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## **cdma2000 Wireless IP Network Standard: Packet Data Mobility and Resource Management**

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## 1 **General Description**

2 This Chapter describes the mechanisms at the PDSN resulting from handoff of an MS from one  
3 BS/PCF to another BS/PCF, and which may result in changing the serving PDSN for the MS.  
4 This Chapter describes an optional fast handoff capability, which is a low latency, low data loss  
5 handoff mechanism between PDSNs. Fast handoff mechanism delays re-negotiation of PPP until  
6 the MS becomes dormant at the Target PDSN. This Chapter also describes resource  
7 management procedures at the PDSN and the HA that are used following an inter PDSN handoff  
8 or under other conditions that require release of resources. Furthermore, a procedure for  
9 provisioning the RN with resource management parameters such as RN packet data inactivity  
10 timers is specified in this Chapter.

1 **1 Glossary and Definitions**

2 See X.S0011-001-C.

3

1 **2 References**

2 See X.S0011-001-C.

3

## 1   **3    Mobility Management**

### 2   **3.1    Mobility Within Radio Network**

3    Mobility in the wireless IP network architecture is achieved via handoffs. When a handoff is  
4    between PCFs with connectivity to the same PDSN so that the Serving PDSN remains the same  
5    before, during, and after handoff, it is called Intra PDSN handoff. When PCFs are connected to  
6    different PDSNs, the handoff is termed Inter PDSN handoff.

### 7   **3.2    Intra PDSN Handoff**

8    The link layer mobility management function is used to manage the change of the R-P session  
9    point of attachment while maintaining the PPP session and IP address(es). The R-P session  
10   point of attachment is the PDSN. When an MS moves from one PCF to another PCF, a new R-P  
11   connection between the Target PCF and the Serving PDSN is established for every packet data  
12   service instance.

13   PCF to PCF handoff may occur while an MS is in the active or dormant state. The purpose of  
14   dormant PCF handoff is to maintain the PPP session while an MS is dormant to minimize the use  
15   of airlink resources.

16   The PCF to PCF handoff involves:

- 17       • PDSN selection.
- 18       • New R-P session setup.
- 19       • Previous R-P session tear down.

20   The Target PCF triggers a new R-P session setup. If the PDSN selected is the same Serving  
21   PDSN for the MS, then the PDSN triggers a release of the previous R-P session.

22   During a PCF to PCF handoff, the selection of the same PDSN is given priority in order to  
23   maintain the existing PPP session between the PDSN and the MS. If a different PDSN is selected  
24   and the MS still desires packet data service, then a PDSN to PDSN handoff may be performed  
25   (see Section 3.3). The PDSN supports a low latency PCF to PCF handoff by multicasting data to the  
26   target and previous PCF while the mobile performs an active handoff.

27   Each PCF is uniquely identified by an Access Network Identifier. At handoff, the new PCF  
28   performs PDSN selection and forwards both the Previous Access Network Identification (if  
29   available from the RN), and its own Access network Identification to the selected PDSN. If the  
30   PDSN recognizes the MSID, it compares the Previous Access Network Identifier if non-zero, to  
31   the Stored Access Network Identifier for the call to determine if it has a stale packet data session  
32   for the MS. If so, the PDSN performs PPP renegotiation with the MS and Mobile IP re-  
33   registration, if required. See PPP establishment procedures in X.S0011-004-C.

34   Detailed requirements and standard procedures for PCF to PCF handoff are described in [4].

### 35   **3.3    Inter PDSN Handoff**

36   For Simple IP, there is no mobility beyond a PDSN coverage area, unless fast handoff  
37   procedures are supported that facilitate the PPP session to be anchored at the Serving PDSN  
38   until the MS becomes dormant.

39   Mobile IP provides the IP layer mobility management function that maintains persistent IP  
40   addresses across PDSNs. For a Mobile IP based MS to maintain a persistent IP address while  
41   moving between PDSNs, the MS re-registers with its HA as per RFC 2002 with extensions as  
42   outlined in X.S0011-002-C.

1 For PDSN to PDSN handoff, the MS may be in active or dormant state. For an active state MS,  
2 fast handoff may be supported between PDSNs. If fast handoff is supported, the Target PDSN  
3 initiates establishment of a P-P session with the Serving PDSN according to the procedures  
4 described later in Section 4. If the MS was in dormant state, the MS transitions to active state for  
5 the purpose of establishing connectivity with the new PDSN.

6 The PDSN to PDSN link for supporting fast handoff is called the P-P interface. Fast handoff with  
7 the P-P interface is used to keep the PPP session anchored when the PDSN to PDSN handoff is  
8 performed. This allows the existing PPP session to continue, thereby reducing service  
9 interruption time and data loss. The forward traffic received at the Serving PDSN is tunneled  
10 through the appropriate P-P connection to the Target PDSN. The Target PDSN then forwards the  
11 traffic to the MS over the corresponding R-P connection. The reverse traffic from the MS is  
12 tunneled through the P-P interface from the Target PDSN to the Serving PDSN. The Serving  
13 PDSN then forwards the traffic to the external network.

14 If fast handoff is not supported, the PDSN to PDSN handoff for Mobile IP involves:

- 15 • Establishment of a new PPP session;
- 16 • Detection of a new FA via the Agent Advertisement Message;
- 17 • Authentication by RADIUS infrastructure;
- 18 • Registration with the HA.

19 If fast handoff is supported, the PDSN to PDSN handoff for Mobile IP involves:

- 20 • Establishment of a P-P connection for each associated R-P connection at the Target  
21 PDSN and the continuation of the current PPP session on the Serving PDSN;
- 22 • Establishment of a new PPP session by the Target PDSN when the MS becomes  
23 dormant or the MS renegotiates PPP;
- 24 • Release of the associated P-P connections while the new PPP session is being  
25 established at the Target PDSN;
- 26 • Detection of a new FA via the Agent Advertisement Message;
- 27 • Authentication by RADIUS infrastructure;
- 28 • Registration with the HA.

29 If fast handoff is not supported, the PDSN to PDSN handoff for Simple IP involves:

- 30 • Establishment of a new PPP session on the Target PDSN.
- 31 • Authentication by the RADIUS infrastructure.

32 If fast handoff is supported, the PDSN to PDSN handoff for Simple IP involves:

- 33 • Establishment of a P-P connection for each associated R-P connection at the Target  
34 PDSN, and continuation of the current PPP session on the Serving PDSN;
- 35 • Establishment of a new PPP session and authentication with the RADIUS  
36 infrastructure by the Target PDSN when the MS becomes dormant or the MS  
37 renegotiates PPP;
- 38 • Release of the associated P-P session while the new PPP session is being  
39 established at the Target PDSN.

## 1 4 P-P Interface

### 2 4.1 Architecture

3 The network reference model is depicted in X.S0011-001-C. This section describes the  
4 functionality for a fast handoff in the context of an inter PDSN handoff. This section provides P-P  
5 interface details. See [4] for fast handoff procedures over the R-P interface.

6 With the implementation of the P-P Interface, the following additional functions are provided by  
7 the PDSNs during fast handoff:

- 8       • For every R-P connection at the Target PDSN, there is a corresponding P-P  
9       connection.
- 10       • The Target PDSN is not the end point of PPP at fast handoff.
- 11       • The Target PDSN provides transparent bi-directional transport of the bearer data  
12       stream over the R-P and P-P connections.
- 13       • The Serving PDSN provides bi-directional transport of the bearer data stream over  
14       the P-P connections.
- 15       • The Target PDSN forwards accounting related airlink records received over an R-P  
16       connection to the Serving PDSN over the corresponding P-P connection.
- 17       • The Serving PDSN processes airlink records received over the P-P connection  
18       similar to the airlink records received over the R-P connection by creating separate  
19       UDRs.
- 20       • The Target PDSN becomes the Serving PDSN when the MS becomes dormant or  
21       the MS initiated PPP renegotiation with the Serving PDSN, in which case The Target  
22       PDSN shall use the main service instance to carry on PPP negotiation. When the MS  
23       closes the PPP session at the Serving PDSN, the Serving PDSN shall release the P-  
24       P connections, and the Target PDSN shall release the R-P connections.

25 During a fast handoff, either two R-P connections (see Figure 3), or an R-P and P-P connection  
26 (see Figure 2), or two P-P connections (see Figure 4) with the same SR\_ID and IMSI may exist  
27 momentarily with the same SR\_ID and IMSI due to the PDSN bicasting.

