3GPP2 X.S0062-0
Version 1.0
Date: October 29, 2010

PCC for cdma2000 1x and HRPD Networks

REVISION HISTORY

Revision	Description of Changes	Date
Rev 0 v1.0	Initial publication (3GPP Rel 9 alignment)	October 2010

PCC for cdma2000 1x and HRPD Networks

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NO TABLE OF FIGURES ENTRIES FOUND.

FOREWORD

(This foreword is not part of this Standard.)

This document was prepared by 3GPP2 TSG-X.

This document is the first version of this specification.

This document contains portions of material copied from 3GPP document number(s):

TS 23.203

TS 29.212

This document is subject to change following formal approval. Should this document be modified, it will be re-released with a change of release date and an identifying change in version number as follows:

X.S0062-X version n.0

where:

X is an uppercase numerical or alphabetic character [0, A, B, C, …] that represents the revision level.

n is a numeric string [1, 2, 3, …] that indicates a point release level.

1 Introduction

This document provides a specification for the Policy and Charging Control (PCC) support for cdma2000®[1] 1x and HRPD networks. The PCC functions and interfaces supported by various cdma2000 1x and HRPD network entities are specified.

1.1 Scope

The scope of the specifications in this document is limited to cdma2000 1x and HRPD networks. This document covers support for 3GPP TS 23.203 specified Policy and Charging Control (PCC) architecture using cdma2000 1x and HRPD air interfaces and networks. This document is limited to alignment with 3GPP Release 9 specifications. Specifically, this specification covers:

- PCC session establishment for Simple IP, Client Mobile IP and Proxy Mobile IP
- Procedures for PCC policy control for home and roaming access
- Procedures for offline charging.

Reference to a 'cdma2000 network' in this document refers to both cdma2000 1x and HRPD air interfaces. The call flows in section 7 are specific to cdma2000 HRPD air interface only. Call flows for cdma2000 1x air interface are not specified in this release of specification.

1.2 Document Convention

"Shall" and "shall not" identify requirements to be followed strictly to conform to the standard and from which no deviation is permitted. "Should" and "should not" indicate that one of several possibilities is recommended as particularly suitable, without mentioning or excluding others; that a certain course of action is preferred but not necessarily required; or (in the negative form) that a certain possibility or course of action is discouraged but not prohibited. "May" and "need not" indicate a course of action permissible within the limits of the standard. "Can" and "cannot" are used for statements of possibility and capability, whether material, physical, or causal.

All fields that are marked as "Reserved" shall be filled with zeros by the sender of that field, and shall be ignored by the receiver of that field.

[1] "cdma2000® 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® is a registered trademark of the Telecommunications Industry Association (TIA-USA) in the United States."

2 References

2.1 Normative References

This section provides references to other specifications and standards that are necessary to implement this document.

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. ANSI and TIA maintain registers of currently valid national standards published by them.

Only Release 9 of 3GPP technical specifications referenced herein apply to this specification.

[1] **3GPP2:** A.S0008-C v1.0: Interoperability Specification (IOS) for High Rate Packet Data (HRPD) Radio Access Network Interfaces with Session Control in the Access Network, August 2007.

[2] **3GPP2:** A.S0009-C v1.0: Interoperability Specification (IOS) for High Rate Packet Data (HRPD) Radio Access Network Interfaces with Session Control in the Packet Control Function, August 2007.

[3] **3GPP2:** A.S0017-D v1.0: Interoperability Specification (IOS) for cdma2000 Access Network Interfaces - Part 7 (A10 and A11 Interfaces), June, 2007.

[4] **3GPP2:** C.S0024-B: cdma2000 High Rate Packet Data Air Interface Specification, April 2007.

[5] **3GPP2:** C.S0063-A: cdma2000 High Rate Packet Data Supplemental Services, April 2007.

[6] **3GPP2:** X.S0011: cdma2000 Wireless IP Network Standard.

[7] **3GPP2:** X.S0054-910: CAN Wireless IP Network: CAN Data Dictionary.

[8] **3GPP2:** X.S0057-A E-UTRAN – eHRPD Connectivity and Interworking: Core Network Aspects.

[Editor's Note: The above document is a work in progress and should not be referenced unless and until it is approved and published. Until such time as this Editor's Note is removed, the inclusion of the above document is for informational purposes only.]

[9] **3GPP2:** X.S0061-0: Network PMIP Support.

[10] **3GPP**: TS 23.003: Numbering, addressing and identification, (Release 9).

[11] **3GPP:** TS 23.203: Policy and Charging Control Architecture, (Release 9).

[12] **3GPP:** TS 23.401: GPRS Enhancements for E-UTRAN Access (Release 9).

[13] **3GPP:** TS 29.212: Policy and Charging Control over Gx Reference Point (Release 9).

[14] **3GPP:** TS 29.213: Policy and Charging Control Signaling Flows and QoS Parameter Mapping (Release 9).

[15] **3GPP:** TS 29.215: Policy and Charging Control over S9 Reference Point (Release 9).

[16] **3GPP:** TS 32.240: Charging Management; Charging Architecture and Principles (Release 9).

[17] **3GPP:** TS 32.251: Charging Management; Packet Switched (PS) Domain Charging (Release 9).

[18] **3GPP:** TS 32.295: Charging Management; Charging Data Record (CDR) Transfer (Release 9).

[19] **3GPP:** TS 32.297: Charging Management; Charging Data Record (CDR) File Format and Transfer (Release 9).

[20] **3GPP:** TS 32.298: Charging Management; Charging Data Record (CDR) Parameter Description (Release 9).

[21] **3GPP:** TS 32.299: Charging Management; Diameter Charging Applications (Release 9).

[22] **IETF:** RFC791: Postel, J., Internet Protocol, STD 5, RFC 791, September 1981.

[23] **IETF:** RFC2460: Deering, et.al., “Internet Protocol, Version 6 (IPv6) Specification”, December 1998.

[24] **IETF:** RFC2472: Haskin et.al., IP Version 6 over PPP, December 1998.

[25] **IETF:** RFC3012: Perkins, et al., Mobile IPv4 Challenge/Response Extensions, November 2000.

[26] **IETF:** RFC3025: Dommety, et al., Mobile IP Vendor/Organization-Specific Extensions, February 2001.

[27] **IETF:** RFC3041: Narten, et al., Privacy Extensions for Stateless Address Autoconfiguration in IPv6, December 2001.

[28] **IETF:** RFC3588: Calhoun et.al., Diameter Base Protocol, September 2003.

[29] **IETF:** RFC3633: Troan, et al., IPv6 Prefix Options for Dynamic Host Configuration Protocol (DHCP) version 6, December 2003.

[30] **IETF:** RFC4283: Patel, et al., Mobile Node Identifier for Mobile IPv6, November 2005.

[31] **IETF:** RFC4285: Patel, et al., Authentication Protocol for Mobile IPv6, January 2006.

[32] **IETF:** RFC4862: Thomson, et al., IPv6 Stateless Address Autoconfiguration, September 2007.

[33] **IETF:** RFC5094: Devarapalli, et al., Mobile IPv6 Vendor Specific Option, December 2007.

[34] **IETF:** RFC5213: Gundavelli, et. Al., Proxy Mobile IPv6, August 2008.

2.2 Informative References

This section provides references to other documents that may be useful for the reader of this document.

No informative references are specified in this release of specifications.

3 Definitions, Symbols and Abbreviations

This section contains definitions, symbols and abbreviations that are used throughout the document.

3.1 Definitions

Accounting

See Charging

Charging

Function within the 3GPP2 network and the associated billing system whereby information related to a chargeable event is collected, formatted, transferred and evaluated in order to make it possible to determine resource usage for which the subscriber may be billed.

Home Agent / Local Mobility Anchor (HA/LMA)

Home Agent (HA) / Local Mobility Anchor (LMA) is the topological anchor point that manages mobile node's binding state. The term HA is used for MIPv4, MIPv6, and PMIPv4. The term LMA is used for PMIPv6.

3.1.1 Symbols and Abbreviations

3GPP	3rd Generation Partnership Project
3GPP2	3rd Generation Partnership Project2
AAA	Authentication, Authorization, Accounting
AVP	Attribute-Valued Pair
BBERF	Bearer Binding and Event Reporting Function
BCM	Bearer Control Mode
BD	Billing Domain
BE	Best Effort
CCoA	Colocated Care of Address
CDF	Charging Data Function
CDR	Charging Data Record
CGF	Charging Gateway Function
CHAP	Challenge Handshake Authentication Protocol
CoA	Care-of Address
CMIP	Client Mobile IP
CTF	Charging Trigger Function
DHCPv6	Dynamic Host Configuration Protocol for IPv6
DL	Down Link
EAP	Encapsulation Authentication Protocol
FBC	Flow Based Bearer Charging
GBR	Guaranteed Bit Rate
GRE	Generic Routing Encapsulation

hPCRF	PCRF in Home Network
HA	Home Agent
HAAA	Home AAA
HoA	Home Address
IP	Internet Protocol
IP-CAN	IP Connectivity Access Network
LCP	Link Control Protocol
LMA	Local Mobility Agent
MAG	Mobile Access Gateway
MBR	Maximum Bit Rate
MIP6	Mobile IPv6
MS	Mobile Station
NAI	Network Access Identifier
OFCS	Offline Charging System
PBA	Proxy Binding Acknowledgement
PBU	Proxy Binding Update
PCEF	Policy and Charging Enforcement Function
PCRF	Policy and Charging Rules Function
PDN	Packet Data Network
PDSN	Packet Data Serving Node
PAP	PPP Authentication Protocol
PMIP	Proxy Mobile IP
PPP	Point-to-Point Protocol
QCI	QoS Class Identifier
QoS	Quality of Service
RA	Router Advertisement
RADIUS	Remote Authentication Dial In User Service
RAN	Radio Access Network
RS	Router Solicitation
RSVP	Resource Reservation Protocol
TFT	Traffic Flow Template
UL	Uplink
vPCRF	PCRF in Visited Network
VSA	Vendor Specific Attribute

4 PCC for cdma2000 System: Architecture and Interfaces

The Policy and Charging Control (PCC) architecture for cdma2000 1x and HRPD networks supports the following interfaces defined in 3GPP 23.203 [10]:

- **Gx:** the signaling interface between the PCRF and the PCEF (ref 3GPP TS 29.212 [13]). Depending on the IP address operation mode, the PCEF may be located in the PDSN or the HA/LMA.
- **Gxa:** the signaling interface between the BBERF and the PCRF (ref 3GPP TS 29.212 [13]).
- **S9:** the signaling interface between the hPCRF and the vPCRF (ref 3GPP TS 29.215 [15]).

4.1 Architecture Reference Model for Non Roaming Access

This section provides an overview of the Policy and Charging Control (PCC) architecture for cdma2000 networks for non-roaming access.

4.1.1 Simple IP Operation

Figure 1 below illustrates the PCC architecture reference model for cdma2000 systems when Simple IP address operation is used.

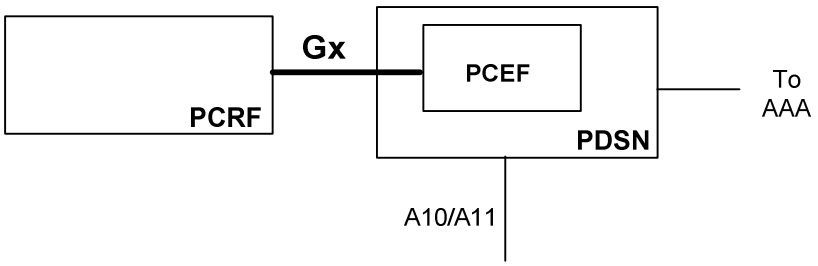

Figure 1 **PCC for cdma2000 for Non Roaming Access – Simple IP Operation**

4.1.2 CMIP/PMIP Operation

Figure 2 below shows the PCC architecture reference model for cdma2000 systems when CMIP/PMIP address operation is used.

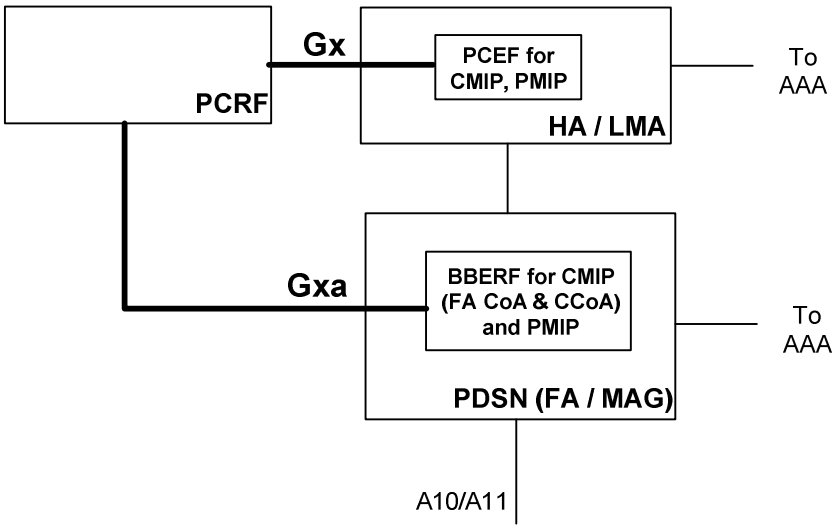

Figure 2 **PCC for cdma2000 for Non Roaming Access – CMIP/PMIP Operation**

4.2 Architecture Reference Model for Roaming With Home Routed Traffic

This section provides an overview of the Policy and Charging Control (PCC) architecture for cdma2000 networks for the roaming case with home routed traffic. In this case, the anchor point i.e., the PCEF (HA/LMA) is located in the home network.

4.2.1 CMIP/PMIP Operation

Figure 3 below shows the PCC architecture reference model for cdma2000 systems when CMIP/PMIP address operation is used for roaming with home routed traffic.

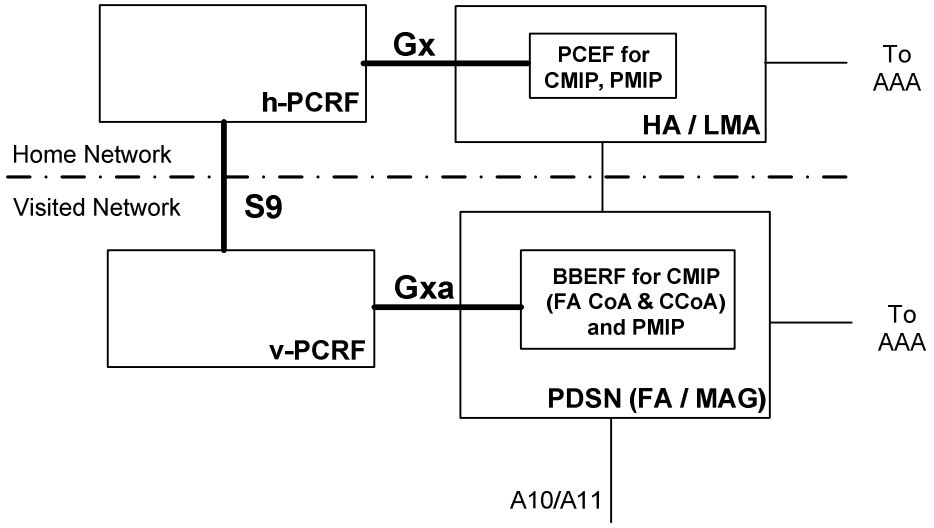

Figure 3 **PCC for cdma2000 for Roaming with Home Routed Access – CMIP/PMIP Operation**

4.3 Architecture Reference Model for Roaming With Local Breakout

This section provides an overview of the Policy and Charging Control (PCC) architecture for cdma2000 networks for the roaming case with local breakout. In this case, the anchor point i.e., the PCEF (PDSN or HA/LMA) is located in the visited network.

4.3.1 Simple IP Operation

Figure 4 below shows the PCC architecture reference model for cdma2000 systems when Simple IP address operation is used for roaming with local breakout.

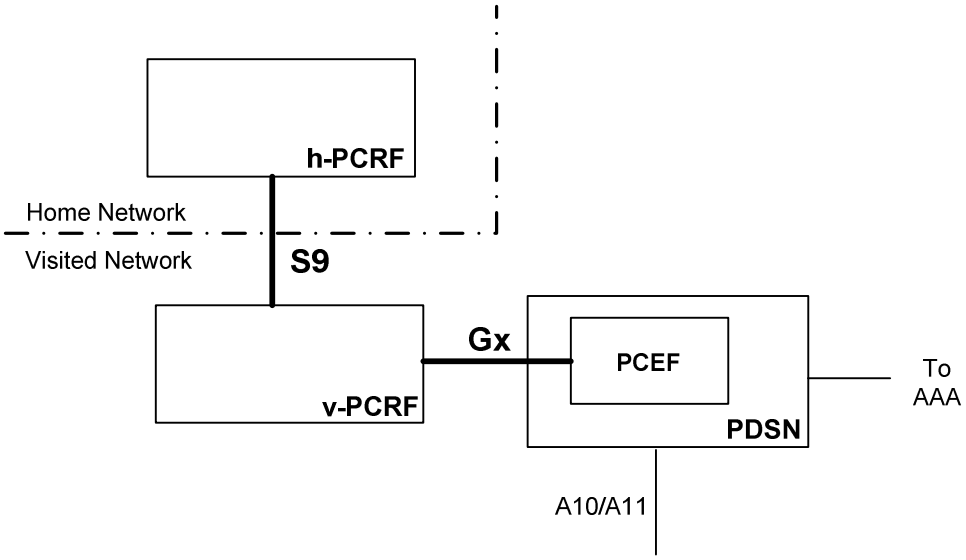

Figure 4 **PCC for cdma2000 for Roaming with Local Breakout – Simple IP Operation**

4.3.2 CMIP/PMIP Operation

Figure 5 below shows the PCC architecture reference model for cdma2000 systems when CMIP/PMIP address operation is used for roaming with local breakout.

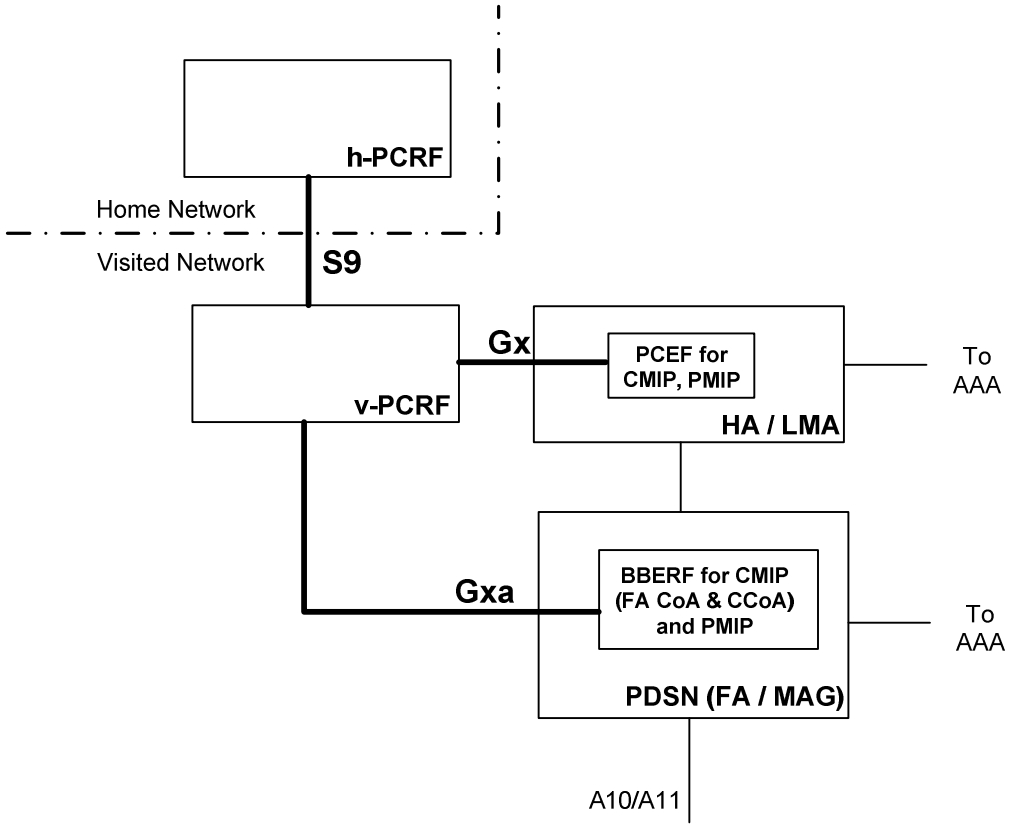

Figure 5 **PCC for cdma2000 for Roaming with Local Breakout – CMIP/PMIP Operation**

4.4 Reference Points

As illustrated in Figure 1 through Figure 5 above, PCC for cdma2000 1x and HRPD architecture reference model defines the following reference points.

4.4.1 Gx Reference Point

For Simple IP address operation, the Gx reference point connects the PCRF to the PCEF in the PDSN. For CMIP and PMIP address operation, the Gx reference point connects the PCRF to the PCEF in the HA/LMA. The protocol supported on the Gx interface is Diameter. Detailed requirements and operation of this interface are defined in 3GPP TS 23.203 [10], TS 29.212 [13] and TS 29.213 [14].

4.4.2 Gxa Reference Point

For Simple IP address operation, the Gxa reference point is not used. For CMIP and PMIP address operation, the Gxa reference point connects the PCRF to the BBERF in the PDSN. The protocol supported on the Gxa interface is Diameter. Detailed requirements and operation of this interface are defined in 3GPP TS 23.203 [10], TS 29.212 [13] and TS 29.213 [14].

4.4.3 S9 Reference Point

For roaming access, the S9 reference point connects the PCRF in the home network (hPCRF) to the PCRF in the visited network (vPCRF). Detailed requirements and operation of this interface are defined in 3GPP TS 23.203 [10], TS 29.212 [13] , TS 29.213 [14]and TS 29.215 [15].

5 PCC Operation

5.1 MS Requirements

5.1.1 MS Initiated QoS Setup

The MS shall follow the procedures specified in Chapter 4 Section 3 and Annex B in X.S0011 [6] to setup, modify and delete a QoS, except the following:

- If the MS receives ResvConf message, as specified in section 10 (Annex B) with IE List included, then the MS shall replace the evaluation precedence of the packet filters that are originally sent by the MS in the Resv message with the modified value in the ResvConf message.

Upon successful PPP renegotiation during inter-PDSN handoff, the MS shall follow the procedures specified in Chapter 4 Section 3 and Annex B in X.S0011 [6] to setup, modify and delete a QoS except the following:

- If the MS has received the MS-PDSN Version Capability Indication packet from PDSN with C9 bit of "List of PDSN Capabilities" is set to '1', then the MS should wait for network to setup the QoS for all the flows that were active prior to the PPP renegotiation and the UE wishes to maintain.

