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Contents

Foreword

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1 Scope

The present document provides the stage 3 specification of the Np reference point. The functional requirements and the stage 2 specifications of the Np reference point are contained in 3GPP TS 23.203 [2]. The Np reference point lies between the RAN Congestion Awareness Function (RCAF) and the Policy and Charging Rules Function (PCRF) for the non-roaming case, between the RCAF and the H-PCRF for the home-routed scenario and between the RCAF and the V-PCRF for the visited access scenario.

NOTE: If not specified explicitly, the PCRF also means H-PCRF for the home-routed scenario or V-PCRF in the visited access scenario in the specification.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 23.203: "Policy and charging control architecture".

[3] 3GPP TS 29.213: "Policy and Charging Control signalling flows and QoS parameter mapping".

[4] IETF RFC 4005: "Diameter Network Access Server Application".

[5] IETF RFC 4006: "Diameter Credit Control Application".

[6] 3GPP TS 29.229: "Cx and Dx interfaces based on Diameter protocol; Protocol details".

[7] IETF RFC 3588: "Diameter Base Protocol".

[8] 3GPP TS 23.401: "GPRS enhancements for E-UTRAN access".

[9] 3GPP TS 23.060: "General Packet Radio Service (GPRS); Service description; Stage 2".

[10] 3GPP TS 29.215: "Policy and Charging Control (PCC) over S9 reference point; Stage 3".

[11] 3GPP TS 29.061: "Interworking between the Public Land Mobile Network (PLMN) supporting packet based services and Packet Data Networks (PDN)".

[12] 3GPP TS 29.274: "3GPP Evolved Packet System. Evolved GPRS Tunnelling Protocol for EPS (GTPv2)".

[13] ITU-T Recommendation E.212: "The international identification plan for mobile terminals and mobile users".

[14] 3GPP TS 29.212: "Policy and Charging Control (PCC); Reference points".

[15] IETF RFC 7683: "Diameter Overload Indication Conveyance".

[16] IETF RFC 7944: "Diameter Routing Message Priority".

[17] IETF RFC 8583: "Diameter Load Information Conveyance".

[18] IETF RFC 6733: "Diameter Base Protocol".

[19] IETF RFC 5719: "Updated IANA Considerations for Diameter Command Code Allocations".

[20] IETF RFC 2234: "Augmented BNF for syntax specifications".

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.

RAN user plane congestion: RAN user plane congestion occurs when the demand for RAN resources exceeds the available RAN capacity to deliver the user data for a prolonged period of time.

NOTE: Short-duration traffic bursts is a normal condition at any traffic load level, and is not considered to be RAN user plane congestion. Likewise, a high-level of utilization of RAN resources (based on operator configuration) is considered a normal mode of operation and might not be RAN user plane congestion.

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].

AF	Application Function
ARR	Aggregated RUCI Report Request
ARA	Aggregated RUCI Report Answer
DRMP	Diameter Routing Message Priority
H-PCRF	Home PCRF
MUR	Modify Uecontext Request
MUA	Modify Uecontext Answer
NRR	Non-Aggregated RUCI Report Request
NRA	Non-Aggregated RUCI Report Answer
PCC	Policy and Charging Control
PCRF	Policy and Charging Rule Function
RCAF	RAN Congestion Awareness Function
RUCI	RAN User Plane Congestion Information
V-PCRF	Visited PCRF

4 Np reference point

4.1 Overview

The Np reference point is located between the RCAF and the PCRF for the non-roaming scenario, between the RCAF and the H-PCRF for the home-routed scenario and between the RCAF and the V-PCRF for the visited access scenario. The Np reference point is used for:

- Reporting the RUCI from the RCAF to the PCRF;

- Provisioning the Reporting Restriction from the PCRF to the RCAF;

- The User Equipment (UE) mobility between RCAFs;
- The removal of the UE context in the RCAF.

The stage 2 level requirements for the Np reference point are defined in 3GPP TS 23.203 [2].

Signalling flows related to Np interface are specified in 3GPP TS 29.213 [3].

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

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

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

4.2 Np reference model

The relationships between the involved functional entities are depicted in figure 4.2.1. The overall PCC architecture is depicted in clause 3a of 3GPP TS 29.213 [3] .