### 28 4.2 The P-P Interface Protocol

29 This section specifies the protocol and messages to be used for signaling for the P-P  
30 connections. The P-P Interface protocol is independent of the physical and link layers of the  
31 transport media over which the P-P connection(s) is/are to be established. The underlying  
32 transport media provides UDP/IP based packet oriented connectivity.

33 There are two components for the P-P Interface:

- 34       • Signaling: Control messages shall be used for managing the P-P connection(s)  
35       between the Serving and the Target PDSNs.
- 36       • Bearer Transport: GRE frames shall be used for the transport of bearer data frames  
37       between Serving and Target PDSNs.

38 The Target PDSN shall initiate establishment of a P-P connection, whereas either the Serving  
39 PDSN or the Target PDSN may initiate termination of the connection. Termination of a P-P  
40 connection shall follow the procedures for R-P connections as specified in [4], in conjunction with  
41 the procedures detailed in this Chapter. Once a P-P connection has been established, the bearer  
42 portion of the P-P connection shall use GRE framing [RFC 2784, RFC 2890] for the transport of  
43 bearer data frames. There shall be one P-P connection between the Serving PDSN and the

1 Target PDSN for each R-P connection between the Target PDSN and Target RN. The GRE  
2 payloads in the P-P connection and R-P connection shall be identical for the same connection.

### 3 **4.2.1 Signaling**

4 The following messages shall be used for P-P Interface call control and signaling:

- 5 • P-P Registration-Request.
- 6 • P-P Registration-Reply.
- 7 • P-P Registration-Update.
- 8 • P-P Registration-Acknowledge.
- 9 • P-P Session Update.
- 10 • P-P Session Acknowledge.

11 These messages use the same format as R-P connection messages specified in [4], including  
12 use of the same UDP port number '699'. The entire signaling message shall be sent within a  
13 single UDP datagram. The source IP address of the P-P Registration-Request, P-P Session-  
14 Acknowledge and P-P Registration-Acknowledge messages is set to the Target P-P Address and  
15 the destination IP address is set to the Serving P-P Address. The source IP address of the P-P  
16 Registration Update, P-P Session-Update and P-P Registration-Reply messages is set to the  
17 Serving P-P Address and the destination IP address is set to the Target P-P Address.

18 The initiator of the P-P connection (Target PDSN) shall pick an available source UDP port, and  
19 send a P-P Registration-Request message to the desired destination (Serving PDSN) at UDP  
20 port '699'. The recipient (Serving PDSN) shall send a P-P Registration-Reply message to the  
21 initiator's (Target PDSN) UDP port that initiated the P-P Registration-Request message. The  
22 following indicates the setting of the fields within a P-P Registration signaling message:

- 23 • Care-of address = Target P-P Address (Only included in P-P Registration-Request  
24 message, P-P Registration Acknowledge message and P-P Session Update  
25 Acknowledge message).
- 26 • Home Address = 0.0.0.0 (in all messages).
- 27 • HA Address = Serving P-P Address (in all messages except P-P Registration-  
28 Acknowledge and P-P Session Update Acknowledge messages).
- 29 • MN-HA Authentication Extension = This element marks the end of the authenticated  
30 data in P-P Registration Request and P-P Registration Reply messages.
- 31 • Registration Update Authentication Extension = This element marks the end of the  
32 authenticated data in P-P Registration Update, P-P Session Update and P-P Session  
33 Update Acknowledge messages.

34 The procedures to support fast handoff over the R-P interface are defined in [4].

### 35 **4.2.2 Bearer Transport**

36 The P-P bearer frames shall use the same payload format as used on the R-P interface,  
37 specified in [4]. The procedures for selection and use of the GRE key are as outlined in [4].

## 38 **4.3 Fast Handoff procedures overview**

39 The P-P interface shall use the signaling messages defined in section 4.2.1 to manage the P-P  
40 connections. The following sections describe the messages and procedures for the P-P interface.

1 In order to obtain packet data services, the MS performs registration with the packet data  
 2 network. The service instance(s) is/are assigned and an R-P connection(s) is/are established for  
 3 each service instance between the Serving RN and the Serving PDSN on behalf of the MS. For  
 4 multiple service instances, handling of the bearer data streams over the R-P connections is  
 5 determined according to X.S0011-004-C.

6 During the course of the packet data session, the MS moves into the coverage area of a Target  
 7 RN, resulting in an Intra or Inter PDSN handoff. The following two sections specify the Inter  
 8 PDSN fast handoff for active and dormant service instances separately.

9 This specification assumes that Inter or Intra PDSN handoffs move both active and dormant  
 10 service instances to the Target RN. The active and dormant service instances are defined in [4].

### 11 **4.3.1 Active Service Instances**

12 On detection of a condition that a handoff is required, the Source RN initiates handoff procedures  
 13 with the Target RN (via the MSC).

14 If the Serving PDSN is reachable from the Target RN, the fast handoff is performed as specified  
 15 in [4], and the Serving PDSN shall release:

- 16 • Existing R-P connection(s) to the Source RN.
- 17 • P-P connection(s) associated with the MS<sup>1</sup> as a result of a handoff back from the  
 18 Target PDSN to the Serving PDSN.

19 If the Serving PDSN is not reachable from the Target RN, the Target RN selects a Target PDSN  
 20 and establishes one R-P connection for each service instance to that PDSN. The R-P  
 21 Registration-Request message(s) have the 'S' bit set to indicate bicasting of the bearer payloads  
 22 and contain the Serving P-P Address, the identity of the MS, and an R-P Connection Setup  
 23 Airlink Record. The Target PDSN shall immediately respond with an R-P Registration-Reply  
 24 message that contains the serving P-P address as received in the R-P Registration-Request  
 25 message. For each R-P connection so established, the Target PDSN attempts to establish a P-P  
 26 connection to the Serving PDSN with the 'S' bit set (to indicate bicasting of the bearer payloads).

27 The Serving PDSN shall use the SR\_ID information in conjunction with the mobile identifier to  
 28 find the link layer context information associated with the service instance. The Serving PDSN  
 29 determines whether a P-P connection corresponds to the main service instance by checking the  
 30 SR\_ID received in the associated P-P connection setup message for the IMSI. The Serving  
 31 PDSN shall apply existing link layer context (e.g., compression, PPP, etc.) when sending packets  
 32 on the P-P connection.

33 If the Serving PDSN accepts the P-P Registration-Request message, and the Serving PDSN  
 34 determines that the P-P connection carries the main service instance, the Serving PDSN shall  
 35 return a P-P Registration-Reply message with a PPP Link Indicator Extension (see Section 4.6)  
 36 that indicates that the P-P connection supports the main service instance. The Serving PDSN  
 37 shall start to bicast bearer data that is appropriately conditioned according to the link layer control  
 38 to both the Source RN via the R-P connection and the Target PDSN via the P-P connection (see  
 39 Figure 2), or to both the previous Target PDSN via the previous P-P connection, and the Target  
 40 PDSN via the P-P connection (see Figure 4). The Serving PDSN shall bicast until it receives a P-  
 41 P Registration-Request with the 'S' bit clear. The Target PDSN shall forward bearer data to the  
 42 Target RN via the R-P connection.

43 Upon successful handoff of a service instance to the Target RN, the Target RN shall deliver the  
 44 bearer data from the associated R-P connection to the MS. Also, the Target RN sends an R-P

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<sup>1</sup> In particular, this addresses the case of a new Target PDSN being exactly the same as the currently Serving PDSN.

1 Registration-Request message with the 'S' bit clear and an Active Start Airlink Record to the  
2 Target PDSN.

3 The Target PDSN shall forward the Active Start Airlink Record to the Serving PDSN over the just  
4 established P-P connection(s) in a P-P Registration-Request message with the 'S' bit clear. Upon  
5 reception of P-P Registration-Request messages with the 'S' bit clear, the Serving PDSN shall  
6 release the corresponding R-P connections to the Source RN as identified by the SR\_ID, or the  
7 P-P connections to the previous Target PDSN.

