by the MS and the 3GPP2 system. For example, the WLAN system may include trusted servers that look after aspects of security and authentication interworking with the 3GPP2 systems (e.g. 802.1x). However, other elements of the WLAN system may be untrusted.
- 3) All of the elements of the WLAN system may be fully trusted by the MS and the 3GPP2 system.

# **5 DETAILED FUNCTIONALITY REQUIREMENTS**

## **5.1 Detailed Feature Characteristics and Requirements**

### **5.1.1 Network selection**

3GPP2 Network Selection aims at

- maximizing the availability of access to the user
- optimizing the use of the 3GPP2 radio access network
- providing both manual and automatic network selection based on 3GPP2 operator policies.

The requirements in this section are applicable to environments where the 3GPP2 systems and the WLANs involved may be operated by the same network operator, different network operators or other entities with interworking agreements.

1 **Netsel-1:** It shall be possible for the 3GPP2 Home System operator to define  
2 a preferred and/or forbidden list of WLAN systems.

3 **Netsel-2:** The user shall have the capability to prioritize the selection of the  
4 3GPP2 Home System or some other preferred system.

5 **Netsel-3:** It shall be possible for the user to select between available 3GPP2  
6 and WLAN systems based on criteria such as cost, service characteristics,  
7 bandwidth, etc.

8 Note: to meet requirement Netsel-3, manual and/or automatic network  
9 selection capability can be provided in the terminal.

10 **Netsel-4:** It shall be possible for the MS to indicate to the user the  
11 availability of access systems, for example, when there is a change of access  
12 network coverage or at user's request.

13 **Netsel-5:** Note: meeting requirement Netsel-4 may result in a brief  
14 interruption in service so the MS can scan for available systems. It shall be  
15 possible for the MS to make automatic switch of network connection among the  
16 available access systems (e.g. when entering or leaving regions of system  
17 coverage) with no manual actions from the user required.

18 **Netsel-6:** It shall be possible for the user to manually initiate the switching  
19 of network connection between the available access systems.

20 **Netsel-7:** It shall be possible for the user to be notified when a switch of  
21 network connection occurs between available access systems.

22 **Netsel-8:** It shall be possible for the user to prevent or override an automatic  
23 switch of network connection based upon provisioning by the service provider.

24

### 25 **5.1.2 3GPP2-WLAN connectivity requirements**

26 **Conn-01:** The 3GPP2-WLAN system interworking shall support IPv4 and  
27 should support IPv6 based connectivity.

28 **Conn-02:** It shall be possible for the MS to establish connectivity to the  
29 Internet through the WLAN System directly, or through the WLAN and 3GPP2  
30 Systems.

31

32 **5.1.3 3GPP2-WLAN Access Control, Authentication and Subscription**  
33 3GPP2-WLAN access authentication and authorization enables the 3GPP2 and  
34 the WLAN operator to protect their resources and provide revenue-based  
35 services.

1 **ACTRL-1:** Mutual authentication between the MS and the WLAN  
2 and/or 3GPP2 System for WLAN access should be supported to assure the  
3 needed level of trust by all entities for interworking.  
4

5 It should be allowable for various WLAN systems to use the MS's home 3GPP2  
6 system to authenticate the MS for WLAN access. The benefit is that the MS  
7 doesn't need to maintain multiple sets of shared secrets and algorithms, one  
8 per WLAN system. Another benefit is that the WLAN system doesn't need to  
9 manage the shared secrets, since each shared secret is maintained between the  
10 MS and its home 3GPP2 system.  
11

12 **ACTRL-2:** If the MS subscribes to both WLAN and 3GPP2 access services  
13 provided by the same operator, or different operators who have mutual  
14 agreement, it shall be possible for the MS to use the same secret and algorithm  
15 for both WLAN and 3GPP2 access authentication.  
16

17 **ACTRL-3:** The 3GPP2 - WLAN interworking service shall support the  
18 authorization and authentication by the home 3GPP2 system of a 3GPP2  
19 subscriber accessing a WLAN system.

20 **ACTRL-4:** The 3GPP2 home system shall maintain a user authorization  
21 profile which is used to manage attributes of the user's WLAN access.  
22

23 **ACTRL-5:** Usage of the 3GPP2 - WLAN interworking bearer service shall be  
24 prohibited prior to successful user authentication and authorization.

25 **ACTRL-6:** Legacy WLAN terminal and access point hardware shall be  
26 supported.

27 Software/firmware of the legacy WLAN terminal and access point may be  
28 upgraded to support 3GPP2-WLAN interworking.

29 **ACTRL-7:** The user identification shall be based on Network Access Identifier  
30 (NAI) format [5] (username@realm).

31 Usage of NAI format ensures that 3GPP2 and WLAN equipments are compatible  
32 with IETF protocols.  
33

34 **ACTRL-8:** It shall be possible for the 3GPP2 - WLAN interworking to support  
35 re-authentication .

36 **ACTRL-9:** Selected Authentication mechanisms for 3GPP2-WLAN  
37 interworking should support data integrity and privacy keying material for the  
38 resulting session.

39 **ACTRL-10:** The WLAN authentication mechanisms shall be secure against  
40 man-in-the-middle attacks.

1 **ACTRL-11:** It shall be possible to store all long-term security credentials used  
2 for subscriber and network authentication in a tamper resistant memory  
3 within an MS.

4 For example, security credentials may be stored in a removable card or in the  
5 MS

6 **ACTRL-12:** It shall be possible to support an authentication mechanism based  
7 on a User ID & Password/Secret.