- If the MS has not received the MS-PDSN Version Capability Indication packet from PDSN, or if C9 bit of "List of PDSN Capabilities" is not set to '1', then the MS shall setup the QoS for all the UE initiated QoS flows that were active prior to the PPP renegotiation and the UE wishes to maintain.

5.1.2 Network Initiated QoS Setup

The MS shall follow the procedures specified in Chapter 4 Section 3 and Annex B in X.S0011 [6].

5.2 PDSN Requirements

5.2.1 Setting of the AVPs by the PDSN

5.2.1.1 RAT-Type AVP

The PDSN uses the Service Option received in the A11 Registration Request message for the set up of the main service connection to determine the RAT-Type AVP. For Service Option related to the use of cdma2000 1x air interface (SO33), the PDSN shall set RAT-Type AVP value to CDMA2000_1X (2000) as specified in 3GPP TS 29.212 [13]. For Service Option related to the use of cdma2000 HRPD (SO59) air interface, the PDSN shall set RAT-Type AVP value to HRPD (2001) as specified in 3GPP TS 29.212 [13].

5.2.1.2 IP-CAN-Type AVP

The PDSN shall set IP-CAN-Type AVP value to 3GPP2 (4) as specified in 3GPP TS 29.212 [13].

5.2.1.3 UE Identity AVP

The PDSN shall set UE Identity to Mobile Station Network Access Identifier (MN-NAI) received from the mobile station during PPP authentication In case the mobile station does not perform PPP for MIPv4, the PDSN shall set UE Identity to Mobile Station Network Access Identifier (MN-NAI) received from the MIP registration. Otherwise, authentication the PDSN shall construct Mobile Station NAI (MN-NAI) as specified in X.S0011 [6]. UE Identity shall be encoded as specified in RFC3588 [28].

5.2.1.4 PDN Identifier AVP

For Simple IP mode of operation, the PDSN shall set the PDN Identifier to the IP address, in ASCII format, of its interface that is connected to the external network.

For MIP/PMIP address mode of operation, the PDSN shall set the PDN Identifier to the IP address of the HA/LMA, in ASCII format.

PDN Identifier shall be encoded in the following format in APN Network Identifier AVP as specified in 3GPP TS 23.003 [10].

An IPv4 address shall be encoded as:

- "3GPP2-IP4-XX-XX-XX-XX", where the 'XX's are the 2-character representation of the hexadecimal value of the four 8-bit pieces of the address. All characters are represented in upper-case. For example, IP address 192.168.123.1 is represented as "3GPP2-IP4-C0-A8-7B-01"

An IPv6 address shall be encoded as:

- "3GPP2-IP6-XXXX-XXXX-XXXX-XXXX-XXXX-XXXX-XXXX-XXXX", where the 'XXXX's are the 4-character representation of the hexadecimal value of the eight 16-bit pieces of the address. All characters are represented in upper-case. For example, IP address 1080::8:800:200C:417A is represented as "3GPP2-IP6-1080-0000-0000-0000-0008-0800-200C-417A"

5.2.1.5 AN-GW-Address AVP

The PDSN shall set AN-GW-Address to the IP address of its interface that is connected to the external network. AN-GW-Address shall be encoded as specified in 3GPP TS 29.212 [13].

5.2.1.6 Network-Request-Support AVP

The PDSN/BBERF shall set Network-Request-Support AVP specified in 3GPP TS 29.212 [13] to 'NETWORK_REQUEST_SUPPORTED', if all of the following conditions are satisfied:

a) if Version/Capability packet as specified in X.S0011 [6] is received from the MS

b) ‘C7’ bit in the ‘List of MS Capability’ of the 3GPP2 Version Capability packet is set to ‘1’, and

c) the PDSN supports Network Initiated QoS.

Otherwise the PDSN/BBERF shall set Network-Request-Support AVP to ‘NETWORK_REQUEST_NOT_SUPPORTED’.

5.2.2 Communicating Bearer Control Mode to the MS

The PDSN shall send the MS-PDSN Version Capability Indication packet to the MS with the C9 bit of "List of PDSN Capabilities" set to ‘1’ if all of the following conditions are satisfied:

- The PDSN receives Bearer-Control-Mode AVP from the PCRF with the value set to “UE_NW (2)” as specified in 3GPP TS 29.212 [13],

- The PDSN determines to provide Network Initiated QoS to the MS,

- The PDSN has not already sent the "List of PDSN Capabilities" to the MS with the value of C9 bit set to ‘1’.

If the PDSN has already sent the MS-PDSN Version Capability Indication packet to the MS with the C9 bit of "List of PDSN Capabilities" set to ‘1’, then the PDSN shall send the MS-PDSN Version Capability Indication packet to the MS with the C9 bit of "List of PDSN Capabilities" set to ‘0’ if any of the following conditions are satisfied:

- The PDSN receives Bearer-Control-Mode AVP from the PCRF with the value not set to “UE_NW (2)” as specified in 3GPP TS 29.212 [13]

- The PDSN determines not to provide Network Initiated QoS to the MS.

5.2.3 MS Initiated QoS Setup During Simple IP Operation

The PDSN shall support the PCEF function as specified in 3GPP TS 23.203 [10], 3GPP TS 29.212 [13] and 3GPP TS 29.213 [14]. The interface between PDSN (PCEF) and the PCRF shall be Gx interface as specified in 3GPP TS 23.203 [10], 3GPP TS 29.212 [13] and 3GPP TS 29.213 [14].

The PDSN shall follow the procedures defined in Chapter 4 Section 3 and Annex B in X.S0011 [6] to support the setup, modification and deletion of QoS with the mobile station. In addition, upon receiving the Requested and Granted FlowProfileID from the access network and the RSVP Resv message from the MS, the PDSN shall perform the following:

- The PDSN shall map the Requested 3GPP2 FlowProfileID(s) and Granted 3GPP2 FlowProfileID into a single set of Requested 3GPP triple <QCI, GBR, MBR> and Granted 3GPP triple <QCI, GBR, MBR> respectively. An example of this mapping is defined in Annex A X.S0057 [8]. Whenever the FlowProfileID does not specify an MBR parameter, the MBR is assumed in the mapping table (Annex A of X.S0057 [8]) to be the same as the GBR. For FlowProfileIDs reserved for proprietary use, QoS mapping is decided by the operator’s policy.

- The PDSN shall perform IP CAN Session Modification procedure with the PCRF as specified in 3GGPP TS 23.203[10]. The PDSN shall send the Requested QCI/MBR/GBR and packet filters to validate MS requested QoS with the PCRF. The PDSN shall verify that the Granted QCI/MBR/GBR is within the Authorized QCI/MBR/GBR received from the PCRF. If the Granted QCI/MBR/GBR is not in the authorized QCI/MBR/GBR received from the PCRF, then the PDSN shall follow the policies specified by the operator.

If the PDSN determines[2] to modify the evaluation precedence value of one or more packet filters that are sent by the MS in the Resv message with the Operation Code set to either of "Create new TFT", "Add packet filters to existing TFT", or "Replace packet filters in existing TFT", then the PDSN shall include those packet filters with the modified evaluation precedence values in the IE List of the ResvConf message, as specified in section 10 (Annex B) with the Operation Code set to “Replace packet filters in existing TFT”.

5.2.4 MS Initiated QoS Setup During CMIP and PMIP Operation

The PDSN shall support the BBERF function as specified in 3GPP TS 23.203 [10], 3GPP TS 29.212 [13] and 3GPP TS 29.213 [14].

The PDSN shall support the 3GPP Gxa interface defined in 3GPP TS 23.203[10], 3GPP TS 29.212 [13] and 3GPP TS 29.213 [14]. Signaling flows related to the Gxa interface are specified in TS 29.213 [14].

The PDSN shall follow the procedures defined in Chapter 4 Section 3 and Annex B in X.S0011[6] to support the setup, modification and deletion of QoS with the mobile station. In addition, upon receiving the Requested and Granted FlowProfileID from the access network and the RSVP Resv message from the MS, the PDSN shall perform the following:

- The PDSN shall map the Requested 3GPP2 FlowProfileID(s) and Granted 3GPP2 FlowProfileID into a single set of Requested 3GPP triple <QCI, GBR, MBR> and Granted 3GPP triple <QCI, GBR, MBR> respectively. An example of this mapping is defined in Annex A of X.S0057 [8]. Whenever the FlowProfileID does not specify an MBR parameter, the MBR is assumed in the mapping table (Annex A X.S0057 [8]) to be the same as the GBR. For FlowProfileIDs reserved for proprietary use, QoS mapping is decided by the operator’s policy.

- The PDSN shall perform Gateway Control and QoS Rules Request procedure with the PCRF as specified in 3GPP TS 23.203 [10]. The PDSN shall send the Requested QCI/MBR/GBR and packet filters to validate MS requested QoS with the PCRF. The PDSN shall verify that the Granted QCI/MBR/GBR is within the Authorized QCI/MBR/GBR received from the PCRF. If the Granted QCI/MBR/GBR is not in the authorized QCI/MBR/GBR received from the PCRF, then the PDSN shall follow the policies specified by the operator.

[2] The PDSN determines whether to modify the evaluation precedence value of the packet filters based on the signaling received from PCRF, or using local policy.

If the PDSN determines[3] to modify the evaluation precedence value of one or more packet filters that are sent by the MS in the Resv message with the Operation Code set to either of "Create new TFT", "Add packet filters to existing TFT", or "Replace packet filters in existing TFT", then the PDSN shall include those packet filters with the modified evaluation precedence values in the IE List of the ResvConf message, as specified in section 10 (Annex B) with the Operation Code set to “Replace packet filters in existing TFT”.

5.2.5 Network Initiated QoS Setup During Simple IP Operation

The PDSN shall follow the procedures defined in Chapter 4 Section 3 and Annex B in X.S0011 [6] to support the setup, modification and deletion of QoS with the MS.

The PDSN shall support the PCEF function as specified in 3GPP TS 23.203 [10], 3GPP TS 29.212 [13] and 3GPP TS 29.213 [14]. The interface between PDSN (PCEF) and the PCRF shall be the Gx interface as specified in 3GPP TS 23.203 [10], 3GPP TS 29.212 [13] and 3GPP TS 29.213 [14].

Upon receiving PCC Rules Provision message from the PCRF, the PDSN (PCEF) shall map 3GPP QCI/MBR/GBR to 3GPP2 QoSFlowProfileID(s) as specified in Annex A of X.S0057 [8]. If the mapped QoSFlowProfileID(s) is not within the Subscriber QoS Profile received from the AAA server during access authentication procedures (See X.S0011 [6]), the PDSN shall send PCC Rule Provision Reject message to the PCRF. Otherwise, the PDSN shall trigger Network initiated QoS procedures as specified in X.S0011 [6] Chapter 4. Upon successful establishment of PCC rules, the PDSN shall send a PCC Rule Provision Ack message to the PCRF.

5.2.6 Network Initiated QoS Setup During CMIP and PMIP Operation

The PDSN shall follow the procedures defined in Chapter 4 Section 3 and Annex B in X.S0011 [6] to support the setup, modification and deletion of QoS with the MS.

The PDSN shall support the BBERF function as specified in 3GPP TS 23.203 [10], 3GPP TS 29.212 [13] and 3GPP TS 29.213 [14]. The PDSN shall support 3GPP Gxa interface defined in 3GPP TS 23.203 [10], 3GPP TS 29.212 [13] and 3GPP TS 29.213 [14]. Signaling flows related to the Gxa interface are specified in TS 29.213 [14].

Upon receiving Gateway Control and QoS Rules Provision message from the PCRF, the PDSN (BBERF) shall map 3GPP QCI/MBR/GBR to 3GPP2 QoSFlowProfileID(s) as specified in Annex A of X.S0057 [8]. If the mapped QoSFlowProfileID(s) is not within the Subscriber QoS Profile received from the AAA server during access authentication procedures (See X.S0011 [6]), the PDSN shall send Gateway Control and QoS Rules Provision Reject message to the PCRF. Otherwise, the PDSN shall trigger Network initiated QoS procedures as specified in X.S0011 [6] Chapter 4. Upon successful establishment of PCC rules, the PDSN shall send Gateway Control and QoS Rules Provision Ack message to the PCRF.

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[3] The PDSN determines whether to modify the evaluation precedence value of the packet filters based on the signaling received from PCRF, or using local policy.

5.3 HA Requirements

5.3.1 Setting of the AVPs by the HA

5.3.1.1 IP-CAN-Type AVP

The HA shall set IP-CAN-Type AVP value to 3GPP2 (4) as specified in 3GPP TS 29.212 [13].

5.3.1.2 UE Identity AVP

The HA shall set UE Identity to the Mobile Station Network Access Identifier (MN-NAI) received in the MIPv4 Registration Request or PMIPv4 Registration Request message. UE Identity shall be encoded as specified in RFC3588 [28].

5.3.1.3 PDN Identifier AVP

The HA shall set the PDN Identifier to its IP address, in ASCII format, on the interface facing the PDSN. PDN Identifier shall be encoded in the following format in APN Network AVP Identifier as specified in 3GPP TS 23.003 [10].

An IPv4 address shall be encoded as:

- "3GPP2-IP4-XX-XX-XX-XX", where the 'XX's are the 2-character representation of the hexadecimal value of the four 8-bit pieces of the address. All characters are represented in upper-case. For example, IP address 192.168.123.1 is represented as "3GPP2-IP4-C0-A8-7B-01"

An IPv6 address shall be encoded as:

- "3GPP2-IP6-XXXX-XXXX-XXXX-XXXX-XXXX-XXXX-XXXX-XXXX", where the 'XXXX's are the 4-character representation of the hexadecimal value of the eight 16-bit pieces of the address. All characters are represented in upper-case. For example, IP address 1080::8:800:200C:417A is represented as "3GPP2-IP6-1080-0000-0000-0000-0008-0800-200C-417A"

5.3.1.4 AN-GW-Address AVP

The HA shall set AN-GW-Address to the IP address of the PDSN received in the MIPv4 Registration Request or PMIPv4 Registration Request message. The AN-GW-Address shall be encoded as specified in 3GPP TS 29.212 [13].

5.3.2 MS Initiated QoS Setup

The HA shall support the PCEF function as specified in 3GPP TS 23.203 [10], 3GPP TS 29.212 [13] and 3GPP TS 29.213 [14]. The interface between HA (PCEF) and the PCRF shall be Gx interface as specified in 3GPP TS 23.203 [10], 3GPP TS 29.212 [13] and 3GPP TS 29.213 [14].

5.3.3 Network Initiated QoS Setup

HA requirements for Network Initiated QoS Setup shall be the same as specified for MS Initiated QoS Setup in section 5.3.3.

5.4 LMA Requirements

5.4.1 Setting of the AVPs by the LMA

5.4.1.1 IP-CAN-Type AVP

The LMA shall set IP-CAN-Type AVP value to 3GPP2 (4) as specified in 3GPP TS 29.212 [13].

5.4.1.2 UE Identity AVP

The LMA shall set UE Identity to the Mobile Station Network Access Identifier (MN-NAI) received in the MIPv6 Binding Update or PMIPv6 Binding Update message. UE Identity shall be encoded as specified in RFC3588 [28].

5.4.1.3 PDN Identifier AVP

The LMA shall set the PDN Identifier to its IP address, in ASCII format, on the interface facing the PDSN. PDN Identifier shall be encoded in the format of APN Network Identifier as specified in 3GPP TS 23.003 [10].

5.4.1.4 AN-GW-Address AVP

The LMA shall set AN-GW-Address to the IP address of the PDSN received in the MIPv6 Binding Update or PMIPv6 Binding Update message. The AN-GW-Address shall be encoded as specified in 3GPP TS 29.212 [13].

5.4.2 MS Initiated QoS Setup

The LMA shall support the PCEF function as specified in 3GPP TS 23.203 [10], 3GPP TS 29.212 [13] and 3GPP TS 29.213 [14]. The interface between LMA (PCEF) and the PCRF shall be Gx interface as specified in 3GPP TS 23.203 [10], 3GPP TS 29.212 [13] and 3GPP TS 29.213 [14].

5.4.3 Network Initiated QoS Setup

LMA requirements for Network Initiated QoS Setup shall be the same as specified for MS Initiated QoS Setup in section 5.4.2.

6 Charging

3GPP2 X.S0011 [6] provides specifications for accounting on per-reservation and/or per-IP-session basis, wherein the PDSN collects resource usage information for each mobile station related to both, the radio network usage and the data network usage. Similarly, 3GPP TS 32.240 [16], 3GPP TS 32.251 [17] and 3GPP TS 23.203 [10] provide a framework and specifications for Flow Based Bearer Charging (FBC) and domain based charging for packet data networks.

Note: 3GPP2 specifications, e.g., X.S0011 [6] use the term 'accounting' for procedures related to resource usage information for user data sessions. 3GPP specifications use the term 'charging' for similar procedures.

This section specifies offline charging procedures for PCC based cdma2000 networks. Online charging for PCC based cdma2000 networks is not specified in this release of specifications. The terms charging and accounting are used interchangeably in this specification.

6.1 Charging in cdma2000 Networks

Charging mode for per-reservation based, per-IP-session based and/or for PCC Flow Based Bearer charging (FBC) may be preconfigured in the Subscriber Profile at the HAAA server. The charging mode (Accounting-Mode) is authorized on per user basis during PPP Session Authentication. Based on the subscriber profile, the HAAA server authorizes the Accounting-Mode that shall be used for the user.

6.2 Offline PCC Charging Reference Architecture

X.S0011 [6] specifies the accounting (charging) architecture for per-reservation based or per-IP-session based accounting (charging) for cmda2000 systems. Figure 6 and 0 below illustrate the reference architecture for supporting 3GPP specified PCC offline charging in cdma2000 systems. The reference architecture maps the charging functions specified in 3GPP TS 32.240 [16] and 3GPP TS 32.251 [17] to the network functional entities supported for PCC based cdma2000 networks. The reference architecture shows the reference points also that are used for the transfer of charging information between the charging functions.

Figure 6 illustrates offline PCC charging architecture for cdma2000 systems when Simple IP address operation is used.

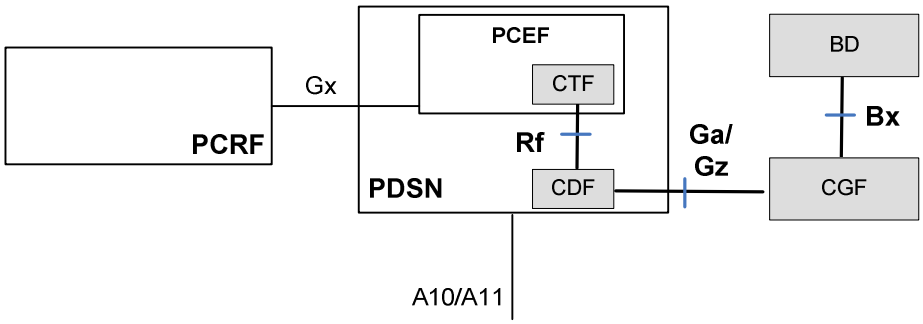

Figure 6 **PCC Offline Charging: Reference Architecture for Simple IP Operation**

0illustrates offline PCC charging architecture for cdma2000 systems when MIP and PMIP address operation are used.

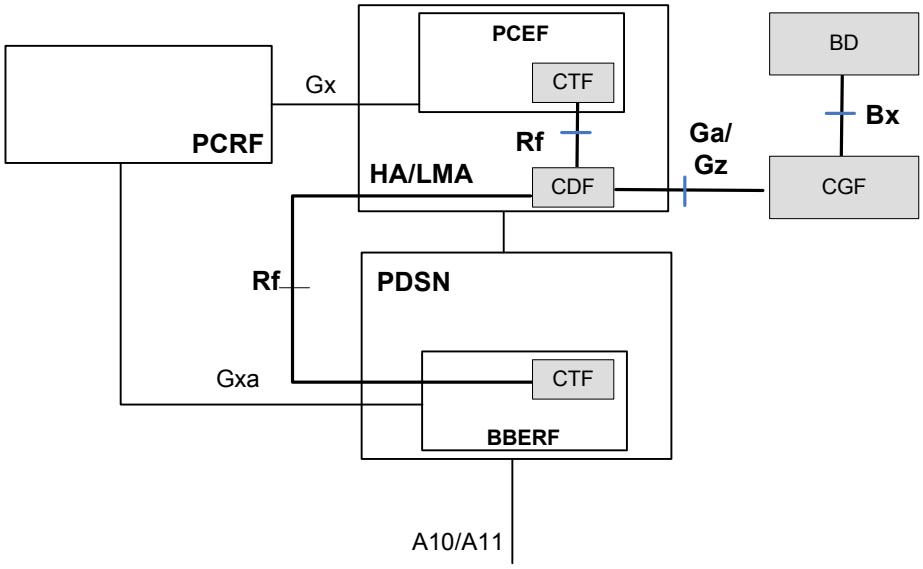

Figure 7 **PCC Offline Charging: Reference Architecture for MIP/PMIP Operation**

As illustrated in Figure 6 and 0Charging Trigger Function (CTF) is integrated with the BBERF (if supported) and the PCEF functional entities. Charging Data Function (CDF) may be located in the entity that hosts the PCEF function or may exist as a separate physical entity in the operator network. Charging Gateway Function (CGF) may be co-located with the CDF, or may be located as a separate physical entity in the operator network or in the billing domain.

6.2.1 PCC Charging Function Mapping

CTF is a mandatory component of BBERF (if supported) and the PCEF. CDF and the CGF may be implemented in any of the ways specified below in this clause. The entity relationships between the CTF, CDF and CGF functions shall be as specified in 3GPP TS 32.240 [16].

For Simple IP operation mode BBERF is not supported and the PDSN hosts the PCEF function. CTF shall be integrated in the PCEF/PDSN. CDF may be located in the PDSN or located as a separate physical entity in the operator network. CGF may be located in the PDSN along with the CDF, or located as a separate physical entity in operator network or in the billing domain.

For MIP and PMIP operation mode, the BBERF function is hosted in the PDSN/MAG. The PCEF function is hosted by the HA/LMA. CTF shall be integrated with the BBERF/PDSN. CTF shall be integrated with the PCEF/HA/LMA as well. CDF may be located in the HA/LMA or located as a separate physical entity in the operator network. CGF may be located in the HA/LMA along with the CDF, or located as a separate physical entity in operator network or in the billing domain

6.2.2 Reference Points

As illustrated in Figure 6 and 0above, offline charging reference model supports the following reference points:

6.2.3 Rf Reference Point

Rf reference point supports interactions between Charging Trigger Function and Charging Data Function. Information flow and protocol capabilities across this reference point shall be as specified in 3GPP TS 32.240 [16]. The interface application for Rf reference points shall be as specified in 3GPP TS 32.299 [21].