8 The Target and Serving P-P addresses, along with the GRE Key form the unique link layer ID for  
9 each P-P connection. With the P-P connection(s) in place, bearer data frames pass over these  
10 connection(s) in both directions via GRE framing. In the reverse direction, the Serving PDSN  
11 shall accept the P-P frames, process and remove the GRE overhead, and then shall process the  
12 GRE payload, as necessary. In the forward direction the Serving PDSN shall encapsulate bearer  
13 data frames in GRE. The Target PDSN shall process and remove the GRE overhead before  
14 passing the bearer data to the associated R-P connection. On the R-P connection, the Target  
15 PDSN shall encapsulate the bearer data frames in GRE and shall forward them to the Target RN.  
16 Thus, the Target PDSN shall provide a transparent bi-directional transport for the bearer data  
17 frames between the R-P connection and the P-P connection so that there is a point-to-point link  
18 layer connection for each service instance between the MS and the Serving PDSN.

19 The Target PDSN shall maintain the P-P connections by periodically sending P-P Registration-  
20 Request messages to the Serving PDSN with 'S' bit clear. Each P-P connection shall be  
21 maintained as long as the corresponding R-P connection exists at the Target PDSN or until such  
22 time as the fast handoff is completed according to Section 4.4.5.

### 23 **4.3.2 Dormant Service Instances**

24 There are two cases to consider when an MS with dormant service instances moves to an RN in  
25 a different packet zone:

- 26 • Case 1: The MS has one or more dormant service instances and no active service  
27 instances.
- 28 • Case 2: The MS has one or more dormant service instances and one or more active  
29 service instances.

#### 30 **Case 1:**

31 Usual dormant handoff procedures apply and there is no fast handoff.

#### 32 **Case 2:**

33 The Target RN connects active service instances first as detailed in section 4.3.1. When the  
34 Target PDSN receives the R-P Registration-Request messages with the R-P connection Setup  
35 Airlink Record for the dormant service instances and the 'S' bit set to '0', from the Target RN, and  
36 it determines that there is a fast handoff already in progress for the MS, it shall then establish P-P  
37 connections to the Serving PDSN with the 'S' bit set to '0' containing the R-P connection Setup  
38 Airlink Record for each of the new R-P connections. If the Serving PDSN accepts the P-P  
39 Registration-Request message, it shall return a P-P Registration-Reply message to the Target  
40 PDSN and shall include the PPP Link Indicator Extension (see Section 4.6) if the P-P connection  
41 supports the main service instance. If the Serving PDSN accepts the P-P Registration-Request  
42 message, it shall return a P-P Registration-Reply message without the PPP Link Indicator  
43 Extension included if the P-P connection supports an auxiliary service instance.

44 The Serving PDSN shall also release the corresponding R-P connection to the Source RN as  
45 identified by the SR\_ID, or the P-P connection to the previous Target PDSN.

46 If the Target PDSN receives an A11 Registration-Request with the 'S' bit cleared and P-P  
47 establishment of any service instance has failed, then the Target PDSN shall accept the request.

1 The Target PDSN shall use the PPP establishment procedures as described in X.S0011-004-C  
2 to establish a new PPP session with the MS.

### 3 **4.4 Detailed P-P Interface Procedures**

#### 4 **4.4.1 P-P Connection Establishment**

5 When a Target PDSN that supports fast handoff receives an R-P Registration-Request from the  
6 Target RN that contains a Serving P-P address, it shall establish a P-P connection to the Serving  
7 PDSN. To establish a P-P connection the Target PDSN shall send a P-P Registration-Request  
8 message to the Serving PDSN including the R-P Connection Setup Airlink Record<sup>2</sup> (as received  
9 from the Target RN) and start the timer  $T_{\text{regreq}}$  see [4]). If this timer expires, the Target PDSN shall  
10 resend the P-P Registration-Request with R-P connection Setup Airlink Record an operator  
11 configurable number of times or until an Active Start Airlink Record is received from the Target  
12 RN. In the event any of the P-P connections setup fail, the fast handoff is abandoned and the  
13 Target PDSN shall release all P-P connections, if any. The Target PDSN shall negotiate PPP  
14 with the MS and shall send its own P-P address to the Target RN as Serving P-P address (see  
15 [4]). Negotiation of PPP at the Target PDSN shall be based on the PPP establishment  
16 procedures described in X.S0011-004-C.

17 In the P-P Registration-Request message, the Target PDSN shall set the Home Address field to  
18 zero, the HA Address field to the Serving P-P address, and the Care-of Address field to the  
19 Target P-P address. The Mobile Identifier, SR\_ID, and Target PDSN Session Identifier Key shall  
20 be included in the Session Specific Extension. The Target PDSN shall assign a Target PDSN  
21 Session Identifier Key for the P-P connection. The Target PDSN Session Identifier Key shall be  
22 unique within a Target PDSN entity. The 'S', 'T', and 'G' bits shall be set. The Lifetime field shall  
23 be set to  $T_{\text{presetup}}$ , whose value is sufficient for the service instance to handoff from the Source RN  
24 to the Target RN. The IP source and destination addresses in the IP header shall be set to the  
25 Target P-P and the Serving P-P address, respectively.

26 If the P-P Registration-Request message is acceptable, the Serving PDSN shall update the  
27 binding record for the MS by creating an association among the IMSI, SR\_ID, the Target PDSN  
28 Session Identifier Key, Serving PDSN Session Identifier Key (if asymmetric P-P session identifier  
29 keys are supported between the Target PDSN and the Serving PDSN), the Target P-P address,  
30 and the Serving P-P address. The Serving PDSN shall indicate to the Target PDSN if the newly  
31 established P-P connection is the main service instance by including the PPP Link Indicator  
32 Extension with a value of 'main service instance' in a P-P Registration-Reply message to the  
33 Target PDSN.

34 The Serving PDSN shall assign a Serving PDSN Session Identifier Key<sup>3</sup> for the P-P connection, if  
35 asymmetric P-P session identifier keys are supported between the Target and Serving PDSNs.  
36 The Serving PDSN Session Identifier Key is unique within a Serving PDSN entity. The Serving  
37 PDSN shall return a P-P Registration-Reply message with an accept indication. In the P-P  
38 Registration-Reply message, the Serving PDSN sets the MS Home Address field to zeros. The  
39 HA Address fields shall be set to the serving P-P address of the Serving PDSN. The Mobile  
40 Identifier, SR\_ID and Serving PDSN Session Identifier Key shall be included in the Session  
41 Specific Extension. The Lifetime field shall be set to  $T_{\text{presetup}}$  (see [4]), whose value is sufficient for  
42 the traffic channel to handoff from the Source RN to the Target RN. The IP source address and  
43 the IP destination address in the IP header shall be set to Serving P-P address and the Target P-  
44 P address, respectively.

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<sup>2</sup> Airlink records are sent over the P-P connection by the use of Critical Vendor/Organization Specific Extension as specified in [4].

<sup>3</sup> This is the same as the PDSN Session Identifier Key as defined in [4].

1 On receipt of the P-P Registration-Reply message, the Target PDSN shall create a binding  
 2 record for the MS by creating an association among the IMSI, SR\_ID, the Serving PDSN Session  
 3 Identifier Key, the Serving P-P Address information, Target PDSN Session Identifier Key, the R-P  
 4 Interface PDSN Session Identifier Key, the Target PCF Session Identifier Key, and the Target  
 5 PCF IP address. Bearer data now flows both to the Source RN via the R-P connection and to the  
 6 Target PDSN over the newly established P-P connections, or for the case of a continuing fast  
 7 handoff, to the previous Target PDSN via the previous P-P connection and to the Target PDSN  
 8 over the newly established P-P connection.

9 The Target PDSN shall use the SR\_ID and the Mobile Identifier to uniquely identify a packet data  
 10 service instance for a specific MS across RNs and PDSNs.

11 The GRE keys for the P-P session (i.e., the Target PDSN Session Identifier and Serving PDSN  
 12 Session Identifier) shall be chosen according to [4].

13 The Target PDSN shall forward the bearer data to the Target RN via the pre-setup R-P  
 14 connection.

15 On successful handoff of the active service instance(s) to the Target RN, the Target RN forwards  
 16 the Start Airlink Records to the Target PDSN over the pre-setup R-P connection(s), with R-P  
 17 connection Lifetime set to  $T_{rp}$ <sup>4</sup> (see [4]) and 'S' bit cleared<sup>5</sup>. The Target RN also starts periodically  
 18 re-registering with the Target PDSN before the expiration of the R-P connection Lifetime.