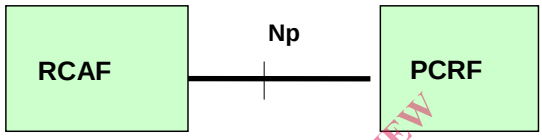

Figure 4.2.1: Np reference model

NOTE: For the home-routed access scenario, the RCAF interacts with the H-PCRF. For the visited access scenario, the RCAF interacts with the V-PCRF.

Figure 4.2.2: Void

Figure 4.2.3: Void

4.3 Functional elements

4.3.1 RCAF

The RCAF is a functional element which reports RAN User Plane Congestion Information (RUCI) via the Np interface to the PCRF to enable the PCRF to take the RAN user plane congestion status into account for policy decisions. RUCI includes the following information:

- The user id (e.g. IMSI) identifying the UE impacted by congestion;
- PDN ID for which congestion information is reported;
- Congestion level information (either congestion level value or congestion level set id) of the UE impacted by congestion;
- eNodeB identifier, ECGI or SAI identifying the eNodeB, E-UTRAN cell or Service Area respectively, serving the UE if a conditional restriction to restrict location reporting is not enabled.

NOTE 1: In case of E-UTRAN, whether the eNodeB identifier or the ECGI are included in the RUCI is up to operator configuration in the RCAF.

The RCAF sends the RUCI to the PCRFs serving the UEs' PDN connections as follows:

- For a PDN connection in a non-roaming scenario the RCAF reports the RUCI to the PCRF;
- For a PDN connection in a local breakout scenario, based on operator configuration, the RCAF reports the RUCI to the V-PCRF;

- For a PDN connection in a home routed scenario, based on the roaming agreement with the HPLMN and operator configuration, the RCAF reports the RUCI to the H-PCRF

NOTE 2: Reporting of congestion information to the HPLMN may be used e.g. in case of a group of PLMNs which belong to a single business entity.

The RCAF determines whether a given PDN connection is served in a local breakout or a home routed roaming scenario based on the APN operator identifier received as part of the APN information from the MME or the SGSN as documented in 3GPP TS 23.401 [8] and 3GPP TS 23.060 [9], respectively.

NOTE 3: Operator configuration can be used to limit RUCI reporting on the Np interface to certain APNs only.

The RCAF maintains a context per user id and APN. The context is identified by the IMSI and the APN. It contains the following information:

- The previously reported congestion level over the Np reference point;
- The reporting restrictions received from the PCRF. The reporting restrictions are stored by the RCAF until the PCRF explicitly signals to remove the reporting restrictions.
- The logical PCRF id received from the PCRF to identify the PCRF that is the Np destination for the RCAF when sending aggregate messages.

4.3.2 PCRF

The PCRF is a functional element that encompasses policy control decision and flow based charging control functionalities.

The PCRF may receive RUCI from the RCAF as input for policy decisions of congestion mitigation. The PCRF may provide, update or remove the reporting restrictions of RUCI, or stop or enable RUCI reporting for a given user id and PDN ID. The PCRF may enable or disable the reporting of congestion location identifier as part of RUCI. The PCRF may also remove the context at the RCAF for a given user id and PDN ID.

NOTE: Depending on the RUCI reporting interval configured in the RCAF, a UE can move outside the area indicated without the RCAF immediately notifying the PCRF. In case the PCRF receives information about the cell currently serving a UE via Np and Gx when the location change reporting is enabled, then the information received via Gx is expected to take precedence.

4.3.3 H-PCRF

Functionality defined in clause 4.3.2 shall apply if UE is roaming with home-routed access scenario.

NOTE: Reporting of congestion information to the HPLMN can be used e.g. in case of a group of PLMNs which belong to a single business entity.

4.3.4 V-PCRF

Functionality defined in clause 4.3.2 shall apply if UE is roaming with visited access scenario.

4.4 Procedures over Np reference point

4.4.1 RUCI Report

4.4.1.1 General

The RCAF shall perform the RUCI reporting to the PCRF when at least one of the following conditions applies:

- the RCAF detects a UE in the congestion area for the first time;
- a reporting restriction is enabled and the congestion level set id is changed;