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1 Scope

The present document provides the Stage 3 specification of the S9 reference point for the present release. The functional requirements of Stage 2 specification for the S9 reference point are contained in 3GPP TS 23.203 [2]. The S9 reference point lies between the PCRF in the home PLMN (also known as H-PCRF) and the PCRF in the visited PLMN (also known as V-PCRF).

Whenever it is possible the present document specifies the requirements for the protocols by reference to specifications produced by the IETF within the scope of Diameter. Where this is not possible extensions to Diameter are defined within the present document.

2 References

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

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- For a specific reference, subsequent revisions do not apply.
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- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 23.203: "Policy and Charging Control Architecture"
- [3] 3GPP TS 29.212: "Policy and Charging Control (PCC); Reference points".
- [4] 3GPP TS 29.213: "Policy and charging control signalling flows and Quality of Service (QoS) parameter mapping"
- [5] 3GPP TS 29.214: "Policy and charging control over Rx reference point"
- [6] Void.
- [7] 3GPP TS 29.229: "Cx and Dx interfaces based on the Diameter protocol; Protocol details"
- [8] IETF RFC 4960: "Stream Control Transmission Protocol".
- [9] 3GPP TS23.003: "Numbering, addressing and identification".
- [10] 3GPP TS 23.261: "IP flow mobility and seamless Wireless Local Area Network (WLAN) offload; Stage 2".
- [11] Void.
- [12] Void.
- [13] 3GPP TS 23.216: "Single Radio Voice Call Continuity (SRVCC); Stage 2".
- [14] Broadband Forum TR-203: "Interworking between Next Generation Fixed and 3GPP Wireless Access".
- [15] Broadband Forum TR-134: "Policy Control Framework".
- [16] Broadband Forum TR-146: "Subscriber Sessions".
- [17] DSL Forum TR-059: "DSL Evolution – Architecture. Requirements for the Support of QoS-Enabled IP Services", September 2003
- [18] 3GPP TS 23.402: "Architecture Enhancements for non-3GPP accesses".

- [19] IETF RFC 4006: "Diameter Credit Control Application".
- [20] 3GPP TS 23.007: "Restoration Procedures".
- [21] Void.
- [22] 3GPP TS 29.274: "3GPP Evolved Packet System. Evolved GPRS Tunnelling Protocol for EPS (GTPv2)".
- [23] 3GPP2 X.S0057-B: "E-UTRAN – eHRPD Connectivity and Interworking: Core Network Aspects".
- [24] IETF RFC 7683: "Diameter Overload Indication Conveyance".
- [25] IETF RFC 4005: "Diameter Network Access Server Application".
- [26] 3GPP TS 23.161: "Network-based IP flow mobility and Wireless Local Area Network (WLAN) offload; Stage 2".
- [27] IETF RFC 7944: "Diameter Routing Message Priority".
- [28] IETF RFC 8583: "Diameter Load Information Conveyance".
- [29] IETF RFC 6733: "Diameter Base Protocol".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

Home Routed Access: Roaming scenario where the PCEF is located in the HPLMN. In a Home Routed roaming scenario, the UE obtains access to the packet data network from the HPLMN.

IP-CAN session: association between a UE and an IP network.

The association is identified by one or more UE IPv4 addresses/ and/or IPv6 prefix together with a UE identity information, if available, and a PDN represented by a PDN ID (e.g. an APN). An IP-CAN session incorporates one or more IP-CAN bearers. Support for multiple IP-CAN bearers per IP-CAN session is IP-CAN specific. An IP-CAN session exists as long as the related UE IPv4 address and/or IPv6 prefix are assigned and announced to the IP network.

Visited Access (also known as local breakout): Roaming scenario where the PCEF is located in the VPLMN. In a Visited Access Roaming scenario, the UE obtains access to the packet data network from the VPLMN.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

ADC	Application Detection and Control
AF	Application Function
AN-Gateway	Access Network Gateway
AVP	Attribute-Value Pair
BBERF	Bearer Binding and Event Reporting Function
DRMP	Diameter Routing Message Priority
H-AF	Home AF
H-PCRF	Home PCRF
HPLMN	Home PLMN
HR	Home-Routed

HRPD	High Rate Packet Data
HSGW	HRPD Serving Gateway
NBIFOM	Network-based IP flow mobility
OCS	Online charging system
OFCS	Offline charging system
PCC	Policy and Charging Control
PCEF	Policy and Charging Enforcement Function
PCRF	Policy and Charging Rule Function
RCAF	RAN Congestion Awareness Function
S-GW	Serving Gateway
TDF	Traffic Detection Function
TSSF	Traffic Steering Support Function
UDC	User Data Convergence
UDR	User Data Repository
VA	Visited Access
V-AF	Visited AF
V-PCRF	Visited PCRF
VPLMN	Visited PLMN

4 S9 Reference Point

4.1 Overview

The S9 reference point is used in roaming scenarios involving a HPLMN and a VPLMN. Two main roaming scenarios are considered: visited access (PCEF in VPLMN and AF in VPLMN or HPLMN) and home-routed access (PCEF in HPLMN and AF in the HPLMN).