6.2.4 Ga/Gz Reference Point

Ga/Gz reference point supports interactions between Charging Data Function and Charging Gateway Function. Information flow and protocol capabilities across this reference point shall be as specified in 3GPP TS 32.240 [16]. The interface application for Ga/Gz reference points shall be as specified in 3GPP TS 32.295 [18].

6.2.5 Bx Reference Point

Bx reference point supports interactions between the Charging Gateway Function and the Billing Domain. Information flow and protocol capabilities across this reference point shall be as specified in 3GPP TS 32.240 [16]. The interface application for Bx reference points shall be as specified in 3GPP TS 32.297 [19].

6.3 Offline PCC Charging Procedures

The CTF function in the BBERF shall collect charging information for each mobile station. The behavior of the CTF/BBERF with respect to the definition of the chargeable events, the matching of charging events and the information elements to collect shall be aligned with the charging functionality specified for the S-GW in 3GPP TS 23.401 [12] and offline flow based bearer charging aspects as specified in 3GPP TS 32.251 [17].

The CTF function in the PCEF shall collect charging information for each mobile station. The behavior of the CTF/PCEF with respect to the definition of the chargeable events, the matching of charging events and the information elements to collect shall be aligned with the charging functionality specified for the P-GW in 3GPP TS 23.203 [10] and offline flow based bearer charging aspects as specified in 3GPP TS 32.251 [17].

The CDF shall use the information contained in the charging events received from the CTF(s) to construct the CDRs. The content and format of these CDRs shall be as specified for offline flow based bearer charging in 3GPP TS 32.251 [17].

The CDRs produced by the CDF shall be transferred to the Charging Gateway Function (CGF) via the Ga/Gz reference point. The CGF transfers CDR file(s) to the Billing Domain via. Bx reference point. Functional requirements for the CGF are specified in 3GPP TS 32.240 [16].

6.4 Charging Modes

Accounting-Mode VSA specified in X.S0054-910 [7] is used to determine the charging mode. If Accounting-Mode VSA is not received from the HAAA server during PPP Session Authentication in RADIUS Access Accept message and for an unrecognized Accounting-Mode value, charging shall be performed according to local policy.

If Accounting-Mode VSA is received from the HAAA server during PPP Session Authentication in RADIUS Access Accept message, charging shall be performed as indicated by the Accounting-Mode VSA value (section 6.5).

6.4.1 Accounting-Mode VSA

Accounting-Mode VSA specified in X.S0054-910 [7] indicates whether charging is performed for Per-Reservation and/or per IP-Session and/or for PCC Flow Based Bearers Charging (FBC). This attribute may be sent in the RADIUS Access-Accept from the HAAA server during PPP Session Authentication.

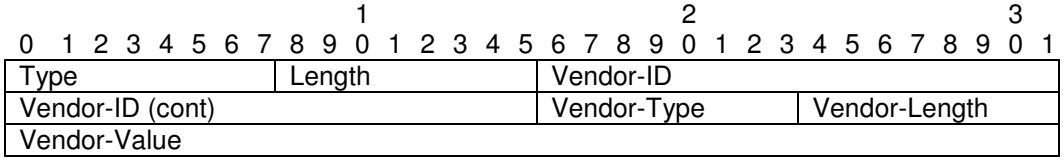

Figure 8 **Accounting Mode VSA**

Type: 26

Length: 12

Vendor ID: 5535

Vendor-Type: 198

Vendor-Length: 6

Vendor-Value:

1: Per-Reservation/IP-Session Accounting (specified in X.S0054-910 [7])

2: Per IP-Session Accounting (specified in X.S0054-910 [7])

3: PCC Flow Based Bearer Offline Charging only

4: Per-Reservation/IP-Session accounting + PCC Flow Based Bearer Offline Charging

5: Per IP-Session accounting + PCC Flow Based Bearer Offline Charging

Other values are reserved

6.5 Performing PCC Charging

PCC charging mode is determined as specified in section 6.4 above. Remote Address accounting procedures specified in X.S0011 [6] shall not be performed.

6.5.1 Per-Reservation/IP-Session Accounting

Per-Reservation/IP-Session accounting shall be performed as specified in X.S0054 [7] and X.S0011 [6].

6.5.2 Per IP-Session Accounting

Per IP-Session accounting shall be performed as specified in X.S0054 [7] and X.S0011 [6].

6.5.3 PCC Flow Based Bearer Offline Charging

PCC flow based bearer offline charging shall be performed as specified for offline Flow Based Bearer Charging (FBC) procedures in 3GPP TS 32.251 [17].

7 Call Flows

The requirements and procedures in this section are per X.S0011 [6], X.S0061 [9]and 3GPP TS 23.203 [10]. In the call flow illustrations that follow, Policy and Charging Control (PCC) related procedures have been highlighted. Details of other procedures shall be as specified in X.S0011 [6] and X.S0061 [9] specifications.

Both roaming and non-roaming scenarios are illustrated. In the roaming case, the vPCRF acts as an intermediary between the PDSN/PCEF or PDSN/BBERF in the visited network and the hPCRF in the home network. For the local breakout of roaming scenario, the vPCRF acts as an intermediary between the HA/PCEF in the visited network and the hPCRF in the home network. vPCRF proxies Gateway Control session and IP-CAN session related messages between the entities in the visited network and the home network. For non-roaming case, the vPCRF is not involved.

7.1 Simple IP Operation With PCC

PCC operations for Simple IP are specified in section 7.1.1, section 7.1.2 and section 7.1.3 below. Section 7.1.1 specifies PPP and PCC Session Establishment procedures. Section 7.1.2 and section 7.1.3 specify MS Initiated and NW Initiated QoS Resource Request, Modification and Release procedures respectively.

7.1.1 PPP and PCC Session Establishment

PPP and PCC session establishment procedures for Simple IPv4 (RFC791 [22]) and Simple IPv6 (RFC2460 [23]) operation are illustrated in section 7.1.1.1 and section 7.1.1.2 respectively.

7.1.1.1 Simple IPv4 Addressing

PPP and PCC session establishment procedures for Simple IPv4 (RFC791 [22]) are illustrated in Figure 9 .

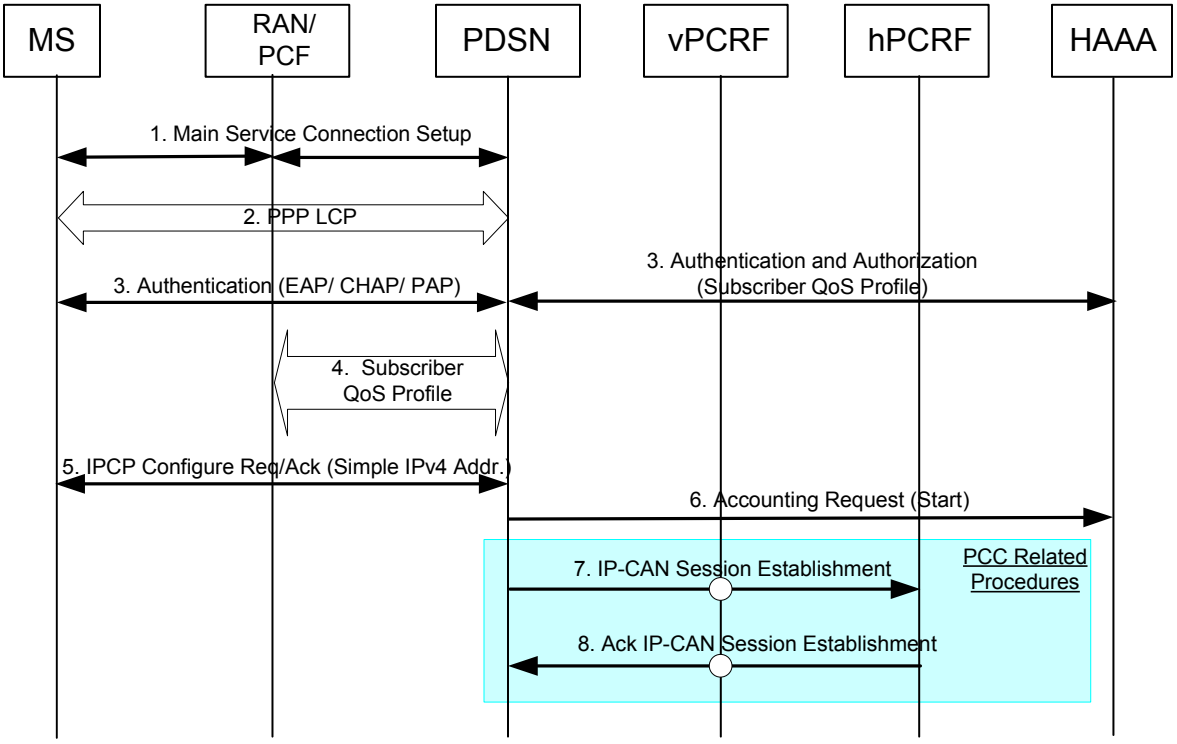

Figure 9 **PPP and PCC Session Establishment With Simple IPv4**

1. The Main Service Connection is setup.
2. PPP LCP negotiation occurs and authentication protocol is selected.
3. Access authentication and authorization is performed using the selected authentication protocol. The MS exchanges authentication related messages with the PDSN. In turn, the PDSN performs authentication and authorization with the AAA server using AAA Access Request/Accept messages. On successful authorization, information such as Subscriber QoS Profile is returned to the PDSN in AAA Access Accept message.
4. The PDSN passes the relevant attributes received in Subscriber QoS Profile to the RAN.
5. The MS and the PDSN perform IPCP procedures for the allocation of an IP address. In the present scenario, an IP address is assigned to the MS as per Simple IPv4 address assignment procedures.
6. The PDSN sends an AAA Accounting Request (Start) message that includes MS's NAI and IP address to the AAA server.
7. The PDSN/PCEF initiates IP-CAN Session Establishment procedures for the MS with the PCRF. The PDSN/PCEF includes the following information in the IP-CAN Session Establishment message: IP-CAN Type, RAT-Type, UE Identity (e.g. MN-NAI), PDN Identifier, the IP Address(es) (if known); and if available, the IP-CAN Bearer Control Mode supported by the MS and the PDSN, and the default charging method, if available. The PCRF establishes an IP-CAN session

for the MS and chooses IP-CAN Bearer Control Mode. PDN Identifier, IP Address(es) and UE Identity enable identification of the IP-CAN session.

8. The PCRF sends an Acknowledge of IP-CAN Session Establishment to the PDSN/PCEF. The PCRF provides information that includes: PCC Rules to activate, Event Triggers to report and IP-CAN bearer establishment mode. Policy and Charging Rules allow enforcement of the policy associated with the IP CAN session, including the QoS Rules to perform bearer binding. Event Triggers indicate to the PDSN/PCEF what events must be reported to the PCRF.

7.1.1.2 Simple IPv6 Addressing

PPP and PCC session establishment procedures for Simple IPv6 (RFC2460 [23]) are illustrated in Figure 10 .

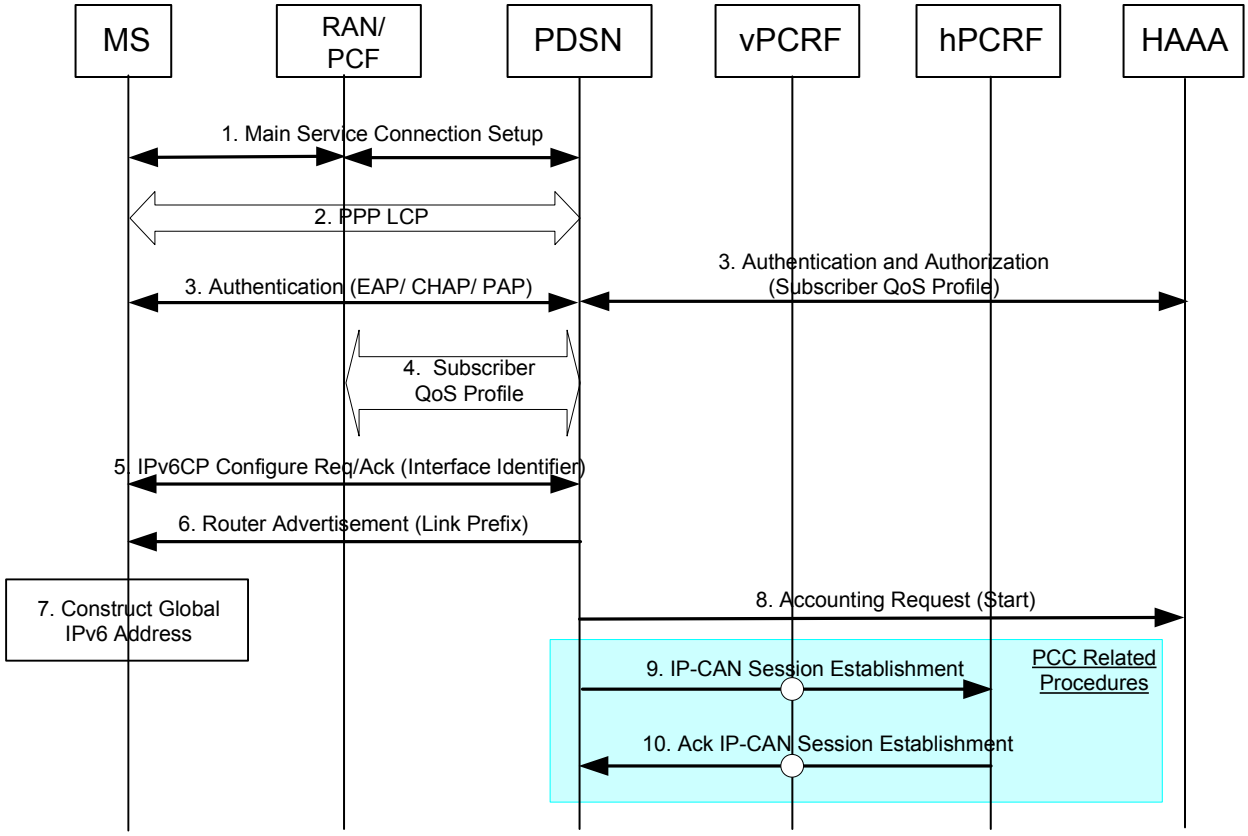

Figure 10 **PPP and PCC Session Establishment With Simple IPv6**

1. The Main Service Connection is setup.
2. PPP LCP negotiation occurs and authentication protocol is selected. MS signals that it supports Simple IPv6 via MS-PDSN Version Capability Indication (C2 bit set to 1).
3. Access authentication and authorization is performed using the selected authentication protocol. The MS exchanges authentication related messages with the PDSN. In turn, the PDSN performs authentication and authorization with the AAA server using AAA Access Request/Accept messages. On successful authorization, information such as Subscriber QoS Profile is returned to the PDSN in AAA Access Accept message. /64 link prefix may also be assigned by the AAA server.
4. The PDSN passes the relevant attributes received in Subscriber QoS Profile to the RAN.
5. The MS and the PDSN perform IPv6CP (RFC 2472 [24]) procedures for Interface Identifier (IID) negotiation. The MS and the PDSN construct the link-local IPv6 address by pre-pending the link-local prefix FE80::/64 to the negotiated IID.
6. The PDSN transmits initial unsolicited Router Advertisement (RA) messages on the PPP link using its link-local address as the source address. The PDSN allocates a globally unique /64 Prefix for the PPP link and includes it in the RA message to the MS.
7. The MS constructs global IPv6 address by pre-pending the /64 PPP link prefix received in the Router Advertisement messages to the Interface Identifier negotiated during the IPv6CP negotiations, or to the Interface Identifiers generated using techniques defined in RFC 3041 [27].
8. The PDSN sends an AAA Accounting Request (Start) message that includes MS's NAI and IPv6 address to the AAA server.
9. The PDSN/PCEF initiates IP-CAN Session Establishment procedures for the MS with the PCRF. The PDSN/PCEF includes the following information in the IP-CAN Session Establishment message: IP-CAN Type, RAT-Type, UE Identity (e.g. MN-NAI), PDN Identifier, the IP Address(es) (if known); and if available, the IP-CAN Bearer Control Mode supported by the MS and the PDSN, and the default charging method, if available. The PCRF establishes an IP-CAN session for the MS and chooses IP-CAN Bearer Control Mode. PDN Identifier, IP Address(es) and UE Identity enable identification of the IP-CAN session.
10. The PCRF sends an Acknowledge of IP-CAN Session Establishment to the PDSN/PCEF. The PCRF provides information that includes: PCC Rules to activate, Event Triggers to report and IP-CAN bearer establishment mode. Policy and Charging Rules allow enforcement of the policy associated with the IP CAN session, including the QoS Rules to perform bearer binding. Event Triggers indicate to the PDSN/PCEF what events must be reported to the PCRF.

7.1.2 MS Initiated Resource Request and Release

MS initiated resource request and release procedures for Simple IP operation are illustrated in Figure 11 .

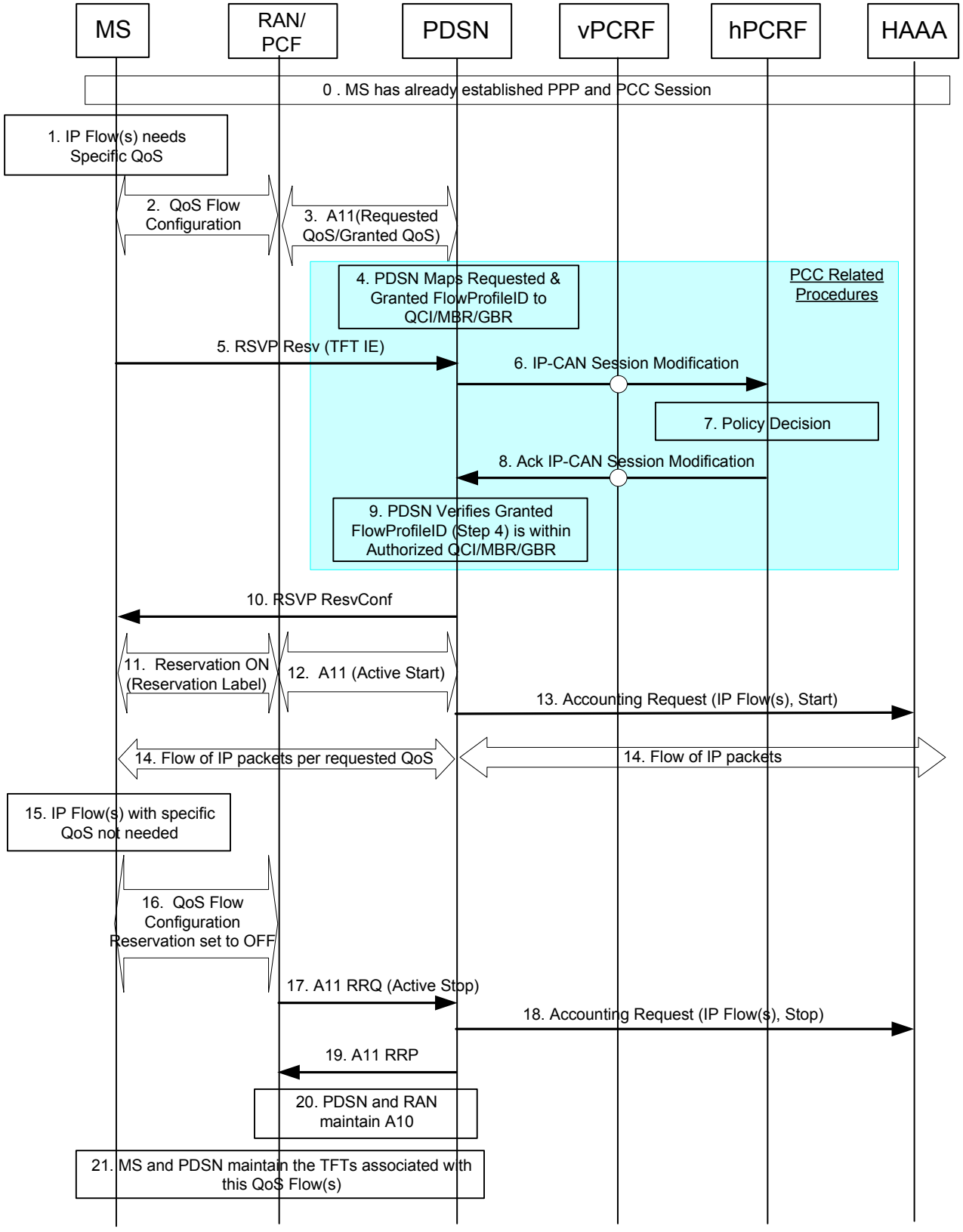

Figure 11 **MS Initiated Resource Request and Release With Simple IP**

1. As a result of user actions and/or application level signaling etc., the MS becomes aware of IP flow(s) that needs a specific QoS.
2. The MS performs HRPD QoS establishment procedures defined in C.S0024 [4]/ C.S0063 [5] using the Requested FlowProfileID determined from the QoS requirements in Step 1. There are two possible sequences that can occur at this step. If a new QoS link flow connection is needed to carry the new flow(s) over the air interface, then the RAN sets up a new air interface link flow. If the RAN decides to carry the flow(s) on an existing link flow, it then reconfigures the parameters of that link flow.
3. If a new link flow is needed, a new A10 connection is also established. The RAN/PCF sends an A11-Registration Request message to the PDSN indicating the GRE key, the Requested QoS information, and Granted QoS information for the flow. The A11 message includes the FLOW_ID. If a new QoS link flow is not needed, the RAN/PCF sends an A11-Registration Request message to the PDSN indicating the GRE key, FLOW_ID, and the modified Granted QoS information for the existing connection (if required). The PDSN examines the QoS requested by the MS and compares it to the QoS authorized for the MS in step 3, Figure 9 and Figure 10 (section 7.1.1.1 and section 7.1.1.2 resp). If there is a discrepancy, the PDSN applies operator policy, for example remove the flow(s) or disconnect PPP connection
4. The PDSN maps the Requested FlowProfileID and the Granted FlowProfileID from Step 3 into a set of QCI/MBR/GBR parameters. The mapping is performed as per 'Annex A – Mapping QoS between 3GPP and 3GPP2' specified in X.S0057 [8].
5. The MS sends an RSVP Resv message to the PDSN to associate the selected Reservation (determined in Step 2) with the appropriate and TFTs. The Resv message is sent over the main service connection. The TFTs include the Flow-ID and packet filters associated with the requested Reservation. The Transaction ID in the RSVP Resv message is dynamically allocated by the MS. This message can be sent in parallel with the start of the signaling in Step 2.
6. The PDSN/PCEF sends an IP-CAN Session Modification request message including Requested QCI/MBR/GBR and packet filters to validate MS requested QoS to the PCRF.
7. The PCRF correlates the IP-CAN Session Modification request with an existing session. The PCRF stores the received Requested QCI/MBR/GBR parameters. The PCRF performs authorization and makes policy decision as needed.
8. The PCRF sends an Acknowledge of IP-CAN Session Modification (PCC Rules, Event Triggers etc) to the PDSN/PCEF. PCC Rules include the Authorized QCI/MBR/GBR parameters.
9. The PDSN/PCEF verifies that Granted FlowProfileID (Step 4) is within the Authorized QCI/MBR/GBR received from the PCRF at Step-8. If the Granted FlowProfileID is not within the Authorized QCI/MBR/GBR, then the PDSN executes operator defined policy.
10. The PDSN acknowledges Resv message with a ResvConf message.
11. The MS triggers the transition of the Reservation to the Open state.