19 If the service instance is not handed over to the Target RN, the pre-setup R-P connection is  
 20 automatically released on expiry of timer  $T_{presetup}$ <sup>6</sup> (see [4])<sup>6</sup>. Upon R-P connection release, the  
 21 Target PDSN shall release the established P-P connections.

22 If the P-P connection has been established successfully by the time the Active Start Airlink  
 23 Record is received from the Target RN, the Target PDSN shall forward the Active Start Airlink  
 24 Record over the P-P connection to the Serving PDSN.

25 On receipt of the R-P Registration-Request message with zero lifetime from the Source RN, or a  
 26 P-P Registration-Request message with zero lifetime from the previous Target PDSN (i.e., as in  
 27 Figure 4), the Serving PDSN shall stop transport of the user data stream to the Source RN or  
 28 previous Target PDSN and release the R-P or P-P connection, respectively. Also, following the  
 29 reception of the Active Stop Airlink Record the Serving PDSN may release the associated R-P  
 30 connection with the Source RN, or P-P connection to the previous Target PDSN. The Target  
 31 PDSN shall also start periodically re-registering with the Serving PDSN before the expiration of  
 32 the P-P connection Lifetime. On receipt of P-P Registration-Request message with 'S' bit not set,  
 33 the Serving PDSN shall stop transport of the bearer data stream to the Source RN or previous  
 34 Target PDSN.

#### 35 4.4.2 P-P Establishment Connection Failure

36 Depending on the result code, the Target PDSN may attempt to retry setting up of the P-P  
 37 connection(s). If the P-P connection(s) cannot be established, the Target PDSN shall abandon P-  
 38 P connection establishment, and shall negotiate PPP with the MS. Negotiation of PPP at the  
 39 Target PDSN shall be based on the PPP establishment procedures described in X.S0011-004-C.

40 At the time an Active Start Airlink Record is received from the Target RN, if the corresponding P-  
 41 P connection with the Serving PDSN has not yet been established successfully, the Target PDSN  
 42 shall fail the fast handoff. It shall initiate release of all P-P connections with the Serving PDSN for

---

<sup>4</sup>  $T_{rp}$  is the lifetime of the R-P connection with the 'S' bit clear.

<sup>5</sup> The Serving and Target RN should take appropriate measures to avoid rapid establishment and release of the serving PDSN to RN R-P connections in the face of a ping-pong condition in which the MS moves rapidly between the Serving and Target RN.

<sup>6</sup>  $T_{presetup}$  is the lifetime of the R-P connection with the 'S' bit set and is much shorter than  $T_{rp}$ .

1 this MS, and shall negotiate PPP with the MS. Negotiation of PPP at the Target PDSN shall be  
2 based on the PPP establishment procedures described in X.S0011-004-C.

3 The P-P Registration-Request message may be retransmitted if no P-P Registration-Reply  
4 message is received within a configurable time ( $T_{Regreq}$ ). Setup of a P-P connection is considered  
5 to have failed if no P-P Registration-Reply message is received after a configurable number of P-  
6 P Registration-Request message retransmissions.

### 7 **4.4.3 P-P Connection – Periodic Re-registration**

8 The Target PDSN shall periodically refresh the P-P connection with the Serving PDSN by  
9 sending a P-P Registration-Request message before P-P connection registration lifetime ( $T_{pp}$ <sup>7</sup>)  
10 expires. The Serving PDSN shall return a P-P Registration-Reply message with an accept  
11 indication, including the refreshed Lifetime timer value for the P-P connection. The P-P  
12 Registration-Request message may be retransmitted if no P-P Registration-Reply message is  
13 received within a configurable time.

14 If no P-P Registration-Replies are received after a configurable number of P-P Registration-  
15 Request message retransmissions for a P-P connection, the Target PDSN shall negotiate a new  
16 PPP session with the MS as per the PPP establishment procedures described in X.S0011-004-  
17 C. The Serving PDSN shall close the PPP session if there is no P-P or R-P connection supporting  
18 the main service instance.

### 19 **4.4.4 P-P Interface Release Procedures**

20 This section provides an overview of the P-P interface release procedures. The complete P-P  
21 interface release procedures, such as handling of timers, are identical to the R-P connection  
22 release procedures found in [4].

23 The release of P-P connections can be initiated either by the Target PDSN or the Serving PDSN.

#### 24 **4.4.4.1 P-P Connection Release – Target PDSN Initiated**

25 The Target PDSN shall initiate the release of a P-P connection if the corresponding R-P  
26 connection has been released, or if the Target PDSN is executing a fast handoff completion as  
27 per section 4.4.5). The Target PDSN shall release a P-P connection by sending a P-P  
28 Registration-Request message to the Serving PDSN with a lifetime field set to zero. The Target  
29 PDSN shall forward any Active Airlink Stop Record received from the Target RN in the P-P  
30 Registration-Request message. The Serving PDSN shall remove the binding information for the  
31 P-P connection, and returns a P-P Registration-Reply message with a PPP Link Indicator  
32 Extension with the appropriate value. On receipt of the P-P Registration-Reply message, the  
33 Target PDSN shall remove binding information for the P-P connection and may initiate PPP  
34 negotiation on the main service instance to the MS if the value of the PPP Link Indicator  
35 Extension is set to one. The Serving PDSN shall release the associated link context and R-P  
36 connection (if one exists).

37 If the Target PDSN does not receive a P-P Registration-Reply message after sending a  
38 configurable number of P-P Registration-Request message retransmissions, the Target PDSN  
39 shall remove the binding information for all the P-P connections for the MS.

#### 40 **4.4.4.2 P-P Connection Release – Serving PDSN Initiated**

41 The Serving PDSN shall initiate the release of a P-P connection if:

- 42
  - the MS returns to an RN that can reach the Serving PDSN, or

---

<sup>7</sup>  $T_{pp}$  is the lifetime of the P-P connection.

- 1           • if the PPP inactivity timer expires and the MS is not Always On, or
- 2           • the Serving PDSN closes the PPP session, or
- 3           • if the MS renegotiates or closes the PPP session, or
- 4           • for administrative reasons.

5 The Serving PDSN may initiate release of a P-P connection by sending a P-P Registration-  
6 Update message to the Target PDSN with a termination indication. When the Serving PDSN  
7 releases the P-P connections because the MS closes the PPP session, the Serving PDSN shall  
8 indicate to the Target PDSN not to negotiate PPP by including the PPP Link Indicator Extension  
9 with a value of 2 (do not negotiate PPP) in a P-P Registration-Reply message to the Target  
10 PDSN. When the Serving PDSN releases the P-P connections because the MS renegotiates  
11 PPP, the Serving PDSN shall indicate to the Target PDSN to negotiate PPP with a P-P  
12 Registration-Update message containing a PPP Link Indicator Extension with a value of 1  
13 (negotiate PPP). In this case the Target PDSN shall reuse the existing R-P connections to  
14 renegotiate the PPP link with the MS. If the P-P connection is released by the serving PDSN  
15 without an indication to negotiate PPP, the Target PDSN shall release the corresponding R-P  
16 connection if one exists. In either case, the Target PDSN shall remove the binding information for  
17 the P-P connection, and return a P-P Registration-Acknowledge message. The Target PDSN  
18 shall send a P-P Registration-Request message with a lifetime of zero containing any accounting  
19 related information received from the Target RN. On receipt of the P-P Registration-Request  
20 message, the Serving PDSN shall respond with a P-P Registration-Reply message and remove  
21 binding information for the P-P connection along with any associated link context.

22 If the Serving PDSN does not receive a P-P Registration-Acknowledge message after  
23 transmitting a configurable number of P-P Registration-Update messages, the Serving PDSN  
24 shall remove the binding information for all the P-P connections for the MS. It shall also initiate  
25 release of the associated link layer context for the MS and R-P connections if one exists.

#### 26 **4.4.5 P-P Fast Handoff Completion**

27 At some point in time, all connected service instances on the Target RN go dormant. The Target  
28 RN includes an "All Dormant" NVSE in the R-P Registration-Request sent to the Target PDSN  
29 when the last service instance goes dormant. This R-P Registration-Request also contains an  
30 Active Stop Airlink Record for that last service instance. The Target PDSN shall in turn forward  
31 the "All Dormant" NVSE and the Active Stop Airlink Record in the P-P Registration Request to the  
32 Serving PDSN. The Target PDSN shall send an LCP Configure-Request to the MS when it  
33 receives a P-P Registration-Reply message containing a PPP Link Indicator Extension with a  
34 value of 1 (negotiate PPP).