8 **ACTRL-13:** It shall be possible to support an authentication mechanism that  
9 does not depend on IEEE 802.1x support in the MS.

10 **ACTRL-14:** It shall be possible for the 3GPP2 system, or Broker System to  
11 indicate to the WLAN system that an ongoing session should be terminated,  
12 interrupted or modified (for example for pre-paid users).  
13

14 A mobile user may have different user profiles for different access types. For  
15 example, some services provided by the 3GPP2 home system may be restricted  
16 to user access from a WLAN system, and this restriction can be indicated in the  
17 user profile for WLAN access. These considerations lead to the following  
18 requirements:  
19

20 **ACTRL-15:** The 3GPP2 home system shall be able to determine the access type  
21 (e.g. WLAN).

22 **ACTRL-16:** The 3GPP2 home system shall be able to use the access type (e.g.  
23 WLAN) to enable the appropriate user profile for authorization.  
24

#### 25 **5.1.4 Data integrity and Privacy**

26 Without WLAN-level privacy protection, 802.11 control messages may become  
27 vulnerable. For example, an attacker can perform denial of service attacks  
28 against a valid MS, by replaying captured 802.11 Disassociate messages to  
29 disconnect the MS from the AP. End-to-end privacy protection at IP or higher  
30 layers may not be able to prevent this type of attacks.

31 **DIP-1:** It shall be possible to support integrity of signalling between the MS  
32 and the WLAN system.

33 **DIP-2:** Integrity of signalling between the WLAN system and the 3GPP2  
34 system shall be supported.

35 **DIP-3:** Privacy of signalling between the WLAN system and the 3GPP2  
36 system shall be supported.  
37

## 1 **5.1.5 Accounting**

2 **ACC-1:** Accounting records shall be generated by either the WLAN system  
3 or 3GPP2 system or both.

4 **ACC-2:** The accounting information for the user's WLAN access shall be  
5 made available to the home 3GPP2 system.

6 **ACC-3:** To assist billing, it shall be possible for the home operator to  
7 receive Accounting records associated with WLAN system usage, to support  
8 online (i.e., prepaid) and offline (i.e., postpaid) accounting by the 3GPP2  
9 system.

10 In many cases system operators prefer to generate simplified bills. As a user  
11 engaged in a data session roams between various WLAN systems or 3GPP2  
12 systems, each system will generate accounting records for the data session. In  
13 order to represent the data session as a single line item on the customer's bill,  
14 the accounting records for each session-segment must be correlated. To  
15 perform the correlation operation the accounting records must have the  
16 appropriate information. These considerations lead to the following  
17 requirements:

18 **ACC-4:** It shall be possible to correlate accounting records generated by  
19 3GPP2 system(s) and WLAN system(s) for a given user session.

20 **ACC-5:** The WLAN system should provide a set of accounting records for  
21 use by the 3GPP2 system operator .

22  
23 The intention of ACC-5 is to maximize compatibility with existing accounting  
24 standards.

25 **ACC-6:** When the user accesses the 3GPP2-WLAN interworking services via  
26 a WLAN system, at a minimum the following accounting data record  
27 information shall be recorded:

- 28 a. User's identity
- 29 b. Session identity
- 30 c. Access network identity
- 31 d. Indication of Access type (e.g. WLAN)
- 32 e. Session usage (e.g. duration and/or number of bytes).
- 33 f. Quality of Service information (if available)

34

### 1 **5.1.6 Common billing and customer care**

2 **CBCC-1:** The 3GPP2 – WLAN interworking service shall support the ability of  
3 the 3GPP2 operator to provide the customer with one bill for the usage of both  
4 3GPP2 and WLAN services.

5 This allows for integrated customer care, which allows for a simplified service  
6 offering from both the operator and the subscriber's perspective.

7

### 8 **5.1.7 Roaming**

9 The 3GPP2-WLAN Interworking allows the 3GPP2 system operator to extend  
10 some of the 3GPP2 system packet data services to the user accessing via the  
11 WLAN system. These services may include, for example, IMS based services,  
12 immediate messaging, presence based services, MMS and any service that is  
13 built upon the combination of several of these components. The packet data  
14 services provided by the 3GPP2 system are transparent to and independent of  
15 any specific access technology, thus are referred to as access independent IP  
16 services.

17 **Roam-1:** While roaming to a WLAN system, it shall be possible for the MS to  
18 obtain all access independent IP services provided by the 3GPP2 Home system.

19 **Roam-2:** It shall be possible for a dual mode MS to revert to the 3GPP2  
20 system to access a desired service if it is unable to access the desired 3GPP2  
21 service via the WLAN system.

22

### 23 **5.1.8 Session continuity**

24 The objective of session continuity is to allow the MS to continue the same  
25 sessions for all access independent IP services while it moves among available  
26 access systems.

27

28 For a packet data session to continue across the changes of connections among  
29 the available access systems, there would be no need for the user to re-  
30 establish the packet data session, but the change may be noticeable to the  
31 mobile user. These considerations lead to the following requirements:

32

33 **SC-1:** It shall be possible to support session continuity as the MS  
34 switches network connections among the available access systems.

35 **SC-2:** Session continuity shall be independent of the access system's air  
36 interface technology.

37 **SC-3:** During the switching of the network connection between two of the  
38 available access systems, if the target access system cannot support the QoS or

- 1 the services provided by the serving access system, a transition to the target
- 2 access system at a reduced set of QoS or services shall be possible.
- 3