12. Once the air interface Reservation is transitioned to the Open state, the RAN triggers an A11-Registration Request (Active Start) message for this Reservation.
13. The PDSN sends a AAA Accounting Request (IP Flow(s), Start) message to the AAA server.
14. At this stage the user/application IP packets flow between the MS and the peer node per the Granted QoS.
15. As a result of user actions and/or application level signaling etc, the MS becomes aware that IP flow(s) with specific QoS is not needed.
16. The MS sends a request to the RAN to set the radio Reservation for the bearer to the Off state, and the RAN acknowledges the change to the Off state.
17. The RAN/PCF sends and A11-Registration Request message to the PDSN with Active Stop indication.
18. The PDSN sends a AAA Accounting Request (IP Flow(s), Stop) message to the AAA server.
19. The PDSN acknowledges the A11-Registration Request message with A11-Registration Reply message.
20. The RAN/PCF and the PDSN maintain the A10 connection used for the QoS flow(s). This A10 connection may be reused later for the same IP flow, e.g., from another VoIP call to the same IP address on the MS. Such reuse would involve only the setting of the radio Reservation state to the ON state, and the sending of the Active Start Airlink Record to the PDSN.
21. The MS and the PDSN maintain the TFTs for the QoS flow(s).

7.1.3 Network Initiated Resource Request and Release

Network Initiated resource request and release procedures for Simple IP operation are illustrated in Figure 12 .

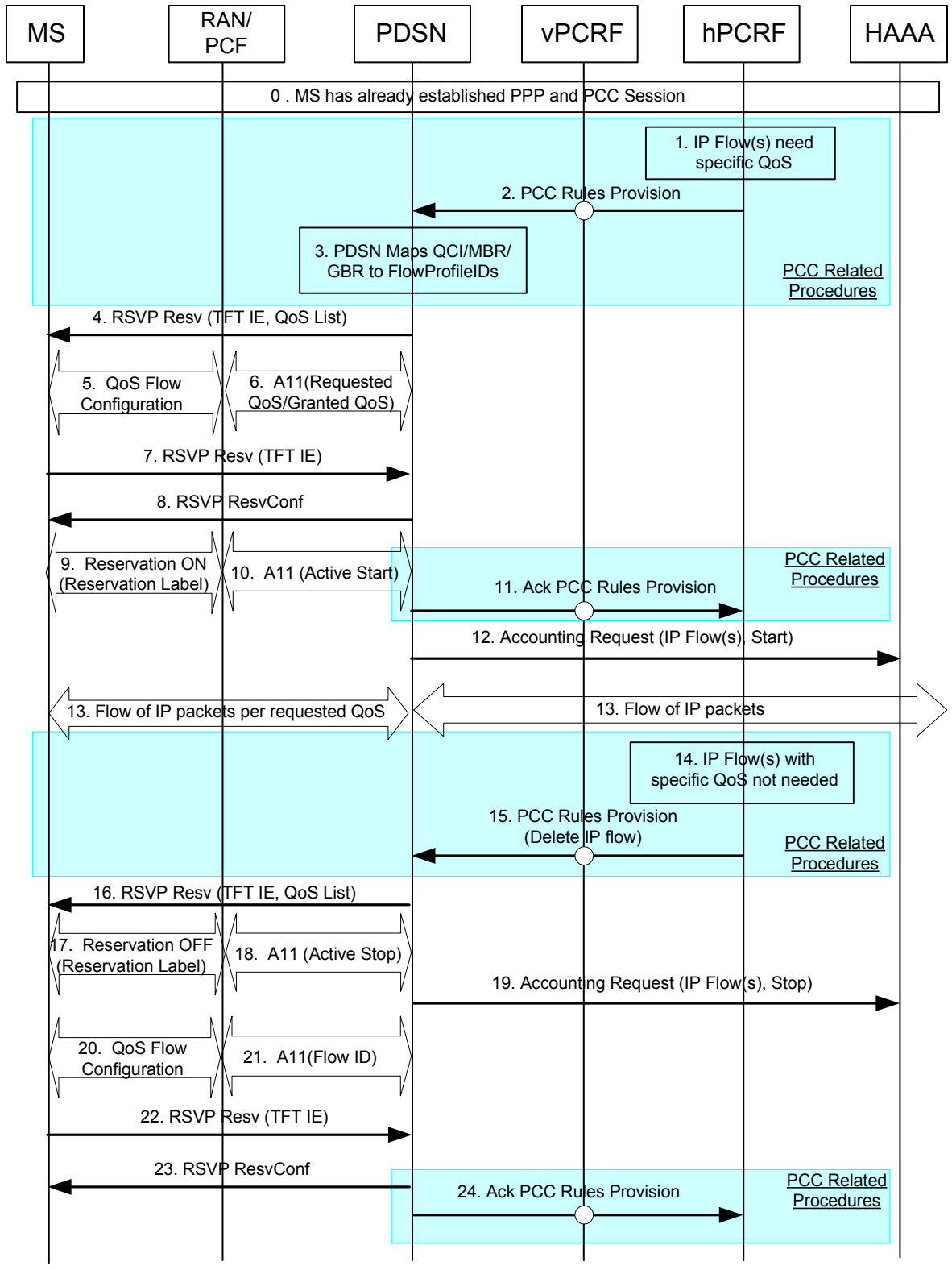

Figure 12 **NW Initiated Resource Request and Release With Simple IP**

1. As a result of interactions with the Application Function or otherwise, the PCRF becomes aware of IP flow(s) that needs a specific QoS.
2. The PCRF sends Policy and Charging Rules Provision (PCC Rules, Event Triggers, Event Report) to the PDSN/PCEF. PCC Rules include the Requested QCI/MBR/GBR parameters.
3. The PDSN maps the received QCI/MBR/GBR parameters to (a list of) FlowProfileID(s). The mapping is performed as per 'Annex A – Mapping QoS between 3GPP and 3GPP2' specified in X.S0057 [8].
4. If the QoS in the (list of) FlowProfileIDs received from the PCRF is within the subscriber QoS Profile received in Step 3 of Figure 9 and Figure 10 (section 7.1.1.1 and 7.1.1.2 resp.), or if the operator policy permits, the PDSN sends an RSVP Resv message with OpCode set to 'Initiate Flow Request' to the MS. The RSVP message is transported over the main service connection and includes the UL/DL packet filter(s), QoS list that includes the FlowProfileIDs determined in Step 3, and a Transaction ID.
5. Note: If the PDSN/PCEF cannot map QCI/MBR/GBR to any authorized FlowProfileID received from the AAA server in Step 3 Figure 9 and Figure 10 in section 7.1.1.1 and section 7.1.1.2 respectively, and the PDSN/PCEF determines to reject the PCEF request based on operator policy, the PDSN/PCEF rejects PCC Rules Provision from the PCRF. No further action is taken by the PDSN to establish the PCRF requested QoS on the Service Connection with the MS. The PCRF may choose to resubmit PCC Rules Provision with a different set of QCI/MBR/GBR parameters (Step 2). The MS performs standard QoS establishment procedures defined in C.S0024 [4] and in C.S0063 [5] using a FlowProfileID from Step 4. There are two possible sequences that can occur at this step. If a new QoS link flow connection is needed to carry the new flow(s) over the air interface, then the RAN sets up a new air interface link flow. If the RAN decides to carry the flow(s) on an existing link flow, it then reconfigures the parameters of that link flow.
6. If a new link flow is needed, a new A10 connection is also established. The RAN/PCF sends an A11-Registration Request message to the PDSN indicating the GRE key, the Requested QoS information, and the Granted QoS information for the flow. The Granted QoS information includes the FLOW_ID. If a new QoS link flow is not needed, the RAN/PCF sends an A11-Registration Request message to the PDSN indicating the GRE key, FLOW_ID, and the modified Granted QoS information for the existing connection (if required). The PDSN examines the QoS selected by the MS (in Step 5) and validates it against the (list of) FlowProfileIDs requested by the PCRF in Step 3.
7. The MS sends an RSVP Resv message to the PDSN to associate the selected Reservation (determined in Step 5) with the appropriate TFTs. The Resv message is sent over the main service connection. The message includes the same UL/DL TFTs and Transaction ID received in step 4. This message can be sent in parallel with the start of the signalling in Step 5. This message is also used as an acknowledgement to the RSVP Resv message in Step 4.
8. The PDSN acknowledges the RSVP Resv message it received in Step 7 by sending a ResvConf message to the MS.
9. The MS triggers the transition to the Open state.
10. Once the air interface Reservation is transitioned to the Open state, the RAN triggers an A11-Registration Request (Active Start) message for this Reservation.

11. The PDSN/PCEF sends Acknowledge PCC Rules Provision (accept or reject of the PCC Rules Provision) to the PCRF. This message may be sent at anytime after Step 7.
12. The PDSN sends a AAA Accounting Request (IP Flow(s), Start) message to the AAA server.
13. At this stage the user/application IP packets flow between the MS and the peer node as per the Granted QoS.
14. As a result of interactions with the Application Function or otherwise, the PCRF becomes aware that IP flow(s) with the specific QoS is not needed.
15. The PCRF sends Policy and Charging Rules Provision to the PDSN/PCEF. Parameters in PCC Rules indicate the IP flow(s) for which QoS is not needed.
16. The PDSN sends an RSVP Resv message to the MS with OpCode set to 'Initiate Delete Packet Filter from Existing TFT' indicating deletion of the desired IP flow(s).
17. The MS sends a request to the RAN to set the radio Reservation for the bearer to the Off state, and the RAN acknowledges the change to the Off state.
18. The RAN/PCF sends and A11-Registration Request message to the PDSN with Active Stop indication to stop the accounting for this bearer connection.
19. The PDSN sends a AAA Accounting Request (IP Flow(s), Stop) message to the AAA server.
20. The MS performs HRPD procedures to reconfigure the air interface in order to remove or modify the requested Reservation(s). If the last Reservation associated with the link flow is removed, the link flow itself is also removed.
21. The RAN/PCF sends an A11-RRQ message to the PDSN indicating the removed Flow ID(s). If the last Flow ID associated with the auxiliary A10 is removed, the auxiliary A10 itself is also removed,
22. The MS sends a RSVP Resv message with OpCode set to 'Initiate Delete Packet Filter from Existing TFT' to indicate to the PDSN which flow(s) have been removed. The TFT IE contains the list of flow identifier(s) for which filters have been deleted. The Transaction ID carried in this message is the same as the Transaction ID carried in the Resv message in step 16. This message is also used as an acknowledgement to the Resv message in Step 16. This message may be sent in parallel with or at anytime after Step 20.
23. The PDSN acknowledges successful update of the IP flow mapping information by sending a ResvConf message to the MS.
24. The PDSN/PCEF sends Acknowledge PCC Rules Provision (accept or reject of the PCC Rules Provision) to the PCRF. The PDSN/PCRF may return Acknowledgment PCC Rules Provision at anytime after Step 22.

7.2 MIP Operation With PCC

PCC operations for MIP are specified in section 7.2.1, section 7.2.2 and section 7.2.3 below. Section 7.2.1 specifies PPP and PCC Session Establishment procedures. Section 7.2.2 and section 7.2.3 specify MS Initiated and NW Initiated QoS Resource Request, Modification and Release procedures respectively.

7.2.1 PPP and PCC Session Establishment

PPP and PCC session establishment procedures for MIPv4 operation and MIPv6 operation are illustrated in sections 7.2.1.1 and 7.2.1.2 respectively.

7.2.1.1 Mobile IPv4 Addressing

PPP and PCC session establishment procedures for MIPv4 only operation are illustrated in Figure 13 .

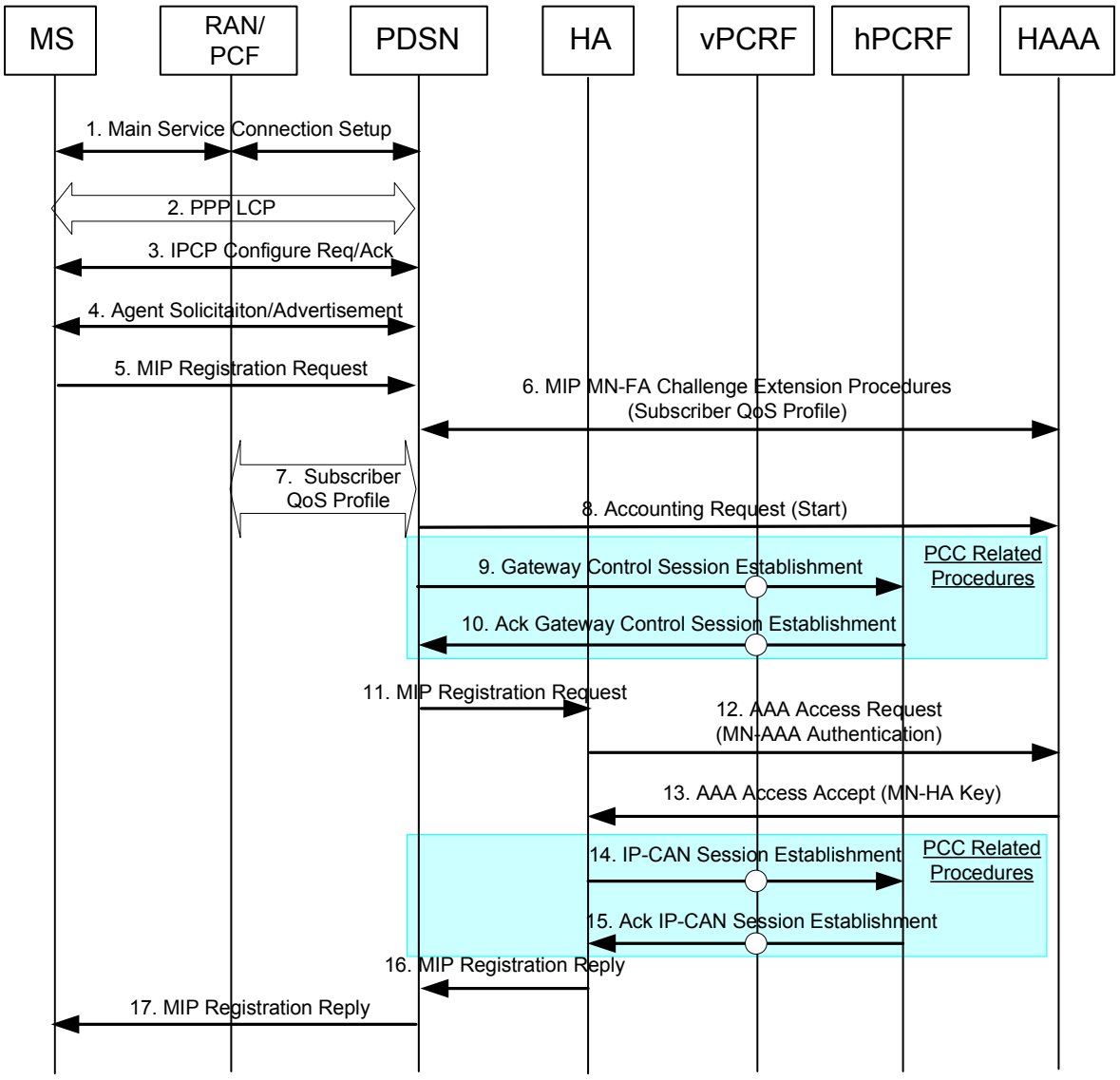

Figure 13 **PPP and PCC Session Establishment With Mobile IPv4**

1. The Main Service Connection is setup.
2. PPP LCP negotiation occurs and authentication protocol is selected.
3. The MS and the PDSN perform IPCP procedures. For MIPv4 only, the MS does not include the IP Address Configuration Option in the IPCP Configuration-Request message to the PDSN.
4. The PDSN begins transmission of an operator configurable number of Agent Advertisements following establishment or re-negotiation of the PPP, or upon receipt of an Agent Solicitation message from the MS.
5. The MS sends a MIPv4 Registration Request message to the PDSN that includes MN-FA Challenge Extension (RFC 3012 [25]). Appropriate settings of the HoA and HA fields are used for dynamic Home Address and Home Agent assignment.
6. On initial mobile access, the PDSN authenticates and authorizes the MS with the AAA server using FAC authentication information by the use of AAA Access Request/Accept messages. On successful authorization, information such as Subscriber QoS Profile, Home Agent Address and other information is returned to the PDSN in AAA Access Accept message.
7. The PDSN passes relevant attributes received in Subscriber QoS Profile to the RAN.
8. Anytime after Step 6, the PDSN sends a AAA Accounting Request (Start) message including MS's NAI and Home Address to the AAA server.
9. The PDSN/BBERF initiates Gateway Control Session Establishment procedures for this packet data session with the PCRF. The PDSN/BBERF includes the following information in the Gateway Control Session Establishment message: IP-CAN Type, RAT-Type, UE Identity (e.g., MN NAI), PDN Identifier, the Home Address (if known), AN-GW-Address (PDSN Address); and if available, the IP-CAN Bearer Control Mode supported by the MS and the PDSN, and the default charging method, if available. The PCRF establishes a Gateway Control session for the packet data session and chooses IP-CAN Bearer Control Mode to be used. The selected Bearer Control Mode applies during the Gateway Control session. PDN Identifier, Home Address and UE Identity enable the identification of the Gateway Control session at the PCRF. The PCRF may generate PCC Rule(s) in preparation for the anticipated IP-CAN session and derive the QoS Rules from them.
10. The PCRF returns Acknowledge of Gateway Control Session Establishment to the PDSN/BBERF. The PCRF includes the QoS Rules, Event Triggers and the chosen IP-CAN bearer establishment mode generated in Step 9. QoS Rules are employed by the PDSN to perform bearer binding. Event Triggers indicate to the PDSN/BBERF what events must be reported to the PCRF.
11. Anytime after Step 6, the PDSN forwards the MIPv4 Registration Request message to the selected/assigned HA,
12. At initial registration, if the HA does not have the MN-HA shared key, it retrieves the information from the AAA server. The HA sends an Access Request message to the AAA server and the MN-AAA key used for the purpose of authentication and retrieving the MN-HA key.
13. On successful authentication, the AAA server returns AAA Access Accept message to the HA that includes the MN-HA key.
14. The HA/PCEF initiates IP-CAN Session Establishment procedures with the PCRF. The HA/PCEF provides information such as UE Identity (MN-NAI), PDN Identifier, IP Address (Home Address) etc. to the PCRF that are used to identify

the IP-CAN session and associate the Gateway Control Session established in Steps 9 and 10.

15. The PCRF sends an Acknowledge of IP-CAN Session Establishment to the HA/PCEF. The PCRF may include the following information: PCC Rules to activate and Event Triggers to report. Policy and Charging Rules allow enforcement of the policy associated with the IP CAN session. Event Triggers indicate to the HA/PCEF what events must be reported to the PCRF.
16. Anytime after Step 13, the HA authenticates the MIP Registration Request received from the PDSN. On successful authentication, the HA returns MIP Registration Reply message to the PDSN that includes the Home Address and 'success' code.
17. Upon receiving a MIP Registration Reply from the HA with successful registration indication (code 0), the PDSN updates the mobility binding for the MS. The PDSN sends MIP Registration Reply to the MS.

7.2.1.2 Mobile IPv6 Addressing

PPP and PCC session establishment procedures for MIPv6 only operation are illustrated in Figure 14 .

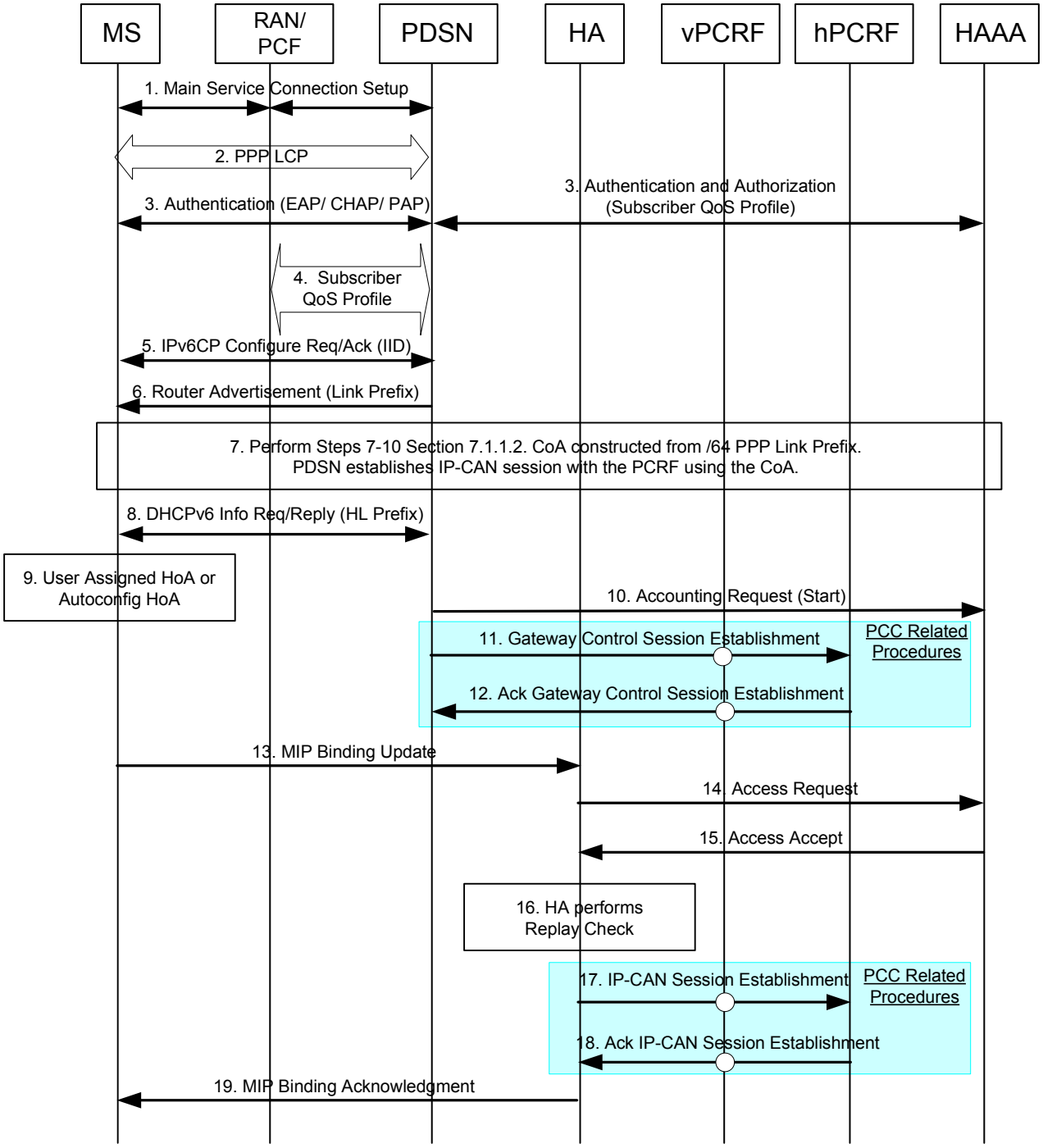

Figure 14 **PPP and PCC Session Establishment With Mobile IPv6**

1. The Main Service Connection is setup.

2. PPP LCP negotiation occurs and authentication protocol is selected. The MS signals that it supports MIPv6 via MS-PDSN Version Capability Indication (C3 bit set to 1). The PDSN allocates a globally unique /64 Prefix for the PPP link.