35 Simultaneously, the Target PDSN shall initiate release of the P-P connections with the Serving  
36 PDSN for the MS.

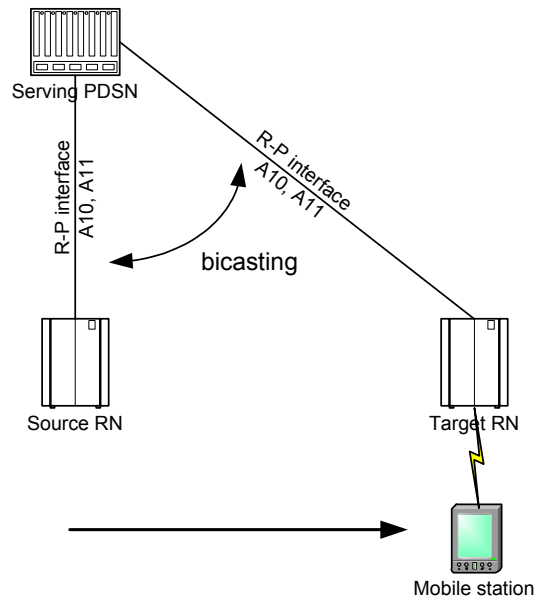
37 The Target PDSN becomes the new Serving PDSN after completing a new PPP session  
38 negotiation with the MS. The Target PDSN shall update the Target RN with the new Serving P-P  
39 Address (i.e., its own P-P address) in the next R-P Registration-Reply message. The new  
40 Serving PDSN shall use the stored R-P Connection Setup Airlink Record from the original R-P  
41 connection establishment for accounting purposes.

### 42 **4.5 Bicasting Scenarios**

43 Bicasting is temporary and starts at the Serving PDSN upon reception of a R-P or P-P  
44 Registration-Request with the 'S' bit set. Unicast of the payload data resumes at the Serving  
45 PDSN upon reception of a R-P or P-P Registration-Request with the 'S' bit clear. The following  
46 scenarios show bicasting of payload data during fast handoff:

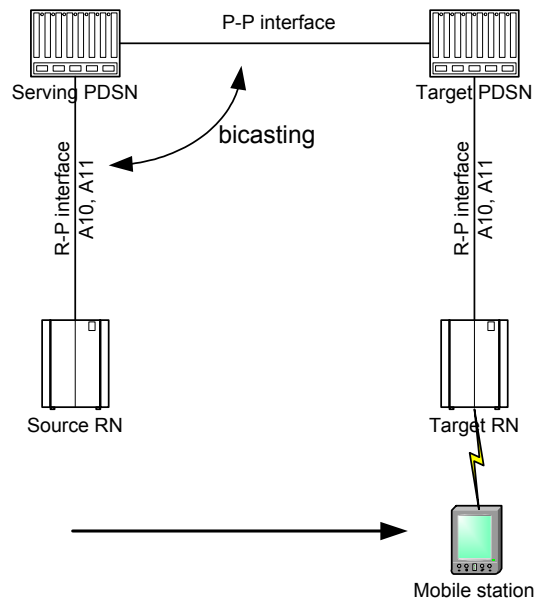
- 47           1. Intra PDSN (see Figure 1)

- 1            2. Inter PDSN, start of fast handoff (see Figure 2)
- 2            3. Intra PDSN, during fast handoff on Target PDSN (see Figure 3)
- 3            4. Inter PDSN, during a fast handoff from one Target PDSN to another Target PDSN
- 4            (see Figure 4).
- 5            Cases 1 and 3 are specified in [4].



6  
7  
8

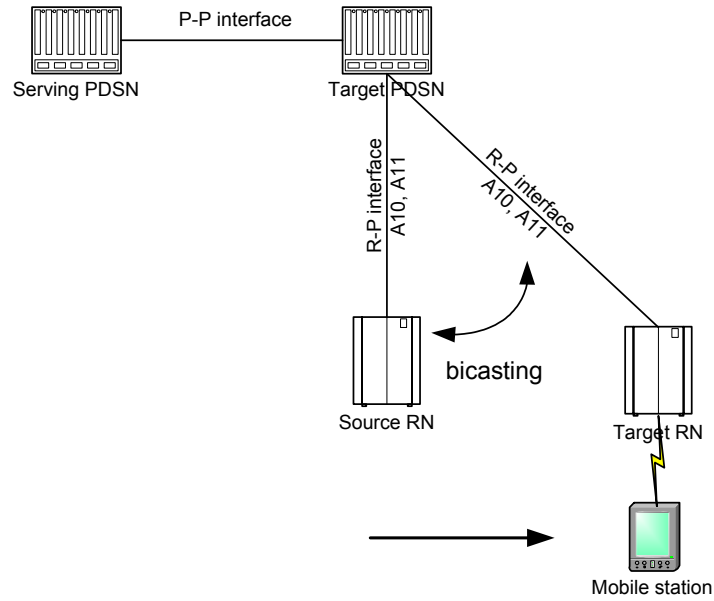
**Figure 1 - Intra PDSN Handoff**



9  
10

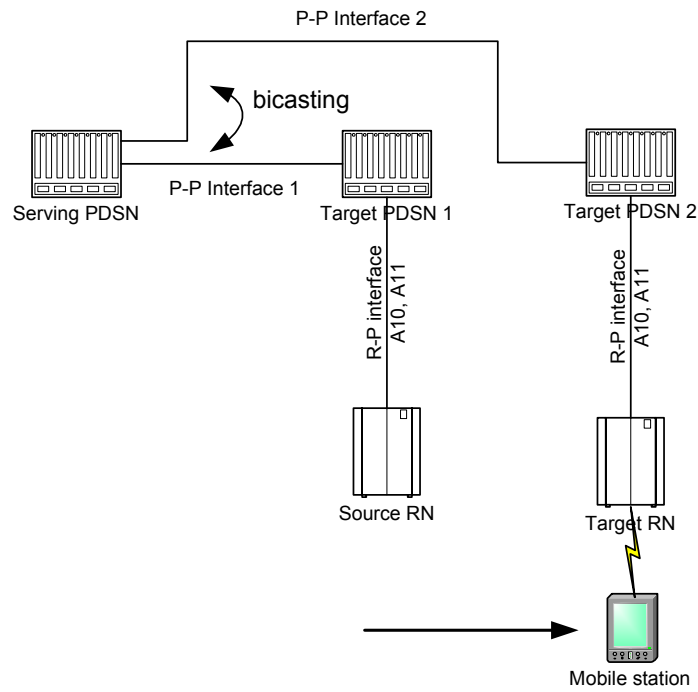
**Figure 2 - Inter PDSN, Beginning of Fast Handoff**

1  
2



3  
4

**Figure 3 - Intra PDSN, Continuation of Fast Handoff on Target PDSN**



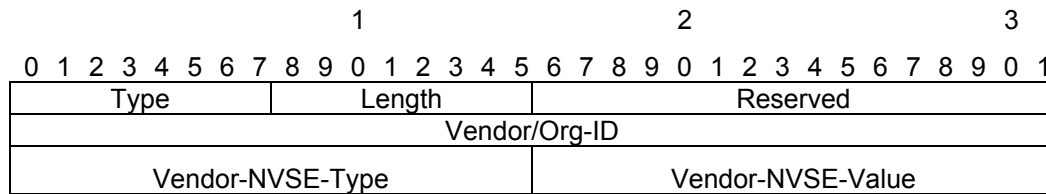
5  
6

**Figure 4 - Inter PDSN Handoff, Continuation of Fast Handoff Between Target PDSNs**

## 1 4.6 PPP Link Indicator Extension

2 The format of a normal P-P vendor specific extension is as follows:

3



4

Type: 134

5

Length: 10

6

Vendor/Org-ID: 5535

7

Vendor-NVSE-Type: 16

8

Vendor-NVSE-Value:

9

0: main service instance

10

1: negotiate PPP

11

2: do not negotiate PPP

12

When the NVSE is present and set to zero, it serves simply to indicate the main service instance.

13

When set to one, it indicates that the PPP session is being renegotiated and the Target PDSN

14

should attempt to negotiate PPP by sending an LCP Configure-Request message to the MS over

15

the main service instance. When set to two, it indicates that the PPP session is closed and the

16

Target PDSN shall not attempt to negotiate the PPP session.