Two Diameter applications are used over the S9 reference point: S9 and Rx. The purpose of the S9 Diameter application is to install PCC rules or QoS rules generated in the HPLMN into the VPLMN and transport the events that may occur in the VPLMN to the HPLMN. Additionally, the S9 Diameter application is used to install ADC rules generated in the HPLMN into the VPLMN and transport the application detection and control information from the VPLMN to the HPLMN, when the H-PCRF and the V-PCRF both support the Application Detection and Control feature. When the AF is in the VPLMN, Rx is used over the S9 reference point to exchange service session information from the V-PCRF to the H-PCRF.

The AF exchanges session information with the H-PCRF or V-PCRF as specified in 3GPP TS 29.214 [5]. The PCRF (H-PCRF and/or V-PCRF) exchanges PCC rules and QoS rules with the PCEF and BBERF respectively as specified in 3GPP TS 29.212 [3]. Additionally, the PCRF (H-PCRF and/or V-PCRF) exchanges ADC rules (for solicited application reporting) and application detection notifications with the TDF as specified in 3GPP TS 29.212 [3].

NOTE: In case of TDF and visited access, the V-PCRF extracts ADC Rules from the received PCC Rules.

Signalling flows related to all the PCC reference points (Gx, Gxx, Rx, Sd and S9) are specified in 3GPP TS 29.213 [4].

Diameter messages over the S9 reference point shall make use of SCTP [8].

Refer to Annex G of 3GPP TS 29.213 [4] for Diameter overload control procedures over the S9 interface.

Refer to Annex J of 3GPP TS 29.213 [4] for Diameter message priority mechanism procedures over the S9 interface.

Refer to Annex K of 3GPP TS 29.213 [4] for Diameter load control procedures over the S9 interface.

4.2 Reference model

The S9 reference point is defined between the V-PCRF and the H-PCRF for home routed access and visited access.

The relationships between the different functional entities involved in the home routed access and visited access are depicted in figure 4.2.1. The overall PCC architecture is depicted in clause 3a of 3GPP TS 29.213 [4].



Figure 4.2.1: S9 reference model

Figure 4.2.1a: Void

Figure 4.2.2: Void

Figure 4.2.2a: Void

4.3 Functional elements

4.3.1 H-PCRF

4.3.1.0 General

The H-PCRF (Home Policy and Charging Rules Function) is a functional element that encompasses policy control decision and flow based charging control functionalities in the HPLMN.

The H-PCRF provides functions for both home routed access and visited access.

The H-PCRF selects the bearer control mode applicable for the user or IP-CAN session. Policy decisions based on the bearer control mode are made in the H-PCRF.

Usage monitoring as defined in 3GPP TS 29.212 [3] is controlled by the H-PCRF.

The H-PCRF shall check whether PCC Rules or QoS Rules have to be provided based on the information received from the V-PCRF.

NOTE: The H-PCRF can use the Called-Station-Id AVP for that purpose. When this AVP is absent, the H-PCRF provides QoS rules that are not related to any IP-CAN session. When it is present, if it identifies a Visited Network, the PCC rules will be provided. If it is present and identifies a Home Network, the QoS rules will be provided. When looking up policies for an APN from the SPR or internal storage, the H-PCRF can apply the APN matching procedures in Annex I of 3GPP TS 29.213 [4].

When provisioning PCC/QoS rules over the S9 reference point, the H-PCRF is responsible for assigning packet filter identifiers for rules provisioned as a result of UE initiated resource modification. For E-UTRAN access with UE initiated resource modification procedure, the H-PCRF shall either authorize the same QoS as requested or reject the request if the requested QoS cannot be authorized.

4.3.1.1 Home routed access

The H-PCRF shall provision QoS Rules to the V-PCRF via the S9 reference point, PCC Rules to the PCEF via the Gx reference point, and if applicable, provision ADC rules to the TDF via the Sd reference point. The H-PCRF ensures that the QoS Rules provisioned are aligned with the PCC Rules. It is PCRF's responsibility to coordinate the PCC rules and QoS rules, if applicable, with ADC rules in order to ensure consistent service delivery.

Based on home operator policy, the H-PCRF may allow a request for sponsored data connectivity, reject a request for sponsored data connectivity, or terminate the AF session associated with sponsored data connectivity.

The H-PCRF PCC Rule decisions may be based on one or more of the following:

- Information obtained from the AF via the Rx reference point.
- Information obtained from the V-PCRF via the S9 reference point.