3. Access authentication and authorization is performed using the selected authentication protocol. The MS exchanges authentication related messages with the PDSN. In turn, the PDSN performs authentication and authorization with the AAA server using AAA Access Request/Accept messages. For a user authorized for MIPv6 access, Home Agent (HA) and a unique Home Link Prefix (HL Prefix) are allocated by the Home/Visited AAA server during access authentication (PPP setup). /64 PPP link prefix may also be assigned by the Home/Visited AAA server. On successful authorization, information such as Subscriber QoS Profile and MIPv6 bootstrap information are returned to the PDSN in AAA Access Accept message. The PDSN caches such information. The MS obtains such bootstrap information from the PDSN using stateless DHCPv6 Information Request message (Step 8).

4. The PDSN passes the relevant attributes received in Subscriber QoS Profile to the RAN.

5. The MS and the PDSN perform IPv6CP procedures for Interface Identifier (IID) negotiation. The MS and the PDSN construct the link-local IPv6 address by pre-pending the link-local prefix FE80::/64 to the negotiated IID .

6. The PDSN transmits initial unsolicited Router Advertisement (RA) messages on the PPP link using its link-local address as the source address. The PDSN includes the allocated /64 link prefix in the RA message to the MS.

7. Steps 7-10 in Figure 10 section 7.1.1.2 (Simple IPv6 Addressing) are performed. The MS uses the global IPv6 address constructed with /64 PPP link prefix acquired from the PDSN as the Care-of-Address (CoA) during MIPv6 operation. The PDSN sends an Accounting Request (Start) message that includes MS's NAI and the constructed CoA to the AAA server. The PDSN establishes an IP-CAN session with the PCRF as per procedures in Steps 9-10, Figure 10 section 7.1.1.2 using the constructed CoA.

8. The MS requests MIPv6 bootstrap information from the PDSN using the DHCPv6 Information-Request message (RFC 3633 [29]) with Client Identifier option.

9. If the MS is assigned a new HoA in Step 8, the MS begins to use it. If no HoA was assigned at Step 8, the MS generates (auto-configures) an IPv6 global unicast address based on the Home Link Prefix (HL) information received in Step 8.

10. Anytime after Step 8, the PDSN sends a AAA Accounting Request (Start) message including MS's NAI and Home Address to the AAA server.

11. Anytime after Step 8, the PDSN/BBERF initiates Gateway Control Session Establishment procedures for this packet data session with the PCRF, The PDSN/BBERF includes the following information in the Gateway Control Session Establishment message: IP-CAN Type, RAT-Type, UE Identity (e.g., MN-NAI), PDN Identifier, the Home Address (if known), AN-GW-Address (PDSN Address) and if available, the IP-CAN Bearer Control Mode supported by the MS and the PDSN, and the default charging method, if available. The PCRF establishes a Gateway Control session for the packet data session and chooses Bearer Control Mode to be used. The selected Bearer Control Mode applies during the Gateway Control session. The PDN Identifier, Home Address and UE Identity enable the identification of the Gateway Control session at the PCRF.

The PCRF may generate PCC Rule(s) in preparation for the anticipated IP-CAN session and derive the QoS Rules from them.

12. The PCRF returns Acknowledge of Gateway Control Session Establishment to the PDSN/BBERF. The PCRF includes the QoS Rules, Event Triggers and the chosen IP-CAN bearer establishment mode generated in Step 11. QoS Rules are employed by the PDSN to perform bearer binding. Event Triggers indicate to the PDSN/BBERF what events must be reported to the PCRF.

    Note: The Gateway Control Session established in Steps 11-12 is associated with the IP-CAN session established in Steps 17-18.

13. Anytime after Step 9, the MS sends a MIPv6 Binding Update message to the selected HA. The MS includes fields in the Binding Update that are set as per RFC 4283 [30] and RFC 4285 [31]. For initial MIPv6 session establishment, the MS includes the MN-AAA mobility message authentication option in the Binding Update message. For subsequent Binding Updates, the MS uses the MN-HA mobility message authentication option (see Step 14).

14. For initial MIPv6 registration, the HA extracts the NAI, authenticator etc. from the Binding Update and sends a AAA Access Request message to the AAA server.

15. The AAA server authenticates and authorizes the user and sends an AAA Access Accept message to the HA indicating successful authentication and authorization. At this step, the AAA server also sends MS's HL Prefix to the HA and distributes the Integrity Key (IK) to the HA for subsequent MN-HA processing.

16. The HA performs replay protection procedures with the Mesg-ID mobility option in the received Binding Update (see RFC 4285 [31]).

17. If replay check is successful, the HA/PCEF initiates IP-CAN Session Establishment procedures with the PCRF. The HA/PCEF provides information such as UE Identity (MN-NAI), PDN Identifier, IP Address (Home Address) etc. to the PCRF that are used to identify the IP-CAN session and associate the Gateway Control Session established in Steps 11 and 12.

18. The PCRF sends an Acknowledge of IP-CAN Session Establishment to the HA/PCEF. The PCRF may include the following information: PCC Rules to activate and Event Triggers to report. Policy and Charging Rules allow enforcement of the policy associated with the IP CAN session. Event Triggers indicate to the HA/PCEF what events must be reported to the PCRF.

19. Anytime after Step 16, the HA sends a Binding Acknowledgment message to the MS. In this Binding Acknowledgment message the HA includes the MN-HA mobility message authentication option, MN-NAI mobility option and the Mesg ID mobility option. The MN-HA authenticator is calculated based on the Integrity Key (IK) that was derived in the Home RADIUS server and sent to the HA at Step 15.

7.2.2 MS Initiated Resource Request and Release

MS initiated resource request and release procedures for MIPv4 operation are illustrated in Figure 15 .

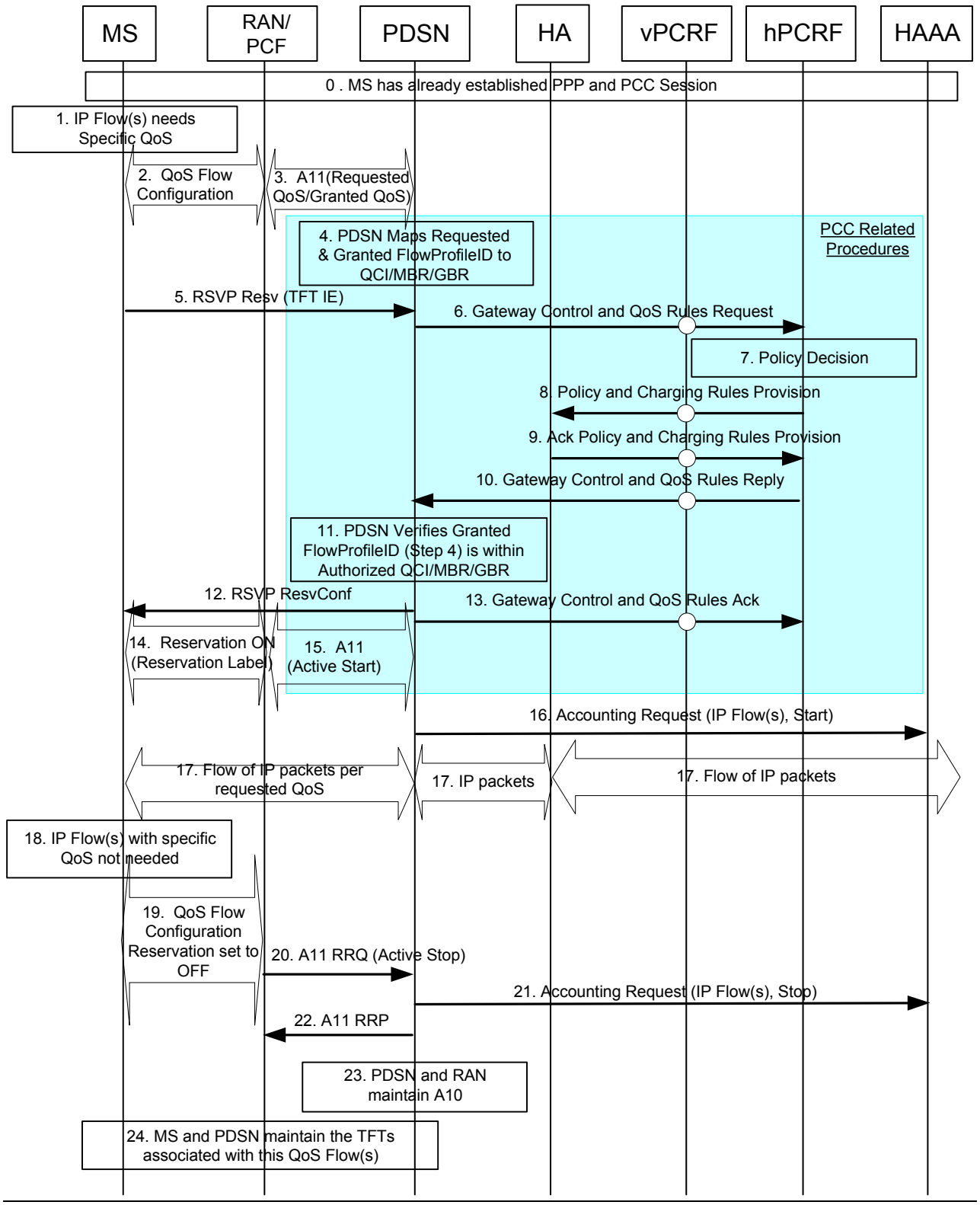

Figure 15 **MS Initiated Resource Request and Release With Mobile IP**

1. As a result of user actions and/or application level signaling etc., the MS becomes aware of IP flow(s) that needs a specific QoS.
2. The MS performs HRPD QoS establishment procedures defined in C.S0024 [4] / C.S0063 [5] using the Requested FlowProfileID determined from the QoS requirements in Step 1. There are two possible sequences that can occur at this step. If a new QoS link flow connection is needed to carry the new flow(s) over the air interface, then the RAN sets up a new air interface link flow. If the RAN decides to carry the flow(s) on an existing link flow, it then reconfigures the parameters of that link flow.
3. If a new link flow is needed, a new A10 connection is also established. The RAN/PCF sends an A11-Registration Request message to the PDSN indicating the GRE key, the Requested QoS information, and Granted QoS information for the flow. The A11 message includes the FLOW_ID. If a new QoS link flow is not needed, the RAN/PCF sends an A11-Registration Request message to the PDSN indicating the GRE key, FLOW_ID, and the modified Granted QoS information for the existing connection (if required). The PDSN examines the QoS requested by the MS and compares it to the QoS authorized for the MS in Step 6 of Figure 13 and Step 3 of Figure 14 (section 7.2.1.1 and section 7.2.1.2 resp.). If there is a discrepancy, the PDSN applies operator policy, for example remove the flow(s) or shut off all activity for the MS.
4. The PDSN maps the Requested FlowProfileID and the Granted FlowProfileID from Step 3 into a set of QCI/MBR/GBR parameters. The mapping is performed as per 'Annex A – Mapping QoS between 3GPP and 3GPP2' specified in X.S0057 [8].
5. The MS sends an RSVP Resv message to the PDSN to associate the selected Reservation (determined in Step 2) with the appropriate TFTs. The Resv message is sent over the main service connection. The TFTs include the Flow-ID and packet filters associated with the requested Reservation. The Transaction ID in the RSVP Resv message is dynamically allocated by the MS. This message can be sent in parallel with the start of the signaling in Step 2.
6. The PDSN/BBERF initiates Gateway Control and QoS Rules Request procedure with the PCRF for authorization of QCI/MBR/GBR derived from the QoS requested by the MS. The Gateway Control and QoS Rules Request message includes Requested QCI/MBR/GBR and packet filters. The PDSN/BBERF provides other information to the PCRF to identify the associated IP-CAN session.
7. The PCRF correlates the Gateway Control and QoS Rules Request message with an existing IP-CAN session. The PCRF stores the received Requested QCI/MBR/GBR parameters. The PCRF makes the authorization decision and generates PCC Rules and corresponding QoS Rules as needed.
8. IP-CAN session modification (Policy and Charging Rules Provision) procedure may occur as a result of Gateway Control and QoS Rules Request. The PCRF forwards an Event Report to the HA/PCEF or issues revised PCC Rules and Event Triggers, or both the Event Report and PCC Rules and Event Trigger provisioning to the HA/PCEF.
9. The HA/PCEF acknowledges with Acknowledge Policy and Charging Rules Provision (accept or reject of the PCC Rules operation(s)) to the PCRF.

10. Anytime after Step 7, the PCRF responds to the PDSN/BBERF with Gateway Control and QoS Rules Reply that includes QoS Rules and Event Triggers. The QoS Rules include the Authorized QCI/MBR/GBR parameters.
11. The PDSN/BBERF verifies that Granted Flow ProfileID (Step 4) is within the Authorized QCI/MBR/GBR received from the PCRF at Step-10. If the Granted FlowProfileID is not within the Authorized QCI/MBR/GBR, then the PDSN executes operator defined policy.
12. The PDSN acknowledges Resv message with a ResvConf message.
13. The result of successful establishment of TFTs (successful QoS Rule activation) is returned to the PCRF via Gateway Control and QoS Rules Ack, indicting whether the resource requested have been successfully allocated.
14. The MS triggers the transition of the Reservation to the Open state.
15. Once the air interface Reservation is transitioned to the Open state, the RAN triggers an A11-Registration Request (Active Start) message for this Reservation.
16. The PDSN sends a AAA Accounting Request (IP Flow(s), Start) message to the AAA server.
17. At this stage the user/application IP packets flow between the MS and the peer node per the requested QoS. For MIPv6 address operation mode, the PDSN applies QoS rules based on inner header of MIPv6 packet for bearer binding purpose.
18. As a result of user actions and/or application level signaling etc, the MS becomes aware that IP flow(s) with specific QoS is not needed.
19. The MS sends a request to the RAN to set the radio Reservation for the bearer to the Off state, and the RAN acknowledges the change to the Off state.
20. The RAN/PCF sends and A11-Registration Request message to the PDSN with Active Stop indication.
21. The PDSN sends a AAA Accounting Request (IP Flow(s), Stop) message to the AAA server.
22. The PDSN acknowledges the A11-Registration Request message with A11-Registration Reply message.
23. The RAN/PCF and the PDSN maintain the A10 connection used for the QoS flow(s). This A10 connection may be reused later for the same IP flow(s), e.g., from another VoIP call to the same IP address on the MS. Such reuse would involve only the setting of the radio Reservation state to the ON state, and the sending of the Active Start Airlink Record to the PDSN.
24. The MS and the PDSN maintain the TFTs for the QoS flow(s).

7.2.3 Network Initiated Resource Request and Release

Network Initiated resource request and release procedures for MIP operation are illustrated in Figure 16 .

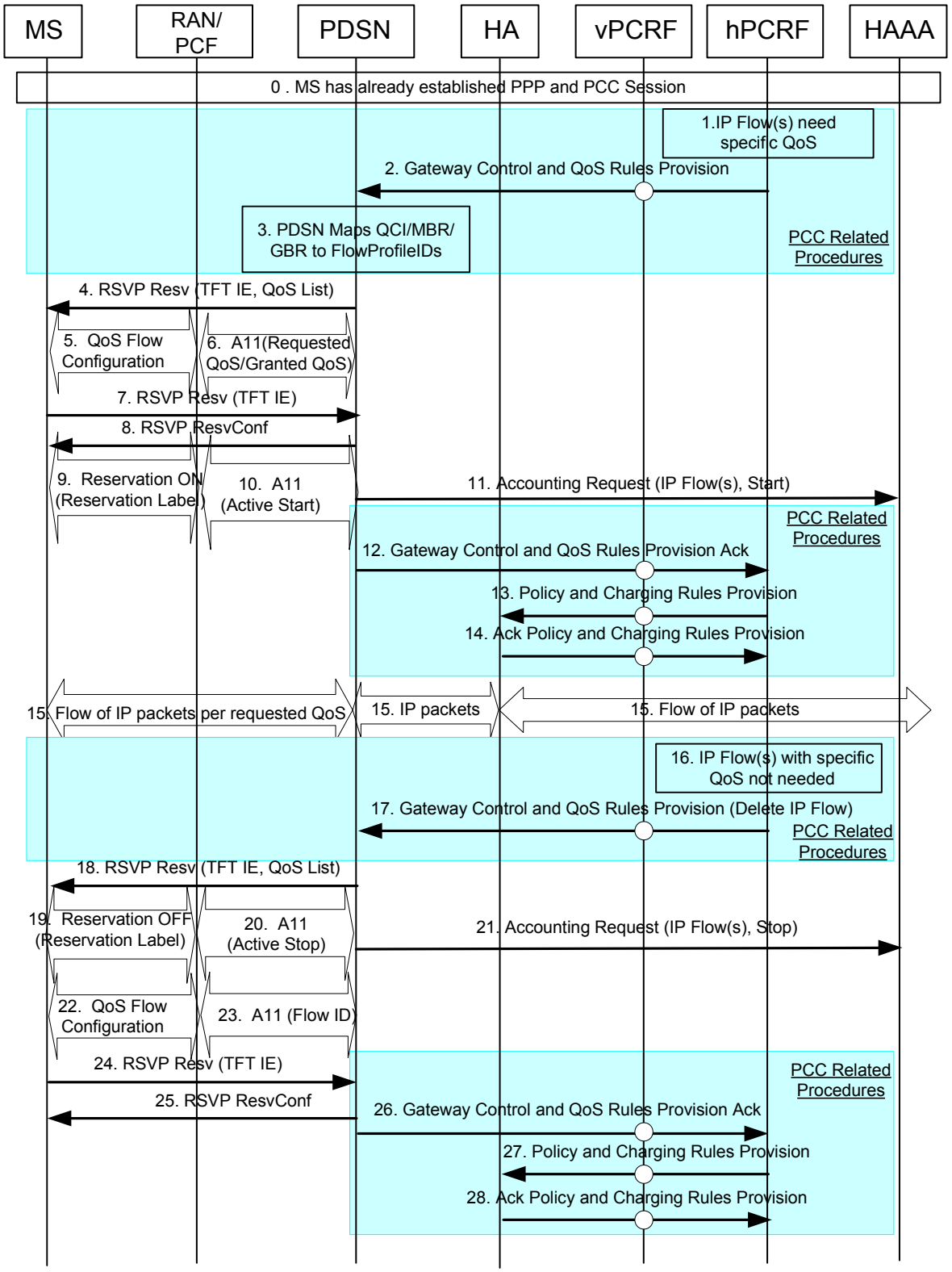

Figure 16 **NW Initiated Resource Request and Release With Mobile IP**

1. As a result of interactions with the Application Function or otherwise, the PCRF becomes aware of IP flow(s) that needs a specific QoS.
2. The PCRF sends a Gateway Control and QoS Rules Provision message to the PDSN/BBERF that includes QoS Rules and Event Triggers. QoS Rules include the Requested QCI/MBR/GBR parameters.
3. The PDSN maps the received QCI/MBR/GBR parameters to (a list of) FlowProfileIDs. The mapping is performed as per 'Annex A – Mapping QoS between 3GPP and 3GPP2' specified in X.S0057 [8].
4. If the QoS in the (list of) FlowProfileIDs received from the PCRF is within the subscriber QoS Profile received in Step 3 of Figure 9 and Figure 10 (section 7.1.1.1 and section 7.1.1.2), the PDSN sends an RSVP Resv message with OpCode set to 'Initiate Flow Request' to the MS. The RSVP message is transported over the main service connection and includes the UL/DL packet filter(s), QoS list that includes the FlowProfileIDs determined in Step 3, and a Transaction ID.

   Note: If the PDSN/BBERF cannot map QCI/MBR/GBR to any authorized FlowProfileID received from the AAA server in Step 6 of Figure 13 and Step 3 of Figure 14 (section 7.2.1.1 and section 7.2.1.2 resp), and the PDSN/PCEF determines to reject the PCEF request based on operator policy, the PDSN/BBERF rejects Gateway Control and QoS Rules Provision from the PCRF. No further action is taken by the PDSN/BBERF to establish the PCRF requested QoS on the Service Connection with the MS. The PCRF may choose to resubmit Gateway Control and QoS Rules Provision with a different set of QCI/MBR/GBR parameters (Step 2).
5. The MS performs standard QoS establishment procedures defined in C.S0024 [4] and in C.S0063 [5] using a FlowProfileID from Step 4. There are two possible sequences that can occur at this step. If a new QoS link flow connection is needed to carry the new flow(s) over the air interface, then the RAN sets up a new air interface link flow. If the RAN decides to carry the flow(s) on an existing link flow, it then reconfigures the parameters of that link flow.
6. If a new link flow is needed, a new A10 connection is also established. The RAN/PCF sends an A11-Registration Request message to the PDSN indicating the GRE key, the Requested QoS information, and the Granted QoS information for the flow. The Granted QoS information includes the FLOW_ID. If a new QoS link flow is not needed, the RAN/PCF sends an A11-Registration Request message to the PDSN indicating the GRE key, FLOW_ID, and the modified Granted QoS information for the existing connection (if required). The PDSN examines the QoS selected by the MS (in Step 5) and validates it against the (list of) FlowProfileIDs requested by the PCRF in Step 3.
7. The MS sends an RSVP Resv message to the PDSN to associate the selected Reservation (determined in Step 5) with the appropriate TFTs. The Resv message is sent over the main service connection. The message includes the same UL/DL TFTs and Transaction ID received in step 4. This message can be sent in parallel with the start of the signalling in Step 5. This message is also used as an acknowledgement to the RSVP Resv message in Step 4.
8. The PDSN acknowledges the RSVP Resv message it received in Step 7 by sending a ResvConf message to the MS.
9. The MS triggers the transition to the Open state.