17

## 1 **5 Resource Management**

2 Resource management defines the mechanisms to release session related resources at the  
3 PDSN and the HA. Resources may be released due to the session being terminated, handoff, the  
4 MS becoming unreachable, or for administrative purposes.

5 The following resources are identified:

- 6 • PPP, R-P, and P-P sessions.
- 7 • Mobile IP bindings.
- 8 • Header Compression and Header Removal Contexts.
- 9 • Traffic Flow Templates.
- 10 • Accounting Usage Data Records.

11 The PDSN shall support both of the following mechanisms:

- 12 • Dynamic Authorization Extensions to RADIUS [RFC 3576].
- 13 • Registration Revocation in Mobile IPv4 [RFC 3543] with the exceptions as indicated  
14 in section 5.2.2.

15 The HA shall support both of the following mechanism:

- 16 • Dynamic Authorization Extensions to RADIUS [RFC 3576].
- 17 • Registration Revocation in Mobile IPv4 [RFC 3543].

18 The RADIUS server shall support the following mechanism:

- 19 • Dynamic Authorization Extensions to RADIUS [RFC 3576].

20 While Dynamic Authorization Extensions to RADIUS may be used for both Simple IP and MIP  
21 sessions, Registration Revocation in Mobile IPv4 is only used for MIP sessions.

22 The PDSN and the HA shall include in the RADIUS Access-Request message to the Home  
23 RADIUS server the 3GPP2 Session Termination Capability (STC) VSA to indicate that they  
24 support both Dynamic Authorization Extensions to RADIUS and Registration Revocation in  
25 Mobile IPv4 using (STC VSA with value 3) (see X.S0011-005-C).

26 Upon receiving a RADIUS Access-Request message containing the STC VSA with value 3, the  
27 Home network shall indicate using the STC VSA in the RADIUS Access-Accept message which  
28 resource management mechanism shall be used for the packet data session. The STC VSA is  
29 interpreted as a bit mask and may take on the following values:

- 30 1. Only Dynamic Authorization Extensions to RADIUS is used.
- 31 2. Only Registration Revocation in Mobile IPv4 is used.
- 32 3. Both Dynamic Authorization Extensions to RADIUS and Registration  
33 Revocation in Mobile IPv4 are used.

### 34 **5.1 Simple IP**

35 The PDSN shall include a 3GPP2 STC VSA in the RADIUS Access-Request message to the  
36 Home RADIUS server. This attribute shall be set to 3 to indicate that Dynamic Authorization  
37 Extensions to RADIUS is supported by the PDSN. The PDSN shall also include the NAS-  
38 Identifier attribute containing a Fully Qualified Domain Name (FQDN) for the PDSN in the  
39 RADIUS Access-Request message.

1 If the RADIUS Access-Request message does not include<sup>8</sup> the STC VSA, the Home RADIUS  
 2 server shall not perform Dynamic Authorization Extensions to RADIUS procedures with the  
 3 PDSN.

4 If a RADIUS Access-Request message is received for a user (identified by an NAI and/or IMSI),  
 5 the Home RADIUS server compares the NAS-Identifier and/or NAS IP address with the stored  
 6 values (if any). If the received values are different than the stored (non-zero) values, the Home  
 7 RADIUS server determines that an inter PDSN handoff has occurred, and updates the state  
 8 information with the received values from the RADIUS Access-Request message. The state  
 9 information shall include at a minimum the NAS-Identifier, the User-Name (NAI), and may include  
 10 the NAS IP address, the Framed-IP-Address (MS IP Address), and the Calling-Station ID (IMSI).

11 The Home RADIUS server shall then send to the previous PDSN a RADIUS Disconnect-Request  
 12 message as per [RFC 3576] to disconnect the user's PPP session and shall include the  
 13 DisconnectReason VSA to indicate 'MS mobility detection'. The RADIUS server shall send a  
 14 Disconnect-Request message to the previous PDSN following successful processing of the  
 15 RADIUS Access-Request message from the new PDSN and sending of a RADIUS Access-  
 16 Accept message to the new PDSN.

17 The RADIUS Disconnect-Request message includes the following attributes:

Attributes	Type	Description
NAS-Identifier	M	Contains the NAS-Identifier of the previous PDSN as was sent in a RADIUS Access-Request message
Correlation ID	O	Uniquely identifies the session to be disconnected.
User-Name	M Note 1	Contains the user's NAI to disconnect
Framed-IP-Address	O	May be included to indicate the MS IP address.
Calling-Station-ID	O	May be included to indicate the IMSI.
DisconnectReason	O	May be included to indicate that the MS has moved to a new PDSN area.
Framed-IPv6-Prefix	O	May be included to indicate the user IPv6 prefix to disconnect.
Framed-Interface-ID	O	May be included to indicate the user IPv6 Interface ID to disconnect.

18 Note 1: If the PDSN receives a RADIUS Disconnect-Request message containing the User-Name attribute  
 19 without the correlation ID or Framed-IP-Address, the PDSN shall disconnect all packet data sessions  
 20 associated with the NAI.

21 **Table 1. RADIUS Disconnect-Request Attributes used for 3GPP2 Resource Management**

22 The RADIUS Disconnect-Request message shall be routed through the RADIUS servers using  
 23 the NAS-Identifier attribute. Upon receiving the RADIUS Disconnect-Request message, the  
 24 PDSN verifies that the session exists and responds with a Disconnect-Ack message.

<sup>8</sup> This may be a PDSN supporting previous version of this specification.

1 If the DisconnectReason VSA is included and indicates 'MS mobility detection', the PDSN shall  
 2 close the PPP session without initiating an LCP Terminate-Request to the MS and shall release  
 3 any R-P and P-P sessions.

4 If the DisconnectReason VSA is not included, and if one or more packet data session is active for  
 5 the MS, the PDSN shall close the PPP session. In this case, the PDSN shall determine if an LCP  
 6 Terminate-Request should be sent to the MS. For an Always On session, the PDSN shall send  
 7 an LCP Terminate-Request to the MS. The PDSN should also send an LCP Terminate-Request  
 8 to a non-Always On session unless it has previously received the 'All Dormant Indicator' NVSE.

9 If the PDSN releases the resources (PPP, R-P and P-P sessions), it shall subsequently send  
 10 RADIUS Accounting-Request (stop) message(s). The PDSN shall set the Session Continue  
 11 attribute to 0 (False) in the RADIUS Accounting-Request (Stop) message before sending it to the  
 12 RADIUS server.

13 If the Home RADIUS server receives a RADIUS Accounting-Request (Stop) message with  
 14 Session Continue VSA set to 'False', the Home RADIUS server shall clear the state information  
 15 associated with the user and the PDSN that sent the RADIUS Accounting-Request (Stop) with  
 16 Session Continue VSA set to FALSE. The Home RADIUS server shall not send a RADIUS  
 17 Disconnect-Request message to that PDSN.

18 If the PDSN receives a RADIUS Disconnect-Request message and determines that session does  
 19 not exist or that the request cannot be honored, it shall send a Disconnect-NAK message as per  
 20 [RFC 3576].

## 21 **5.2 Mobile IP**

22 The Home RADIUS server shall use the STC VSA together with the home domain policy and the  
 23 IPsec policy for the user to determine the session termination mechanism that shall be used for  
 24 each session. The Home RADIUS server shall not send a RADIUS Disconnect-Request  
 25 message to the PDSN or the HA if the STC VSA:

- 26 • is absent<sup>9</sup> in the RADIUS Access-Request message or,
- 27 • indicates support for both mechanisms and the home domain policy allows only  
 28 Registration Revocation in Mobile IPv4 by the HAs.

### 29 **5.2.1 Dynamic Authorization Extensions to RADIUS**

30 The Home IP network shall use Dynamic Authorization Extensions to RADIUS [RFC 3576] for  
 31 resource management for Mobile IP sessions when both the HA and the PDSN i support both  
 32 Dynamic Authorization Extensions and Registration Revocation for Mobile IPv4, and the home  
 33 domain policy indicates that Dynamic Authorization Extensions is preferred.