10. Once the air interface Reservation is transitioned to the Open state, the RAN triggers an A11-Registration Request (Active Start) message for this Reservation
11. The PDSN sends a AAA Accounting Request (IP Flow(s), Start) message to the AAA server.
12. The PDSN/BBERF sends Gateway Control and QoS Rules Provision Ack (Result) to the PCRF. The Result information element indicates whether the indicated QoS Rules could be implemented. This message may be sent anytime after Step 7.
13. IP-CAN session modification (Policy and Charging Rules Provision) procedure may occur as a result of Gateway Control and QoS Rules Provision. The PCRF provides the PCC Rules and Event Triggers to the HA/PCEF.
14. The HA/PCEF acknowledges with Acknowledge Policy and Charging Rules Provision (accept or reject of the PCC Rules operation(s)) to the PCRF.
15. At this stage the user/application IP packets flow between the MS and the peer node as per the Granted QoS.
16. As a result of interactions with the Application Function or otherwise, the PCRF becomes aware that IP flow(s) with the specific QoS is not needed.
17. The PCRF sends a Gateway Control and QoS Rules Provision to the PDSN/BBERF that includes QoS Rules and Event Triggers. QoS Rules indicate the IP flow(s) for which QoS is not needed.
18. The PDSN sends an RSVP Resv message to the MS with OpCode set to 'Initiate Delete Packet Filter from Existing TFT' indicating deletion of the desired IP flow(s).
19. The MS sends a request to the RAN to set the radio Reservation for the bearer to the Off state, and the RAN acknowledges the change to the Off state.
20. The RAN/PCF sends and A11-Registration Request message to the PDSN with Active Stop indication to stop the accounting for this bearer connection.
21. The PDSN sends a AAA Accounting Request (IP Flow(s), Stop) message to the AAA server.
22. The MS performs HRPD procedures to reconfigure the air interface in order to remove or modify the requested Reservation(s). If the last Reservation associated with the link flow is removed, the link flow itself is also removed.
23. The RAN/PCF sends an A11-RRQ message to the PDSN indicating the removed Flow ID(s). If the last Flow ID associated with the auxiliary A10 is removed, the auxiliary A10 itself is also removed,
24. The MS sends a RSVP Resv message with OpCode set to 'Initiate Delete Packet Filter from Existing TFT' to indicate to the PDSN which flow(s) have been removed. The TFT IE contains the list of flow identifier(s) for which filters have been deleted. The Transaction ID carried in this message is the same as the Transaction ID carried in the Resv message in step 18. This message is also used as an acknowledgement to the Resv message in Step 18. This message may be sent in parallel with or at anytime after Step 22.
25. The PDSN acknowledges successful update of the IP flow mapping information by sending a ResvConf message to the MS.
26. The PDSN/BBERF sends Gateway Control and QoS Rules Provision Ack (Result) to the PCRF. The Result information element indicates whether the indicated TFTs could be deleted.

27. IP-CAN session modification (Policy and Charging Rules Provision) procedure may occur as a result of Gateway Control and QoS Rules Provision. The PCRF provides the PCC Rules and Event Triggers to the HA/PCEF.
28. HA/PCEF acknowledges with Acknowledge Policy and Charging Rules Provision (accept or reject of the PCC Rules operation(s)) to the PCRF.

7.3 Proxy MIP Operation With PCC

PCC operations for network Proxy MIP (PMIP) are specified in section 7.3.1, section 7.3.2 and section 7.3.3 below. Section 7.3.1 specifies PPP and PCC Session Establishment procedures. Section 7.3.2 and section 7.3.3 specify MS Initiated and NW Initiated QoS Resource Request, Modification and Release procedures respectively.

7.3.1 PPP Setup and PCC Establishment

PPP and PCC session establishment procedures for network PMIP for IPv4 (RFC791 [22]) and IPv6 RFC2460 [23] operations are illustrated in sections 7.3.1.1 and 7.3.1.2 respectively. PMIP PPP and PCC session establishment procedures for both PMIPv4 and PMIPv6 are similar as specified in X.S0061 [9].

7.3.1.1 IPv4 Addressing with PMIP

PPP and PCC session establishment procedures for the allocation of an IPv4 address (RFC791 [22]) for PMIP operation are illustrated in Figure 17 . It may be noted that IPv4 address assignment procedures for both PMIPv4 and PMIPv6 are similar (X.S0061 [9]).

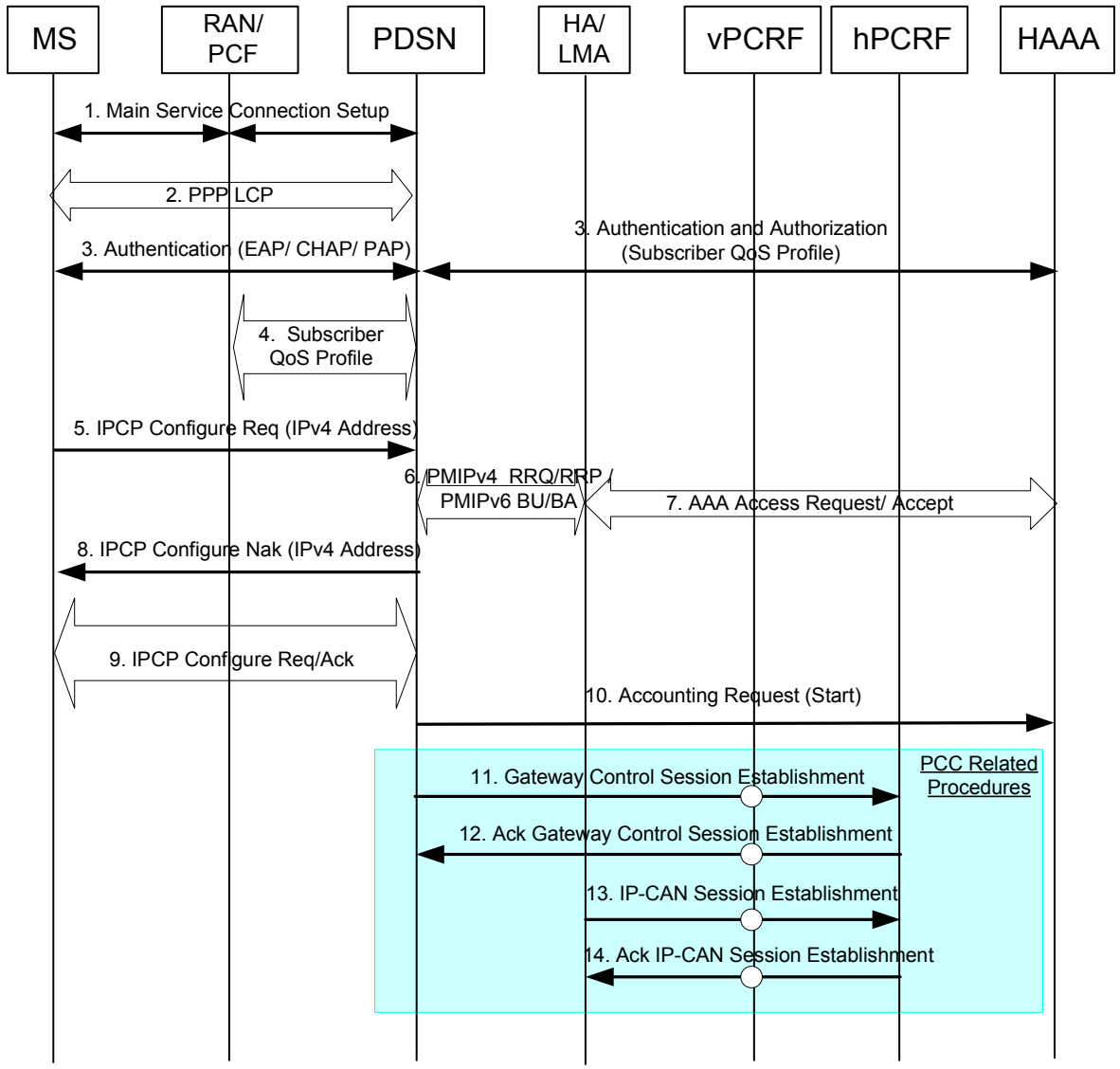

Figure 17 **PPP and PCC Session Establishment for IPv4 Operation With PMIP**

1. The Main Service Connection is setup.
2. PPP LCP negotiation occurs and authentication protocol is selected.
3. Access authentication and authorization is performed using the selected authentication protocol. The MS exchanges authentication related messages with the PDSN. In turn, the PDSN performs authentication and authorization with the AAA server using AAA Access Request/Accept messages. On successful authorization, information such as Subscriber QoS Profile is returned to the PDSN in AAA Access Accept message. The AAA server also indicates network PMIP support for the MS and returns the assigned HA/LMA address, Network-PMIP-NAI, PMN-HA key and PMN-HA-SPI information to the PDSN.
4. The PDSN passes the relevant attributes received in Subscriber QoS Profile to the RAN.

5. The MS sends an IPCP Configure Request message with IP Address configuration option to the PDSN.

6. The PDSN generates MN-HA/LMA Authentication Extension and sends a PMIPv4 Registration Request /PMIPv6 Binding Update message to the HA/LMA for establishing a PMIPv4/v6 tunnel between the PDSN and the HA/LMA.. See X.S0061 [9] for details. On receiving PMN-HA/LMA key from the AAA server and successfully authenticating the PRRQ/PBU (see Step 7), the HA/LMA sends PMIPv4 Registration Reply /PMIPv6 Binding Acknowledgment message to the PDSN that includes the IPv4 address assigned to the MS. In turn, the PDSN passes the assigned IPv4 address to the MS as per IPCP procedures performed in Steps 8 and 9.

7. The HA/LMA sends AAA Access Request to the AAA server to verify the received PRRQ/PBU. The AAA server retrieves the PMN-HA/LMA key using the PMN-HA/LMA-SPI and sends AAA Access Accept to the HA/LMA. The PMN-HA/LMA key and the PMN-HA/LMA-SPI are included in the AAA Access Accept.

8. The PDSN sends an IPCP Configure Nak message that includes the assigned IP Address received in PRRP/PBA to the MS.

9. The MS and the PDSN continue to perform IPCP procedures for the allocation of IP Address. See X.S0061 [9] for details.

10. The PDSN sends a AAA Accounting Request (Start) message that includes MS's NAI and IP address to the AAA server.

11. The PDSN/BBERF initiates Gateway Control Session Establishment procedures for this packet data session with the PCRF. The PDSN/BBERF includes the following information in the Gateway Control Session Establishment message: IP CAN Type, RAT-Type, UE Identity (e.g., MN-NAI), PDN Identifier, IP Address(es) (if known), AN-GW-Address (PDSN Address) and, if available, the IP CAN Bearer Control Modes supported by the MS and the PDSN, and the default charging method, if available. The PCRF establishes a Gateway Control session for the packet data session and chooses IP-CAN Bearer Control Mode to be used. The selected Bearer Control Mode applies during the Gateway Control session. PDN Identifier Home Address and UE identity enable the identification of the Gateway Control session at the PCRF. The PCRF may generate PCC Rule(s) in preparation for the anticipated IP-CAN session and derive the QoS Rules from them.

12. The PCRF returns Acknowledge of Gateway Control Session Establishment to the PDSN/BBERF. The PCRF includes the QoS Rules, Event Triggers and : the chosen IP CAN bearer establishment mode generated in Step 11. The QoS Rules are employed by the PDSN to perform bearer binding. Event Triggers indicate tothe PDSN/BBERF what events must be reported to the PCRF.

13. Anytime after completion of Step 7, the HA/LMA/PCEF initiates an IP-CAN Session Establishment procedures with the PCRF. The HA/LMA/PCEF provides information such as UE Identity (MN-NAI), PDN Identifier , IP Address (Home Address) etc. to the PCRF that are used to identify the IP-CAN session and associate the Gateway Control Session established in Steps 11 and 12.

14. The PCRF sends an Acknowledge of IP-CAN Session Establishment to the HA/LMA/PCEF. The PCRF may include the following information: PCC Rules to activate and Event Triggers to report. Policy and Charging Rules allow enforcement of the policy associated with the IP CAN session. Event Triggers indicate to the HA/LMA/PCEF what events must be reported to the PCRF.

7.3.1.2 IPv6 Addressing with PMIP

PPP and PCC session establishment procedures for the allocation of an IPv6 address RFC2460 [23] for PMIP operation are illustrated in Figure 18 . It may be noted that IPv6 address assignment procedures for both PMIPv4 and PMIPv6 are similar (ref X.S0061 [9]).

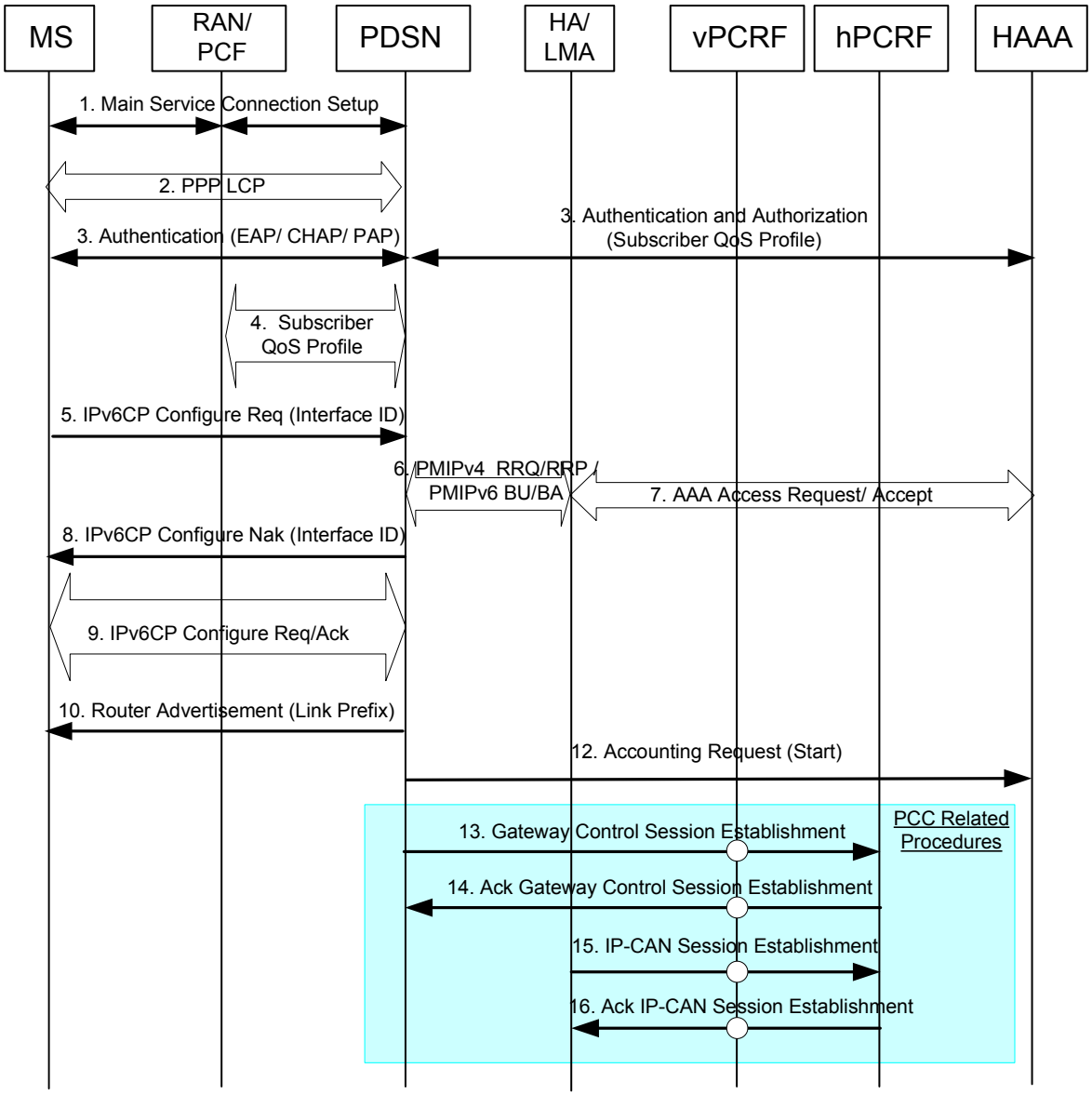

Figure 18 **PPP and PCC Session Establishment for IPv6 Operation With PMIP**

1. The Main Service Connection is setup.
2. PPP LCP negotiation occurs and authentication protocol is selected.

3. Access authentication and authorization is performed using the selected authentication protocol. The MS exchanges authentication related messages with the PDSN. In turn, the PDSN performs authentication and authorization with the AAA server using AAA Access Request/Accept messages. On successful authorization, information such as Subscriber QoS Profile is returned to the PDSN in AAA Access Accept message. The AAA server also indicates network PMIP support for the MS and returns the assigned HA/LMA address, Network-PMIP-NAI, PMN-HA/LMA key and PMN-HA/LMA-SPI information to the PDSN. /64 PPP link prefix for IPv6 operation may also be assigned by the AAA server.

4. The PDSN passes the relevant attributes received in Subscriber QoS Profile to the RAN.

5. The MS sends an IPv6CP Configure Request message with Interface ID configuration option to the PDSN. The PDSN allocates an Interface ID to the MS. /64 PPP link prefix is assigned to the MS as per Proxy Mobile IPv4/v6 procedures performed in Steps 6 and 7. See X.S0061 [9] for details.

6. The PDSN generates MN-HA/LMA Authentication Extension and sends a PMIPv4 Registration Request / PMIPv6 Binding Update message to the HA/LMA for establishing a PMIPv4/v6 tunnel between the PDSN and the HA/LMA. See X.S0061 [9] for details. On receiving PMN-HA/LMA key from the AAA server and successfully authenticating the PRRQ/PBU (see Step 7), the HA sends PMIPv4 Registration Reply / PMIPv6 Binding Acknowledgment message to the PDSN that includes the /64 PPP link prefix assigned to the MS. In turn, the PDSN passes the assigned the assigned Interface Identifier to the MS as per IPv6CP procedures performed in Steps 8 and 9.

7. The HA/LMA sends AAA Access Request to the AAA server to verify the received PRRQ / PBU. The AAA server retrieves the PMN-HA/LMA key using the PMN-HA/LMA-SPI and sends AAA Access Accept to the HA/LMA. The PMN-HA/LMA key and the PMN-HA/LMA-SPI are included in the AAA Access Accept.

8. The PDSN sends an IPv6CP Configure Nak message that includes the assigned Interface Identifier to the MS.

9. The MS and the PDSN perform IPv6CP procedures for the allocation of Interface Identifier. The MS and the PDSN construct the link-local IPv6 address by pre-pending the link-local prefix FE80::/64 to the negotiated IID. See X.S0061 [9] for details.

10. The PDSN transmits initial unsolicited Router Advertisement (RA) messages on the PPP link using its link-local address as the source address. The PDSN includes the allocated /64 link prefix in the RA message to the MS.

11. The MS constructs global IPv6 address by pre-pending the /64 PPP link prefix received in the Router Advertisement messages to the Interface Identifier negotiated during the IPv6CP negotiations, or to the Interface Identifiers generated using techniques defined in RFC 3041 [27].

12. The PDSN sends a AAA Accounting Request (Start) message that includes MS's NAI and IP address to the AAA server.

13. The PDSN/BBERF initiates Gateway Control Session Establishment procedures for this packet data session with the PCRF. The PDSN/BBERF includes the following information in the Gateway Control Session Establishment message: IP CAN Type, RAT-Type, UE Identity (e.g., MN-NAI), PDN Identifier, IP Address(es) (if known), AN-GW-Address (PDSN Address) and, if available, the IP CAN Bearer Control Modes supported by the MS and the PDSN, and the

default charging method, if available. The PCRF establishes a Gateway Control session for the packet data session and chooses IP-CAN Bearer Control Mode to be used. The selected Bearer Control Mode applies during the Gateway Control session. PDN Identifier, Home Address and UE identity enable the identification of the Gateway Control session at the PCRF. The PCRF may generate PCC Rule(s) in preparation for the anticipated IP-CAN session and derive the QoS Rules from them.

14. The PCRF returns Acknowledge of Gateway Control Session Establishment to the PDSN/BBERF. The PCRF includes the QoS Rules, Event Triggers and the chosen IP CAN bearer establishment mode generated in Step 13. The QoS Rules are employed by the PDSN to perform bearer binding. Event Triggers indicate to the PDSN/BBERF what events must be reported to the PCRF.
15. Anytime after Step 7, the HA/LMA/PCEF initiates an IP-CAN Session Establishment procedure with the PCRF. The HA/LMA/PCEF provides information such as UE Identity (MN-NAI), PDN Identifier , IP Address (Home Address) etc. to the PCRF that are used to identify the IP-CAN session and associate the Gateway Control Session established in Steps 13 and 14.
16. The PCRF sends an Acknowledge of IP-CAN Session Establishment to the HA/LMA/PCEF. The PCRF may include the following information: PCC Rules to activate and Event Triggers to report. Policy and Charging Rules allow enforcement of the policy associated with the IP CAN session. Event Triggers indicate to the HA/LMA/PCEF what events must be reported to the PCRF.

7.3.2 MS Initiated Resource Request and Release

MS initiated resource request and release procedures for Proxy Mobile IP operation is illustrated in Figure 19 .

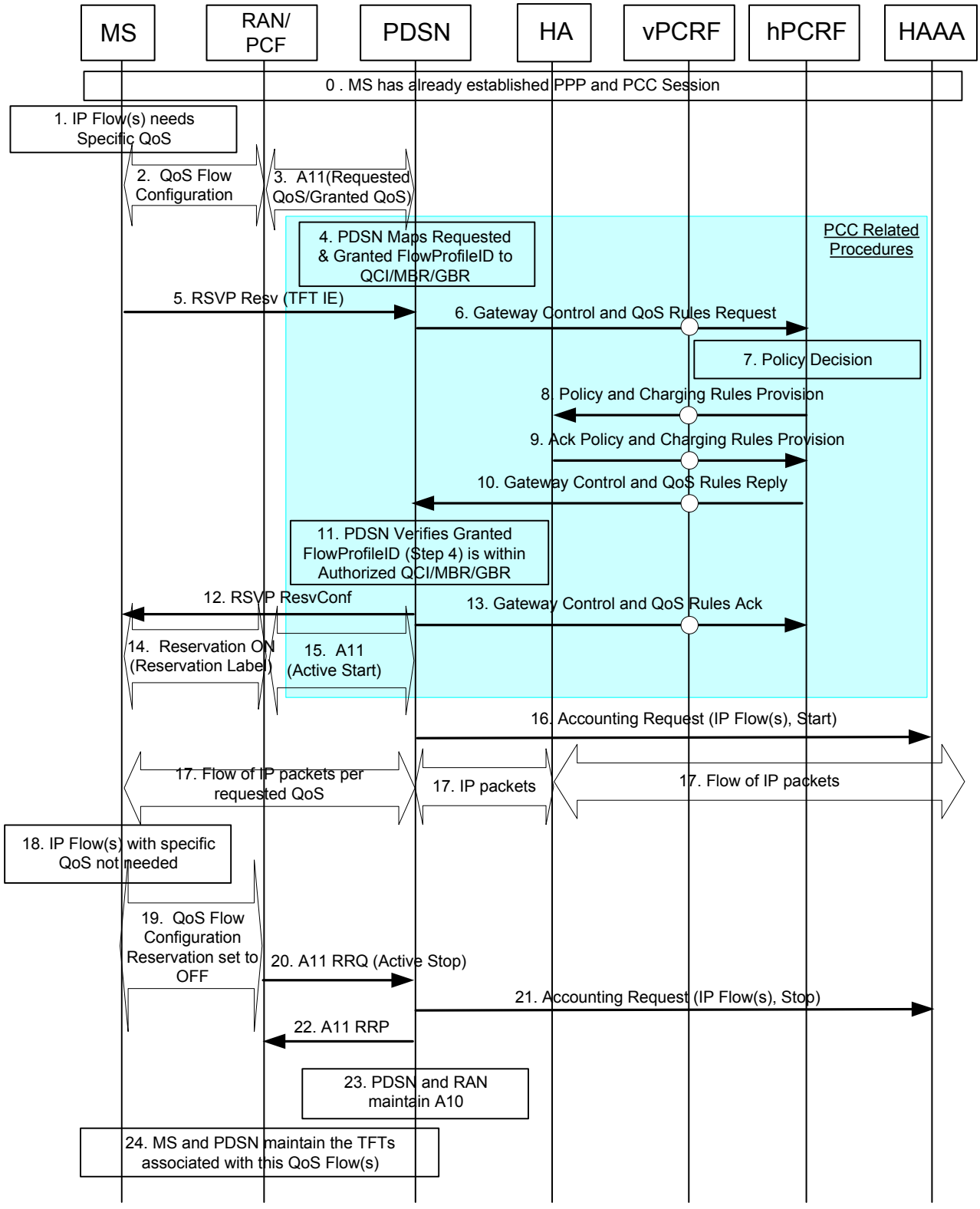

Figure 19 **MS Initiated Resource Request and Release With PMIP**

1. As a result of user actions and/or application level signaling etc., the MS becomes aware of IP flow(s) that needs a specific QoS.
2. The MS performs HRPD QoS establishment procedures defined in C.S0024 [4] / C.S0063 [5] using the Requested FlowProfileID determined from the QoS requirements in Step 1. There are two possible sequences that can occur at this step. If a new QoS link flow connection is needed to carry the new flow(s) over the air interface, then the RAN sets up a new air interface link flow. If the RAN decides to carry the flow(s) on an existing link flow, it then reconfigures the parameters of that link flow.
3. If a new link flow is needed, a new A10 connection is also established. The RAN/PCF sends an A11-Registration Request message to the PDSN indicating the GRE key, the Requested QoS information, and Granted QoS information for the flow. The A11 message includes the FLOW_ID. If a new QoS link flow is not needed, the RAN/PCF sends an A11-Registration Request message to the PDSN indicating the GRE key, FLOW_ID, and the modified Granted QoS information for the existing connection (if required). The PDSN examines the QoS requested by the MS and compares it to the QoS authorized for the MS in Step 3 of Figure 17 and Figure 18 (section 7.3.1.1 and section 7.3.1.2 resp.) If there is a discrepancy, the PDSN applies operator policy, for example remove the flow or shut off all activity for the MS.
4. The PDSN maps the Requested FlowProfileID and the Granted FlowProfileID received from Step 3 into a set of QCI/MBR/GBR parameters. The mapping is performed as per 'Annex A – Mapping QoS between 3GPP and 3GPP2' specified in X.S0057 [8].
5. The MS sends an RSVP Resv message to the PDSN to associate the selected Reservation (determined in Step 2) with the appropriate TFTs. The Resv message is sent over the main service connection. The TFTs include the FLOW_ID and packet filters associated with the requested Reservation. The Transaction ID in the RSVP Resv message is dynamically allocated by the MS. This message can be sent in parallel with the start of the signaling in Step 2.
6. The PDSN/BBERF initiates Gateway Control and QoS Rules Request procedure with the PCRF for authorization of QCI/MBR/GBR derived from the QoS requested by the MS. The Gateway Control and QoS Rules Request message includes the Requested QCI/MBR/GBR and packet filters. The PDSN/BBERF provides other information to the PCRF to identify the associated IP-CAN session.
7. The PCRF correlates the Gateway Control and QoS Rules Request message with an existing IP-CAN session. The PCRF stores the received Requested QCI/MBR/GBR parameters. The PCRF makes the authorization decision and generates PCC Rules and corresponding QoS Rules as needed.
8. IP-CAN session modification (Policy and Charging Rules Provision) procedure may occur as a result of Gateway Control and QoS Rules Request. The PCRF forwards an Event Report to the HA/PCEF or issues revised PCC Rules and Event Triggers, or both the Event Report and PCC Rules and Event Trigger provisioning to the HA/PCEF.
9. The HA/PCEF acknowledges with Acknowledge Policy and Charging Rules Provision (accept or reject of the PCC Rules operation(s)) to the PCRF.
10. Anytime after Step 7, the PCRF responds to the PDSN/BBERF with Gateway Control and QoS Rules Reply that includes QoS Rules and Event Triggers. The QoS Rules include the Authorized QCI/MBR/GBR parameters.

11. The PDSN verifies that Granted FlowProfileID (Step 3) is within the Authorized QCI/MBR/GBR received from the PCRF at Step-10. If the Granted FlowProfileID is not within the Authorized QCI/MBR/GBR, then the PDSN executes operator defined policy.
12. The PDSN acknowledges Resv message with a ResvConf message.
13. The result of successful establishment of TFTs (successful QoS Rule activation) is returned to the PCRF via Gateway Control and QoS Rules Ack, indicting whether the resource requested have been successfully allocated.
14. The MS triggers the transition of the Reservation to the Open state.
15. Once the air interface reservation is transitioned to the Open state, the RAN triggers an A11-Registration Request (Active Start) message for this Reservation.
16. The PDSN/PCEF sends a AAA Accounting Request (Flow(s), Start) message to the AAA server.
17. At this stage the user/application IP packets flow between the MS and the peer node per the Granted QoS.
18. As a result of user actions and/or application level signaling etc, the MS becomes aware that IP flow(s) with specific QoS is not needed.
19. The MS sends a request to the RAN to set the radio Reservation for the bearer to the Off state, and the RAN acknowledges the change to the Off state.
20. The RAN/PCF sends and A11-Registration Request message to the PDSN with Active Stop indication.
21. The PDSN sends a AAA Accounting Request (IP Flow(s), Stop) message to the AAA server.
22. The PDSN acknowledges the A11-Registration Request message with A11-Registration Reply message.
23. The RAN/PCF and the PDSN maintain the A10 connection used for the QoS flow(s). This A10 connection may be reused later for the same IP flow(s), e.g., from another VoIP call to the same IP address on the MS. Such reuse would involve only the setting of the radio Reservation state to the ON state, and the sending of the Active Start Airlink Record to the PDSN.
24. The MS and the PDSN maintain the TFTs associated with the QoS flows.

7.3.3 Network Initiated Resource Request and Release

Network initiated resource request and release procedures for PMIP operation is illustrated in Figure 20 .

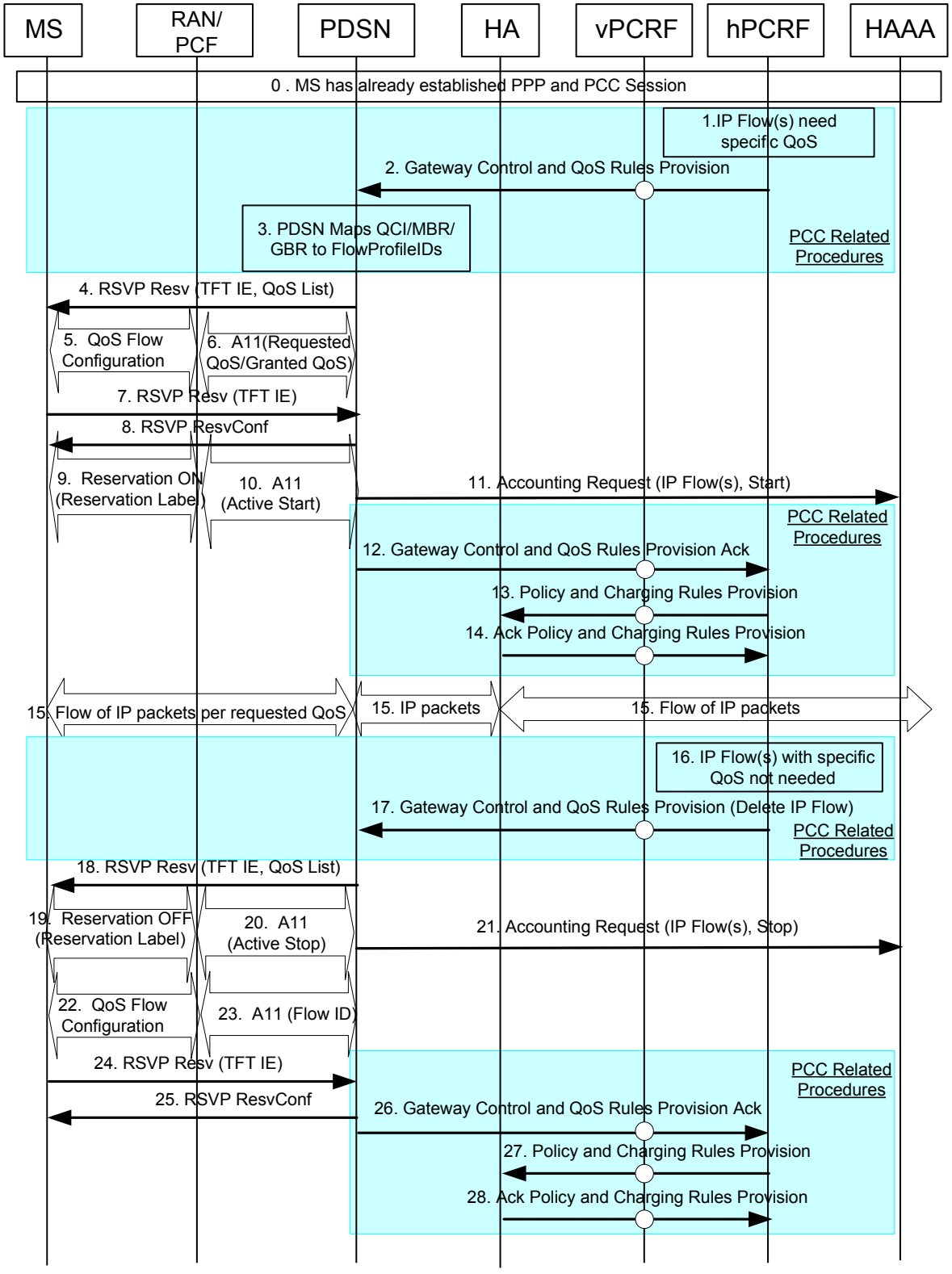

Figure 20 **NW Initiated Resource Request and Release With PMIP**

1. As a result of interactions with the Application Function or otherwise, the PCRF becomes aware of IP flow(s) that needs a specific QoS.

2. The PCRF sends a Gateway Control and QoS Rules Provision message to the PDSN/BBERF that includes QoS Rules and Event Triggers. QoS Rules include the Requested QCI/MBR/GBR parameters.

3. The PDSN maps the received QCI/MBR/GBR parameters to (a list of) FlowProfileID(s). The mapping is performed as per 'Annex A – Mapping QoS between 3GPP and 3GPP2' specified in X.S0057 [8].

4. If the QoS in the (list of) FlowProfileIDs received from the PCRF is within the subscriber QoS Profile received in Step 3 of Figure 17 and Figure 18 (section 7.3.1.1 and section 7.3.1.2 resp.), the PDSN sends an RSVP Resv message with OpCode set to 'Initiate Flow Request' to the MS. The RSVP message is transported over the main service connection and includes the UL/DL packet filter(s), QoS list that includes the FlowProfileIDs determined in Step 3, and a Transaction ID.

   Note: If the PDSN/BBERF cannot map QCI/MBR/GBR to any authorized FlowProfileID received from the AAA server in Step 3 of Figure 17 and Figure 18 (section 7.3.1.1 and section 7.3.1.2 resp), and the PDSN/PCEF determines to reject the PCEF request based on operator policy, the PDSN/BBERF rejects Gateway Control and QoS Rules Provision from the PCRF. No further action is taken by the PDSN/BBERF to establish the PCRF requested QoS on the Service Connection with the MS. The PCRF may choose to resubmit Gateway Control and QoS Rules Provision with a different set of QCI/MBR/GBR parameters (Step 2).

5. The MS performs standard QoS establishment procedures defined in C.S0024 [4] and in C.S0063 [5] using a FlowProfileID from Step 4. There are two possible sequences that can occur at this step. If a new QoS link flow connection is needed to carry the new flow(s) over the air interface, then the RAN sets up a new air interface link flow. If the RAN decides to carry the flow(s) on an existing link flow, it then reconfigures the parameters of that link flow.

6. If a new link flow is needed, a new A10 connection is also established. The RAN/PCF sends an A11-Registration Request message to the PDSN indicating the GRE key, the Requested QoS information, and the Granted QoS information for the flow. The Granted QoS information includes the FLOW_ID. If a new QoS link flow is not needed, the RAN/PCF sends an A11-Registration Request message to the PDSN indicating the GRE key, FLOW_ID, and the modified Granted QoS information for the existing connection (if required). The PDSN examines the QoS selected by the MS (in Step 5) and validates it against the (list of) FlowProfileIDs requested by the PCRF in Step 3.

7. The MS sends an RSVP Resv message to the PDSN to associate the selected Reservation (determined in Step 5) with the appropriate TFTs. The Resv message is sent over the main service connection. The message includes the same UL/DL TFTs and Transaction ID received in step 4. This message can be sent in parallel with the start of the signaling in Step 5. This message is also used as an acknowledgement to the RSVP Resv message in Step 4.

8. The PDSN acknowledges the RSVP Resv message it received in Step 7 by sending a ResvConf message to the MS.

9. The MS triggers the transition of Reservation to the Open state.

10. Once the air interface Reservation is transitioned to the Open state, the RAN triggers an A11-Registration Request (Active Start) message for this Reservation.
11. The PDSN sends a AAA Accounting Request (IP Flow(s), Start) message to the AAA server.
12. The PDSN/BBERF sends Gateway Control and QoS Rules Provision Ack (Result) to the PCRF. The Result information element indicates whether the indicated QoS Rules could be implemented. This message may be sent anytime after Step 7.
13. IP-CAN session modification (Policy and Charging Rules Provision) procedure may occur as a result of Gateway Control and QoS Rules Provision. The PCRF provides the PCC Rules and Event Triggers to the HA/PCEF.
14. The HA/PCEF acknowledges with Acknowledge Policy and Charging Rules Provision (accept or reject of the PCC Rules operation(s)) to the PCRF.
15. At this stage the user/application IP packets flow between the MS and the peer node as per the Granted QoS.
16. As a result of interactions with the Application Function or otherwise, the PCRF becomes aware that IP flow(s) with the specific QoS is not needed.
17. The PCRF sends a Gateway Control and QoS Rules Provision to the PDSN/BBERF that includes QoS Rules and Event Triggers. QoS Rules indicate the IP flow(s) for which QoS is not needed.
18. The PDSN sends an RSVP Resv message to the MS with OpCode set to 'Initiate Delete Packet Filter from Existing TFT' indicating deletion of the desired IP flow(s).
19. The MS sends a request to the RAN to set the radio Reservation for the bearer to the Off state, and the RAN acknowledges the change to the Off state.
20. The RAN/PCF sends and A11-Registration Request message to the PDSN with Active Stop indication to stop the accounting for this bearer connection.
21. The PDSN sends a AAA Accounting Request (IP Flow(s), Stop) message to the AAA server.
22. The MS performs HRPD procedures to reconfigure the air interface in order to remove or modify the requested Reservation(s). If the last Reservation associated with the link flow is removed, the link flow itself is also removed.
23. The RAN/PCF sends an A11-RRQ message to the PDSN indicating the removed Flow ID(s). If the last Flow ID associated with the auxiliary A10 is removed, the auxiliary A10 itself is also removed,
24. The MS sends a RSVP Resv message with OpCode set to 'Initiate Delete Packet Filter from Existing TFT' to indicate to the PDSN which flow(s) have been removed. The TFT IE contains the list of flow identifier(s) for which filters have been deleted. The Transaction ID carried in this message is the same as the Transaction ID carried in the Resv message in step 18. This message is also used as an acknowledgement to the Resv message in Step 17. This message may be sent in parallel with or at anytime after Step 22.
25. The PDSN acknowledges successful update of the IP flow mapping information by sending a ResvConf message to the MS.
26. The PDSN/BBERF sends Gateway Control and QoS Rules Provision Ack (Result) to the PCRF. The Result information element indicates whether the indicated TFTs could be deleted.

27. IP-CAN session modification (Policy and Charging Rules Provision) procedure may occur as a result of Gateway Control and QoS Rules Provision. The PCRF provides the PCC Rules and Event Triggers to the HA/PCEF.

28. The HA/PCEF acknowledges with Acknowledge Policy and Charging Rules Provision (accept or reject of the PCC Rules operation(s)) to the PCRF.

8 Mobility Extensions and Mobility Options

This section defines 3GPP2 Organization/Vendor Specific mobility extensions and mobility options for supporting Flow Based Offline bearer Charging (FBC). Mobility Extensions for supporting MIPv4 and PMIPv4 procedures are specified in section 8.1. Mobility Options for supporting PMIPv6 procedures are specified in section 8.2. Mobility options for supporting FBC for MIPv6 are not specified in this revision of specifications.

8.1 MIPv4 Mobility Extensions

3GPP2 Organization/Vendor Specific mobility extensions for MIPv4 and PMIPv4 Registration Request message sent from the PDSN/FA to the Home Agent (HA) are listed in Table 1 below. These mobility extensions are formatted as Normal Vendor Specific Extensions (NVSE) specified in RFC 3025 [26].

Table 1 **3GPP2 Organization/Vendor Specific NVSEs for MIPv4 and PMIPv4**

NVSE Name	NVSE-Type	Instances of NVSE Supported	Reference	Remarks
3GPP2_MEID	TBD	0-1	8.1.1	Note 1
Note 1: Based on operator policy, one instance of 3GPP2_MEID mobility extension is included if MS MEID is received in A10 Connection Setup Airlink Record. Else, 3GPP2_MEID NVSE shall not be included.				

8.1.1 3GPP2_MEID

3GPP2-MEID NVSE is used to convey the Mobile Equipment Identifier of the subscriber device to the Home Agent. The format of the 3GPP2_MEID NVSE is shown below:

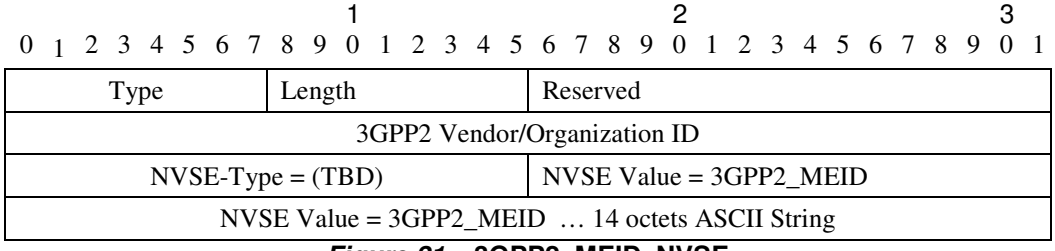

Figure 21 **3GPP2_MEID NVSE**

Type: 134

Length: 24 octets.

Vendor/Org-ID: 5535

NVSE-Type: 3585 (0EH01H)

NVSE-Value: This field contains Mobile Equipment Identifier of the subscriber device formatted as a 14 octet ASCII string according to X.S0011-005 [6].

8.2 PMIPv6 Mobility Options

3GPP2 Organization/Vendor Specific mobility options for PMIPv6 Proxy Binding Update message sent from the PDSN/MAG to the Local Mobility Agent (LMA) are listed in Table 2 below. These mobility options have 4n+2 alignment requirement and are formatted as specified in RFC 5094 [33].

Table 2 **3GPP2 Organization/Vendor Specific Mobility Options for PMIPv6**

Mobility Option (MO) Name	MO-Type	Instances of MO Supported	Reference	Remarks
3GPP2_MEID	TBD	0-1	8.2.1	Note 1
Note 1: Based on operator policy, one instance of 3GPP2_MEID mobility option is included if MS MEID is received in A10 Connection Setup Airlink Record. Else, 3GPP2_MEID mobility option shall not be included.				