34 The PDSN shall include in the RADIUS Access-Request message to the Home RADIUS server  
 35 the 3GPP2 STC VSA with value 3 and the NAS-Identifier attribute containing a Fully Qualified  
 36 Domain Name (FQDN) for the PDSN and shall be able to process a RADIUS Disconnect-  
 37 Request message from the RADIUS server. A RADIUS Disconnect-Request message may be  
 38 received by the PDSN during an active PrePaid packet data session (see X.S0011-006-C).

39 The HA shall send a RADIUS Access-Request message to the home RADIUS server upon  
 40 receiving the initial RRQ for a user and shall include the STC VSA with value 3, a Correlation ID  
 41 VSA and the NAS-Identifier attribute containing a Fully Qualified Domain Name (FQDN) of the  
 42 HA.

43 If the Home RADIUS server receives a RADIUS Access-Request message for a user (identified  
 44 by an NAI and/or IMSI) and containing the STC VSA, it compares the NAS-Identifier and/or NAS

---

<sup>9</sup> This may be a PDSN or an HA supporting previous version of this specification.

1 IP address in the received RADIUS Access-Request message with the stored corresponding  
2 values (if any). If the received values are different than the stored (non-zero or null) values, the  
3 Home RADIUS server determines that an inter PDSN handoff has occurred, and updates the  
4 state information with the received values from the RADIUS Access-Request message. The state  
5 information shall include at a minimum the NAS-Identifier, the User-Name (NAI), and may include  
6 the NAS IP address, the Framed-IP-Address (MS IP Address), and the Calling-Station ID (IMSI).  
7 The Home RADIUS server shall send to the previous PDSN a RADIUS Disconnect-Request  
8 message as per [RFC 3576]. The RADIUS Disconnect-Request message should be sent  
9 following successful processing of the RADIUS Access-Request message from the new PDSN  
10 and sending of a RADIUS Access-Accept message. The RADIUS Disconnect-Request message  
11 shall include the attributes as defined in Table 1.

12 The RADIUS Disconnect-Request message shall be routed through the RADIUS servers using  
13 the NAS-Identifier attribute. Upon receiving the RADIUS Disconnect-Request message, the  
14 PDSN verifies that the session exists and responds with a Disconnect-Ack message. If the  
15 DisconnectReason VSA is included and indicates 'MS mobility detection', the PDSN shall close  
16 the PPP session without initiating an LCP Terminate-Request to the MS and shall release any  
17 corresponding R-P and P-P sessions.

18 If the DisconnectReason VSA is not included, the PDSN shall perform the following:

- 19 • If no more than one packet data session is active for the MS, the PDSN shall close  
20 the PPP session and shall clear the Mobile IP binding. In this case, the PDSN shall  
21 determine if an LCP Terminate-Request should be sent to the MS. For an Always On  
22 session, the PDSN shall send an LCP Terminate-Request to the MS. The PDSN  
23 should also send an LCP Terminate-Request to a non-Always On session unless it  
24 has previously received the 'All Dormant Indicator' NVSE.
- 25 • If the packet data session for which the RADIUS Disconnect-Request message is  
26 received is a Mobile IP session and more than one packet data session is active for  
27 the MS, the PDSN shall remove the binding associated with the packet data session  
28 and shall send a unicast Agent Advertisement to the MS Home Address [RFC2002].  
29 In this Agent Advertisement, the PDSN shall set the B bit and set the sequence  
30 number field to zero.

31 If the PDSN releases the resources (e.g. PPP, R-P and P-P sessions, Mobile IP binding), it shall  
32 subsequently send RADIUS Accounting-Request (stop) message(s) to the RADIUS server. The  
33 PDSN shall set the Session Continue attribute to 0 (False) in the RADIUS Accounting-Request  
34 (Stop) message before sending it to the RADIUS server.

35 If the Home RADIUS server receives a RADIUS Accounting-Request (Stop) message with  
36 Session Continue VSA set to 'False', the Home RADIUS server shall clear the state information  
37 associated with the user and the PDSN that sent the RADIUS Accounting-Request (Stop) with  
38 Session Continue VSA set to FALSE. The Home RADIUS server shall not send a RADIUS  
39 Disconnect-Request message to that PDSN.

40 If the PDSN receives a RADIUS Disconnect-Request message and determines that session does  
41 not exist or that the request shall not be honored, it shall send a Disconnect-NAK message as  
42 per [RFC 3576]. The Home RADIUS server shall send a RADIUS Disconnect-Request message  
43 to the HA if it determines that the session shall be terminated at the HA and the HA previously  
44 indicated the support for the Dynamic Authorization Extensions to RADIUS capability.

## 45 **5.2.2 Registration Revocation in Mobile IPv4 at the PDSN**

46 The PDSN shall support Registration Revocation in Mobile IPv4 per RFC 3543. Upon receiving  
47 the initial RRQ from the MS, the PDSN shall send a RADIUS Access-Request message to the  
48 Home RADIUS server and shall include the STC VSA and a Correlation ID VSA. The PDSN shall  
49 set the STC VSA value to 3. If the RADIUS Access-Accept message includes the STC VSA with  
50 value 2 or 3, the PDSN shall use Registration Revocation in Mobile IPv4 for the session.

1 If the RADIUS Access-Accept message includes the STC value with value 1, the PDSN shall not  
2 include the Revocation Support Extension in the MIP RRQ message. In this case, the HA shall  
3 not include the Revocation Support Extension in the MIP RRP, and both the agents will consider  
4 the binding to be not revocable via the Registration Revocation in Mobile IPv4 procedures.

5 A PDSN that is allowed by the Home RADIUS server to participate in registration revocation shall  
6 include a Revocation Support Extension in all MIP RRQ messages including MIP Re-registration  
7 messages. If the associated MIP RRP also includes a valid Revocation Support Extension, then  
8 the PDSN shall follow registration revocation procedures as defined in RFC 3543, and shall  
9 consider the associated registration to be revocable. For a registration that is revocable, the  
10 PDSN shall send a Registration Revocation message to the HA when the Mobile IP binding is  
11 released.

12 If the PDSN receives a RADIUS Access-Accept message, which does not<sup>10</sup> contain the STC  
13 VSA, the PDSN shall use its local policy to determine if Registration Revocation in Mobile IPv4  
14 should be used for the session.

15 Upon reception of a valid Registration Revocation message for a revocable binding, the PDSN  
16 shall clear the associated binding and shall send a Registration Revocation Acknowledgement  
17 according to RFC 3543. If no other Mobile IP registrations are active on the PPP session  
18 associated with the revoked binding then the PDSN shall release the associated PPP, R-P and  
19 P-P sessions for the revoked registration, in accordance with X.S0011-002-C.

20 If other Mobile IP registrations are active on the PPP session (i.e., multiple Mobile IP sessions),  
21 the PDSN may notify the MS of the revoked binding if the I bit is set in the Registration  
22 Revocation message received from the HA and the local policy at the PDSN allows notification.

23 The PDSN shall send a Registration Revocation Acknowledgement according to RFC 3543. The  
24 PDSN shall send a Registration Revocation Acknowledgement message without processing the  
25 request for all Registration Revocation messages when the binding does not exist.

#### 26 **5.2.2.1 Security of revocation messages**

27 A security Association (SA) shall exist between the PDSN and the HA to protect the MIP  
28 Registration Revocation messages. The Registration Revocation message shall be protected  
29 using an FA-HA Authentication Extension, if a static/pre-configured FA-HA SA exists, or, using  
30 IPsec Security Association, or both. See X.S0011-002-C for IPsec SA procedures.

31 If the PDSN does not have a static FA-HA MIP SA or has not established an IPsec SA with the  
32 HA at initial MIP RRQ, then Registration Revocation in Mobile IPv4 capability shall not be used,  
33 and it shall discard any unprotected Registration Revocation messages that may be received  
34 from the HA.

#### 35 **5.2.3 Registration Revocation in Mobile IPv4 at the HA**

36 The HA shall support Registration Revocation in Mobile IPv4 capability [RFC 3543]. Upon  
37 receiving the initial RRQ containing the Revocation Support Extension, the HA shall send a  
38 RADIUS Access-Request message to the home RADIUS server and shall include the STC VSA  
39 and a Correlation ID VSA. The HA shall set the STC VSA value to 3. If the RADIUS Access-  
40 Accept message includes the STC VSA with value 1, the HA shall not use Registration  
41 Revocation in Mobile IPv4 for the session. If the RADIUS Access-Accept message includes the  
42 STC VSA with value 2 or 3, the HA shall use Registration Revocation in Mobile IPv4 for the  
43 session.