8.2.1 3GPP2_MEID

3GPP2-MEID mobility option is used to convey the Mobile Equipment Identifier of the subscriber device to the LMA. The format of the 3GPP2_MEID mobility option is shown below:

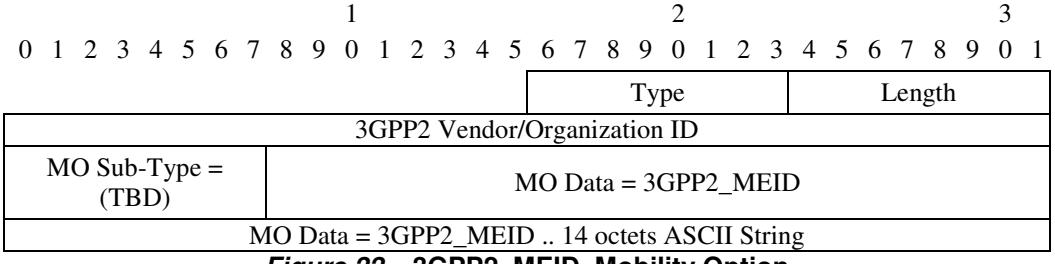

Figure 22 **3GPP2_MEID Mobility Option**

Type: 19

Length: 21 octets.

Vendor/Org-ID: 5535

MO Sub-Type: 1

MO Data: This field contains Mobile Equipment Identifier of the subscriber device formatted as a 14 octet ASCII string according to See X.S0011-005 [6].

9 Annex A (Normative) – AVPs used by the PDSN and the HA/LMA

Table 3 lists the AVPs used by the PDSN and the HA/LMA. A value of '0' indicates that the AVP shall not be present over the interface, and a value of '1' indicates that exactly one instance of this AVP shall be present over the interface identified in Table 3.

Table 3 **AVPs Used by the PDSN and the HA/LMA**

AVP Name	Simple IP Address Mode of Operation	MIP/PMIP Address Mode of Operation		References
	PDSN (Gx Interface)	PDSN (Gxa Interface)	HA/LMA (Gx Interface)	
RAT-Type	1	1	0	Section 5.3.31, 3GPP TS 29.212 [13]
IP-CAN-Type	1	1	1	Section 5.3.27, 3GPP TS 29.212 [13]
UE Identity	1	1	1	Section 8.14, RFC3588 [28]
PDN Identifier	1	1	1	Section 9.1.1, 3GPP TS 23.003 [10]
Network-Request-Support	1	1	0	Section 5.3.24, 3GPP TS 29.212 [13]
AN-GW-Address	1	1	1	Section 5.3.49, 3GPP TS 29.212 [13]

10 Annex B (Normative) – ResvConf Message

The PDSN and MS shall follow the following format for ResvConf message.

The ResvConf message specified in X.S0011 [6] is modified in this specification by adding the IE List to the message.

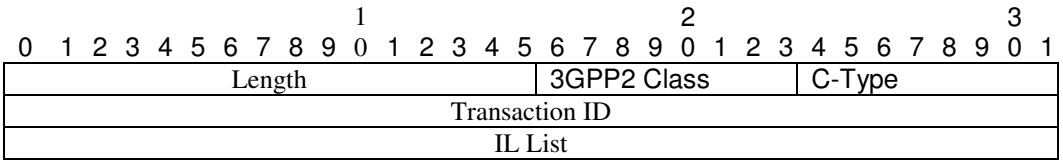

Figure 23 **3GPP2 OBJECT in ResvConf Message**

Length:

Length of the 3GPP2 OBJECT. Length in octets and shall always be a multiple of 4 octets.

3GPP2 Class:

231

C-Type:

1

Transaction ID:

The PDSN shall set this field to the same number that is received in Resv message from the MS fro which this ResvConf is generated.

IE List:

The PDSN shall include this field if the PDSN determines to modify the evaluation precedence value of one or more packet filters that are sent by the MS in the Resv message. The IE List may include one or more IEs. The format of the IE List shall follow the IE List specified in section B.1.1.1 of X.S0011 [6].

11 Annex C – (Normative) Setting of CDR Parameters for Flow Based Bearer Charging

3GPP TS 32.251 [17] provides a brief description of CDR parameter used over the Ga/Gz reference point. Further definitions of the parameters are provided in 3GPP TS 32.298 [20]. Table 4 below provides setting of CDR parameters that are significant in the context of 3GPP2 cdma2000 1x and HRPD networks.

Table 4 **CDR Parameter Setting by PDSN and HA/LMA**

CDR Parameter Name	Description
Served 3GPP2 MEID	• For Simple IP mode of operation, the PDSN shall set Served 3GPP2 MEID to the MS MEID if received in A10 Connection Setup Airlink Record (X.S0011 - 005 [6]). Served 3GPP2 MEID shall be encoded as 14 octet string field. • For Mobile IP mode of operation, the HA/LMA shall set Served 3GPP2 MEID to the 3GPP2_MEID if received in (P)MIPv4 Registration Request message or PMIPv6 Binding Update message.
Served MN NAI	• For Simple IP mode of operation, the PDSN shall set Served MN NAI to be the same as the UE Identity (section 5.2.1.3). Served MN NAI shall be encoded as specified in RFC3588 [28]. • For Mobile IP mode of operation, the HA/LMA shall set Served MN NAI to be the same as the UE Identity (section 5.3.1.2). Served MN NAI shall be encoded as specified in RFC3588 [28].
PGW Address Used	• For Simple IP mode of operation, the PDSN shall set the PGW Address Used to its IP address, on the interface facing the external network. • For Mobile IP mode of operation, the HA/LMA shall set the PGW Address Used to its IP address, on the interface facing the PDSN.
Serving Node Address	• For Simple IP mode of operation, Serving Node Address shall be set to the PDSN IP address on the interface facing the external network. • For Mobile IP mode of operation, Serving Node Address shall be set to the PDSN IP address on the interface facing the HA/LMA.
Serving Node Type	• Serving Node Type shall be set to value based on operator policy. Note: At this time there is no definition for Serving Node Type of 'PDSN' in 3GPP specifications. The operator may choose to set this field according to operator policy.
Access Point Name Network Identifier	• For Simple IP mode of operation, the Access Point Name Network Identifier shall be set to the IP address of the PDSN, in ASCII format, of its interface that is connected to the external network. • For Mobile IP mode of operation, the Access Point Name Network Identifier shall be set to the IP address of HA/LMA, in ASCII format, on the interface facing the PDSN. • Access Point Name Network Identifier shall be encoded in the format of PDN Identifier AVP specified in section 5.2.1.4 and 5.3.1.3.
APN/HA/LMA Selection Mode	• APN/HA/LMA Selection Mode indicates how the HA/LMA was selected.

	• The HA/LMA determines if it is in the home or visited domain of the mobile station and shall encode the APN/HA/LMA selection as follows: o Value '0': HA/LMA in the home domain, Valid for MIPv4 and PMIPv4/v6 mode of operation. o Value '1': HA/LMA in the home domain, HA in visited domain was requested. Valid for MIPv4 mode of operation only. o Value '2': HA in the visited domain.Valid for MIPv4 and PMIPv4/v6 mode of operation. o Other values for future use. Shall not be sent. If received, shall be interpreted as the value '0.
3GPP2 User Location Information	• 3GPP2 User Location Information shall be set to 3GPP2-BSID if available, as described in TS 29.212 [13].
Charging Characteristics	• Transfer of Charging Characteristics from the 3GPP2 AAA to the PDSN is not specified in this specification. • Charging Characteristics if available are configured by the operator. • For Simple IP address node of operation, Charging Characteristics are configured at the PDSN. • For Mobile IP address node of operation, Charging Characteristics are configured at the HA/LMA.. • Charging Characteristics shall be encoded as specified in TS 32.298 [20].

12 Annex D – (Informative) Support of CDR Parameters for Flow Based Bearer Charging

3GPP TS 32.251 [17] lists CDR parameter used over the Ga/Gz reference point. Table 5 below indicates if such parameters are required and how they are used in the context of cdma2000 1x and HRPD networks. Accounting for emergency services as specified in X.S0060 are not supported in this specifications.

Table 5 **Support of CDR Parameters for Flow Based Bearer Charging**

Field	Description	Is cdma2000 Mapping Required	Is it Supported for FBC on cdma2000 Access	Mapping Reference
Record Type	IP CAN bearer record	No	Yes	
Served IMSI	IMSI of the served party, if available.	No	Yes	
IMSI Unauthenticated Flag	Used for emergency services	No	No	
Served IMEISV	Used for emergency services	No	No	
Served 3GPP2 MEID	MEID of the served party's terminal equipment, if available	Yes	Yes	Section 11 Annex C
Served MN NAI	Mobile Node Identifier in NAI format, if available.	Yes	Yes	Section 11 Annex C
P-GW Address used	The IP address of the P-GW used.	Yes	Yes	Section 11 Annex C
Charging ID	Charging Identifier for different records	No	Yes	
PDN Connection Id	PDN connection Id for MUPSAP	No	No	
Serving node Address	List of PDSN IP addresses used	No	Yes	Section 11 Annex C
Serving node Type	List of serving node types listed in the field "Serving node Address" in sequence.	No	Yes	Section 11 Annex C
PGW PLMN Identifier	PLMN identifier (MCC MNC) of the PGW.	No	No	
Access Point Name Network Identifier	Logical name of the external packet data network	Yes	Yes	Sectio11 Annex C
PDP/PDN Type	PDN type (i.e IPv4, IPv6 or IPv4v6).	No	Yes	
Served PDP/PDN Address	IP address allocated for the PDN connection	No	Yes	
Dynamic Address Flag	Indicates whether served PDN address is dynamic. This field is missing if address is static.	No	Yes	
List of Service Data	A list of charging data etc.	No	Yes	

Field	Description	Is cdma2000 Mapping Required	Is it Supported for FBC on cdma2000 Access	Mapping Reference
Record Opening Time	Time stamp when IP CAN bearer is activated in this P-GW or record opening time on subsequent partial records.	No	Yes	
MS Time Zone	MS Time Zone the MS is currently located in.	No	No	
Duration	Duration of this record	No	Yes	
Cause for Record Closing	The reason for the release of record	No	Yes	
Diagnostics	A more detailed reason for the release of the connection, if available	No	Yes	
Record Sequence Number	Partial record sequence number	No	Yes	
Node ID	Name of the recording entity	No	Yes	
Record Extensions	A set of network operator/manufacturer specific extensions to the record	No	Yes	
Local Record Sequence Number	Consecutive record number created by this node	No	Yes	
APN Selection Mode	An index indicating how the APN was selected.	Yes	Yes	Section 11 Annex C
Served MSISDN	Primary MSISDN of the subscriber.	No	No	
User Location Information	User Location Information of the MS for GPRS case	No	No	
User CSG information	User CSG Information of the MS	No	No	
3GPP2 User Location information	User Location Information of the MS for 3GPP2 access	Yes	Yes	Section 11 Annex C
Charging Characteristics	Charging Characteristics applied	Yes	Yes	Section 11 Annex C
Charging Characteristics Selection Mode	How Charging Characteristics were selected	No	Yes	
IMS Signalling Context	Used for IM-CN Subsystem	No	No	
External Charging Identifier	Used of IM-CN Subsystem	No	No	
Serving node PLMN Identifier	Serving node PLMN Identifier (MCC and MNC) used during this record	No	No	

Field	Description	Is cdma2000 Mapping Required	Is it Supported for FBC on cdma2000 Access	Mapping Reference
PS Furnish Charging Information	Online charging session specific information	No	No	
CAMEL Information	Set of CAMEL information related to IP CAN bearer, if available.	No	No	
RAT Type	Radio Access Technology (RAT) type currently used by the Mobile Station, when available	Yes	Yes	Section 9 Annex A
Start Time	Time when User IP-CAN session starts, available in the CDR for the first bearer in an IP-CAN session	No	Yes	
Stop Time	Time when User IP-CAN session is terminated, available in the CDR for the last bearer in an IP-CAN session	No	Yes	

13 Annex E – (Informative) Gx Parameters Supported for cdma2000 Access

3GPP TS 29.212 [13] lists Diameter AVPs used over the Gx interface. Table 6 indicates the Gx specific AVPs that are used in cdma2000 HRPD networks. Table 7 indicates the Gx reused AVPs that are used in cdma2000 HRPD networks.

Table 6 **Support of Gx Specific Diameter AVPs for cdma2000 Access**

Attribute Name	3GPP TS 29.212 Section Reference	Is cdma2000 Mapping Required
Access-Network-Charging-Identifier-Gx	5.3.22	No
Allocation-Retention-Priority	5.3.32	No
AN-GW-Address	5.3.49	No
APN-Aggregate-Max-Bitrate-DL	5.3.39	No
APN-Aggregate-Max-Bitrate-UL	5.3.40	No
Bearer-Control-Mode	5.3.23	No
Charging-Rule-Install	5.3.2	No
Charging-Rule-Remove	5.3.3	No
Charging-Rule-Definition	5.3.4	No
Charging-Rule-Base-Name	5.3.5	No
Charging-Rule-Name	5.3.6	No
Charging-Rule-Report	5.3.18	No
Charging-Correlation-Indicator	5.3.67	No
Default-EPS-Bearer-QoS	5.3.48	No
Event-Report-Indication	5.3.30	No
Event-Trigger	5.3.7	No
Flow-Information	5.3.53	No
Flow-Label	5.3.52	No
IP-CAN-Type	5.3.27	No
Guaranteed-Bitrate-DL	5.3.25	No
Guaranteed-Bitrate-UL	5.3.26	No
Metering-Method	5.3.8	No
Network-Request-Support	5.3.24	No
Offline	5.3.9	No
Packet-Filter-Content	5.3.54	No
Packet-Filter-Identifier	5.3.55	No
Packet-Filter-Information	5.3.56	No
Packet-Filter-Operation	5.3.57	No
Packet-Filter-Usage	5.3.66	No

Precedence	5.3.11	No
Priority-Level	5.3.45	No
Reporting-Level	5.3.12	No
PCC-Rule-Status	5.3.19	No
Session-Release-Cause	5.3.44	No
QoS-Class-Identifier	5.3.17	No
QoS-Information	5.3.16	No
Resource-Allocation-Notification	5.3.50	No
Rule-Failure-Code	5.3.38	No
Security-Parameter-Index	5.3.51	No
ToS-Traffic-Class	5.3.15	No
Tunnel-Header-Filter	5.3.34	No
Tunnel-Header-Length	5.3.35	No
Tunnel-Information	5.3.36	No
RAT-Type	5.3.31	No
Revalidation-Time	5.3.41	No
Rule-Activation-Time	5.3.42	No

Table 7 **Support of Gx Re-Used Diameter AVPs for cdma2000 Access**

Attribute Name	Description	Is cdma2000 Mapping Required	Notes
3GPP2-BSID	User Location Information of the MS for 3GPP2 access	No	
Access-Network-Charging-Address	IP Address of network entity within the access network performing charging	No	
Access-Network-Charging-Identifier-Value	Charging identifier (e.g. GCID).	No	
AF-Charging-Identifier	AF charging identifier that may be used in charging correlation	No	
Called-Station-ID	Address the user is connected to (i.e., the PDN identifier).	No	
CC-Request-Number	The number of the request for mapping requests and answers	No	
CC-Request-Type	The type of the request (initial, update, termination)	No	
Charging-Information	Charging-Information AVP is of type Grouped	No	
Flow-Description	Service flow filter parameters for a QoS rule	No	

Flows	Flow identifiers of the IP flows related to a PCC rule as provided by the AF. May be only used in charging correlation together with AF-Charging-Identifier AVP.	No	
Flow-Status	Defines whether the service flow is enabled or disabled. The value "REMOVED" is not applicable to Gx.	No	
Framed-IP-Address	The IPv4 address allocated for the user.	No	
Framed-IPv6-Prefix	The IPv6 address prefix allocated for the user.	No	
Max-Requested-Bandwidth-UL	Maximum authorized bandwidth for uplink.	No	Note 1
Max-Requested-Bandwidth-DL	Maximum authorized bandwidth for downlink.	No	Note 1
Rating-Group	Charging key for the PCC rule used for rating purposes	No	
Service-Identifier	Identity of the service or service component the service data flow in a PCC rule relates to.	No	
Subscription-Id	The identification of the subscription (i.e., IMSI)	No	
Supported-Features	This AVP informs the destination host about the features that the origin host requires to successfully complete this command exchange	No	
Used-Service-Unit	Measured volume for usage monitoring control purposes. The volume threshold for usage monitoring control purposes. Only the CC-Total-Octets or one of the CC-Input-Octets and CC-Output-Octets AVPs are re-used. This AVP shall have the 'M' bit cleared.	No	
User-Equipment-Info	Identification and capabilities of the terminal (IMEISV, etc.) When the User-Equipment-Info-Type is set to IMEISV(0), the value within the User-Equipment-Info-Value shall be a UTF-8 encoded decimal.	No	
AF-Signalling-Protocol	Indicates the protocol used for signalling between the MS and the AF. This AVP shall have the 'M' bit cleared.	No	
Note 1: When sending from the PCRF to the PCEF, the Max-Requested-Bandwidth-UL/DL AVP indicate the maximum allowed bit rate for the uplink/downlink direction; when sending from the PCEF to the PCRF, the Max-Requested-Bandwidth-UL/DL AVP indicate the maximum requested bit rate for the uplink/downlink direction.			

14 Annex F – (Informative) Gxa Parameters Supported for cdma2000 Access

3GPP TS 29.212 [13] lists Diameter AVPs used over the Gxa interface. Table 8 below indicates the Gxa specific AVPs used in cdma2000 HRPD networks. Table 9 indicates the Gxa reused AVPs that are used in cdma2000 HRPD networks.

Table 8 **Support of Gxa Specific Diameter AVPs for cdma2000 Access**

Attribute Name	3GPP TS 29.212 Section Reference	Is cdma2000 Mapping Required
QoS-Rule-Install	5a.3.1	No
QoS-Rule-Remove	5a.3.2	No
QoS-Rule-Definition	5a.3.3	No
QoS-Rule-Name	5a.3.4	No
QoS-Rule-Base-Name	5a.3.7	No
QoS-Rule-Report	5a.3.5	No
Session-Linking-Indicator	5a.3.6	No

Table 9 **Support of Gxa Re-Used Diameter AVPs for cdma2000 Access**

Attribute Name	Description	Is cdma2000 Mapping Required	Notes
AN-GW-Address	Carries the address of the AN-GW (PDSN)	Yes	Section 10 Annex B
3GPP2-BSID	User Location Information of the MS for 3GPP2 access	No	
Allocation-and-Retention-Priority	Indicates a priority for accepting or rejecting a bearer establishment or modification request and dropping a bearer in case of resource limitations.	No	
APN-Aggregate-Max-Bitrate-DL	Aggregate maximum bitrate for the downlink direction	No	
APN-Aggregate-Max-Bitrate-UL	Aggregate maximum bitrate for the uplink direction	No	
Bearer-Control-Mode	PCRF selected bearer control mode.	No	
Called-Station-ID	Address the user is connected to (i.e., the PDN identifier).	No	
CC-Request-Number	The number of the request for mapping requests and answers	No	
CC-Request-Type	The type of the request (initial, update,	No	

	termination)		
Event-Trigger	Reports the event that occurred on the BBERF.	No	
Flow-Description	Defines the service flow filter parameters for a QoS rule	Yes	PDSN maps the 'flow-description' to the packet filter field in the TFT.
Flow-Information	Defines the service flow filter parameters for a QoS rule	No	
Flow-Label	Defines the IPv6 flow label	No	
Framed-IP-Address	The IPv4 address allocated for the user.	No	
Framed-IPv6-Prefix	The IPv6 address prefix allocated for the user.	No	
Guaranteed-Bitrate-DL	Defines the guaranteed bit rate for downlink.	No	Note 1
Guaranteed-Bitrate-UL	Defines the guaranteed bit rate for uplink.	No	Note 1
IP-CAN-Type	Indicates the type of Connectivity Access Network that the user is connected to.	Yes	Section 10 Annex B
Max-Requested-Bandwidth-UL	Maximum authorized bandwidth for uplink	No	Note 2
Max-Requested-Bandwidth-DL	Maximum authorized bandwidth for downlink	No	Note 2
Packet-Filter-Content	Indicates the content of the packet filter.	No	
Packet-Filter-Identifier	The identity of the packet filter.	No	
Packet-Filter-Information	Information related to the packet filters that the BBERF provides to the PCRF.	No	
Packet-Filter-Operation	Indicates the operation that the terminal is requesting over the packet filters provided by the Packet-Filter-Information AVPs.	No	
Packet-Filter-Usage	Indicates whether the MS shall be provisioned with the related traffic mapping information.	No	
Network-Request-Support	Indicates whether the access network supports the network requested bearer control mode or not.	No	
Precedence	Indicates the precedence of QoS rules or packet filters.	No	
PCC-Rule-Status	Describes the status of one or a group of QoS rules.	No	
QoS-Class-Identifier	Identifies a set of IP-CAN specific QoS parameters	No	
QoS-Information	Defines the QoS information for a resource or QoS rule.	No	
Default-EPS-Bearer-QoS	Defines the QoS information of the default	No	

	bearer		
RAT-Type	Identifies the radio access technology that is serving the MS	Yes	Section 10 Annex B
Resource-Allocation-Notification	Indicates whether successful resource allocation notification for rules is needed or not.	No	
Rule-Failure-Code	Identifies the reason a QoS rule is being reported.	No	
Security-Parameter-Index	Defines the IPSec SPI	No	
Session-Release-Cause	Indicate the reason of termination initiated by the PCRF.	No	
Subscription-Id	Identification of the subscription (i.e., IMSI)	Yes	PDSN uses the IMSI obtained from A11 messaging to map to this AVP
Supported-Features	This AVP informs the destination host about the features that the origin host requires to successfully complete this command exchange	No	
ToS-Traffic-Class	Defines the IPv4 ToS or IPv6 Traffic Class	No	PDSN may include this in the TFT sent to or received from the MS.
Tunnel-Header-Filter	Defines the tunnel (outer) header filter information of a tunnelled IP flow.	No	
Tunnel-Header-Length	Indicates the length of the tunnel (outer) header.	No	
Tunnel-Information	Defines the tunnel (outer) header information for an IP flow.	No	
User-Equipment-Info	The identification and capabilities of the terminal (IMEISV, etc.) When the User-Equipment-Info-Type is set to IMEISV(0), the value within the User-Equipment-Info-Value shall be a UTF-8 encoded decimal.	Yes	PDSN sets this to indicate that the MS provides an IMSI MN-ID.

NOTE 1: When sending from the PCRF to the BBERF, the Guaranteed-Bit-Rate-UL/DL AVP indicate the allowed guaranteed bit rate for the uplink/downlink direction; when sending from the BBERF to the PCRF, the Guaranteed-Bit-Rate-UL/DL AVP indicate the requested guaranteed bit rate for the uplink/downlink direction.

NOTE 2: When sending from the PCRF to the BBERF, the Max-Requested-Bandwidth-UL/DL AVP indicate the maximum allowed bit rate for the uplink/downlink direction; when sending from the BBERF to the PCRF, the Max-Requested-Bandwidth-UL/DL AVP indicate the maximum requested bit rate for the uplink/downlink direction.