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<sup>10</sup> This is the case of a RADIUS Access-Accept message received from a Home RADIUS server that supports previous version of this standard.

1 When the HA is allowed by the Home RADIUS server to use Registration Revocation in Mobile  
 2 IPv4 for a session, it shall include a Revocation Support Extension in all MIP RRP for which the  
 3 associated MIP RRQ contained a valid Revocation Support Extension. A registration for which  
 4 the HA received a Revocation Support Extension and responded with a subsequent Revocation  
 5 Support Extension shall be considered revocable by the HA. If the MIP RRQ does not include a  
 6 Revocation Support Extension, the HA shall not send a Registration Revocation message to that  
 7 PDSN.

8 If the HA receives a RADIUS Access-Accept message, which does not<sup>11</sup> contain the STC VSA,  
 9 the HA shall use its local policy to determine if Registration Revocation in Mobile IPv4 should be  
 10 used for the session.

11 For a registration that is revocable, the HA shall send a Registration Revocation message to the  
 12 PDSN in the following circumstances:

- 13 • The MIP session is administratively disconnected. The HA should set the I bit in the  
 14 Registration Revocation Message if the FA has indicated that it supports mobile  
 15 notification in Revocation Support Extension (i.e., I bit is set).
- 16 • MIP handoff to a different PDSN has been detected, and the Registration Request  
 17 from the new PDSN has the S bit cleared (i.e. the MS is not requesting for  
 18 simultaneous binding). In this case, the HA shall set the I bit to 0 in the Registration  
 19 Revocation message to the previous PDSN.

20 The format of a Registration Revocation message sent from the HA to the PDSN shall adhere to  
 21 that of RFC 3543.

22 Upon receiving a valid Registration Revocation message, the HA shall send a Registration  
 23 Revocation Acknowledgement message to the IP source address of the Registration Revocation  
 24 message and should free up any resources associated with the former binding and discontinue  
 25 all Mobile IP services for it<sup>12</sup>.

### 26 5.2.3.1 Security of revocation messages

27 A security Association (SA) shall exist between the PDSN and the HA to protect the MIP  
 28 Registration Revocation messages. The Registration Revocation message shall be protected  
 29 using an FA-HA Authentication Extension, if a static/pre-configured FA-HA SA exists, or, using  
 30 IPsec Security Association, or both. See X.S0011-002-C for IPsec SA procedures.

31 If the HA does not have a static FA-HA MIP SA or an IPsec SA with the PDSN, then Registration  
 32 Revocation in Mobile IPv4 capability shall not be used, and it shall discard any unprotected  
 33 Registration Revocation messages that may be received from the PDSN.

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<sup>11</sup> This is the case of a RADIUS Access-Accept message received from a Home RADIUS server that supports previous version of this standard.

<sup>12</sup> The HA may choose not to free up resources (e.g., Home Address) and discontinue all Mobile IP services for that binding based on local policy or other implementation dependent reasons. For example, the HA may be unable to detect and/or prevent potential revocation and registration race condition that may occur during inter PDSN mobility.

## 1 **6 RN Packet Data Inactivity Timer**

2 In the RN, the expiration of the RN PDIT (RN Packet Data Inactivity Timer) is used to trigger the  
3 transition of a packet data service instance from the active state to the dormant state. The RN  
4 PDIT value may be provisioned in the RADIUS server (Visited RADIUS/Home RADIUS), and  
5 provided to the RN via the PDSN, during the user authentication with the RADIUS infrastructure.  
6 In this specification, one RN PDIT value is provisioned for a user and is sent to the RN over the  
7 R-P interface in accordance with [4].

8 The RN PDIT value may be stored, on a per user basis, at the Home RADIUS server as part of  
9 the user profile, in which case it is sent to the PDSN via the Visited RADIUS server in the  
10 RADIUS Access-Accept message. The Visited RADIUS server may override the RN PDIT value,  
11 based on the local policy, prior to forwarding the RADIUS Access-Accept message to the PDSN.  
12 If the RADIUS Access-Accept message received from the Home RADIUS does not contain an  
13 RN PDIT VSA<sup>13</sup>, the Visited RADIUS server may include an RN PDIT VSA with a value, based on  
14 the local policy, prior to forwarding the RADIUS Access-Accept message to the PDSN.

15 If the PDSN supports providing the RN PDIT to the RN, the PDSN shall forward the RN PDIT  
16 value to the RN, in accordance with [4]. In this case the PDSN shall also store the RN PDIT value  
17 in order to support intra PDSN handoffs. If a user initiates multiple packet data sessions, the  
18 PDSN may receive more than one RN PDIT VSA from different home domains. In this case, the  
19 largest RN PDIT value received from different home domains is sent from the PDSN to the RN.  
20 This update may happen during an ongoing packet data session when the PDSN receives a new  
21 RN PDIT value that is greater than the one previously sent to the RN.

22 The RN PDIT value is formatted as an optional extension as specified in [4], and is sent to the RN  
23 over the R-P interface and the P-P interface.

24  
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<sup>13</sup> For example, based on the local policy, the RN PDIT value may be provisioned at the Visited RADIUS server on a per realm basis, if the packet data traffic models are known for the associated realms. A default RN PDIT value may be provisioned for those realms for which the packet data traffic models are not known.

## 1 **7 Radio Network Requirements**

### 2 **7.1 General**

3 The PDSN interfaces to the Radio Network only through the R-P interface and there are no RN  
4 dependent signaling messages transmitted to the PDSN. However, there are some general  
5 requirements placed on the RN:

- 6 • Each RN is connected to at least one PDSN.
- 7 • The RN relays PPP octets between the MS and PDSN.
- 8 • For octet oriented service options, the RN passes octets between the MS and PDSN  
9 without any framing conversion.
- 10 • The RN establishes an R-P connection for each MS initiated packet data service  
11 instance. If the MS initiates multiple service instances, each R-P connection is  
12 directed to the same PDSN.
- 13 • The RN terminates the R-P connection if the MS terminates the corresponding  
14 packet data service instance with the service inactive indication.
- 15 • The RN terminates all the R-P connections for the MS if the MS terminates the  
16 packet data session with a power down indication.
- 17 • The RN terminates the R-P connection upon request from the PDSN.
- 18 • The RN may buffer user data from the PDSN when radio resources are not in place  
19 or insufficient to support the flow of data.

20 Note: No changes to the IP version used in the RN are required in order to support IPv6 MSs,  
21 i.e., the IP version used in the RN (including the R-P interface), shall be independent of the IP  
22 version of the packets carried in the PPP Sessions.

### 23 **7.2 R-P Interface Requirements**

24 The PDSN and RN shall support the R-P interface defined as A10 and A11 interfaces in [4].

25 In order to support fast handoff, the PDSN and the RN shall support the A10 and A11 interfaces  
26 defined in [4].

27 For octet oriented service options, the PDSN shall use sequential numbering in the GRE packet  
28 header of packets on the R-P interface, to ensure sequential delivery of packets over the R-P  
29 interface because:

- 30 • The PDSN is configured to send GRE packets that contain incomplete PPP frames  
31 or multiple PPP frames.
- 32 • The MS negotiates a header or payload compression algorithm that requires PPP  
33 frames to be delivered in sequence.

### 34 **7.3 R-P General Handoff Capabilities**

35 These requirements cover the duration of a packet data session and include periods when the  
36 RN does not allocate radio resources to the MS (if such a dormant/standby capability is  
37 supported by the RN).

- 38 • The RN has the capability to determine when an MS enters its coverage area.

- 1           • The RN shall be capable to determine with which PDSN an MS currently has a PPP  
2 session, if a PPP session already exists.
- 3           • During a packet data session, an MS can move outside the coverage area of one RN  
4 into the coverage area of another RN. If the previous and the new RN have  
5 connectivity to the same PDSN, the PDSN completes establishment of the R-P  
6 session with the new RN in such a way that the MS maintains the same PPP  
7 session. Subsequently, the release of the R-P session will be performed with the  
8 previous RN as described in [4]. If the previous and the new RN do not have  
9 connectivity to the same PDSN, the new RN establishes a new R-P session to a new  
10 PDSN.

11 Specific handoff procedures for the R-P are not called out in this specification but can be found in  
12 [4].

13