ETSI TS 132 426 V15.1.0 (2018-10)

TECHNICAL SPECIFICATION

LTE;
Telecommunication management;
Performance Management (PM);
Performance measurements Evolved Packet Core (EPC)
network
(3GPP TS 32.426 version 15.1.0 Release 15)

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Sous-Préfecture de Grasse (06) N° 7803/88

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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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    y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

    z the third digit is incremented when editorial only changes have been incorporated in the document.

Introduction

The present document is part of a TS-family covering the 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Telecommunication management; as identified below:

32.401 Performance Management (PM); Concept and requirements

52.402 Performance Management (PM); Performance measurements - GSM

32.404 Performance Management (PM); Performance measurements - Definitions and template

32.405 Performance Management (PM); Performance measurements Universal Terrestrial Radio Access Network (UTRAN)

32.406 Performance Management (PM); Performance measurements Core Network (CN) Packet Switched (PS) domain

32.407 Performance Management (PM); Performance measurements Core Network (CN) Circuit Switched (CS) domain

32.408 Performance Management (PM); Performance measurements Teleservice

32.409 Performance Management (PM); Performance measurements IP Multimedia Subsystem (IMS)

32.425 Performance Management (PM); Performance measurements Evolved Universal Terrestrial Radio Access Network (E-UTRAN)

32.426 Performance Management (PM); Performance measurements Evolved Packet Core network (EPC)

The present document is part of a set of specifications, which describe the requirements and information model necessary for the standardised Operation, Administration and Maintenance (OA&M) of a multi-vendor LTE SAE-system.

During the lifetime of a LTE SAE network, its logical and physical configuration will undergo changes of varying degrees and frequencies in order to optimise the utilisation of the network resources. These changes will be executed through network configuration management activities and/or network engineering, see TS 32.600 [2].

Many of the activities involved in the daily operation and future network planning of a LTE SAE network require data on which to base decisions. This data refers to the load carried by the network and the grade of service offered. In order

to produce this data performance measurements are executed in the NEs, which comprise the network. The data can then be transferred to an external system, e.g. an Operations System (OS) in TMN terminology, for further evaluation. The purpose of the present document is to describe the mechanisms involved in the collection of the data and the definition of the data itself.

Annex B of TS 32.404 helps in the definition of new performance measurements that can be submitted to 3GPP for potential adoption and inclusion in the present document. Annex B of TS 32.404 discusses a top-down performance measurement definition methodology that focuses on how the end-user of performance measurements can use the measurements.

1   Scope

The present document describes the measurements for EPC and combined EPC/UMTS/GSM.
TS 32.401 [1] describes Performance Management concepts and requirements.
The present document is valid for all measurement types provided by an implementation of an EPC network and combined EPC/UMTS/GSM network. Only measurement types that are specific to EPC or combined EPC/UMTS/GSM networks are defined within the present documents.

Vendor specific measurement types used in EPC and combined EPC/UMTS/GSM networks are not covered. Instead, these could be applied according to manufacturer's documentation.

Measurements related to "external" technologies (such as IP) as described by "external" standards bodies (e.g. IETF) shall only be referenced within this specification, wherever there is a need identified for the existence of such a reference.

The definition of the standard measurements is intended to result in comparability of measurement data produced in a multi-vendor network, for those measurement types that can be standardised across all vendors' implementations.

The structure of the present document is as follows:

- Header 1: Network Element (e.g. MME related measurements);

- Header 2: Measurement function;

- Header 3: Measurements.

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 and/or edition number or version number) 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 TS 32.401: "Telecommunication management; Performance Management (PM); Concept and requirements".

[2]   3GPP TS 32.600: "Telecommunication management; Configuration Management (CM); Concept and high-level requirements".

[3]   3GPP TS 24.301: " Technical Specification Group Core Network and Terminals; Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3".

[4]   3GPP TS 29.274: "Evolved General Packet Radio Service (GPRS); Tunnelling Protocol for Control plane (GTPv2-C); Stage 3".

[5]   3GPP TS 23.401: "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access (Release 8)".

[6]   3GPP TS 29.274: " Tunnelling Protocol for Control plane (GTPv2-C)".

[7]   3GPP TS 29.281: "GPRS Tunnelling Protocol User Plane (GTPv1-U)".

[8]   3GPP TS 36.414: "Evolved Universal Terrestrial Access Network (E-UTRAN); S1 data transport".

[9]   3GPP TS 29.272: "Mobility Management Entity (MME) and Serving GPRS Support Node (SGSN) related interfaces based on Diameter protocol".

[10]   3GPP TS 23.203: "Policy and charging control architecture".

[11]   3GPP TS 36.413: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP)".

[12]   3GPP TS 36.412: "Evolved Universal Terrestrial Access Network (E-UTRAN); S1 signaling transport".

[13]   3GPP TS 23.402: "Architecture enhancements for non-3GPP accesses".

[14]   IETF RFC 5136: "Defining Network Capacity".

[15]   3GPP TS 23.246: "Multimedia Broadcast Multicast Service (MBMS); Architecture and functional description".

[16]   3GPP TS 36.445: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); M1 data transport".

[17]   3GPP TS 23.272: Circuit Switched (CS) fallback in Evolved Packet System (EPS); Stage 2.

[18]   3GPP TS 29.212: "Policy and charging control over Gx reference point".

[19]   3GPP TS 29.213: "Policy and charging control signalling flows and Quality of Service (QoS) parameter mapping".

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

[21]   3GPP TS 28.500: "Management concept, architecture and requirements for mobile networks that include virtualized network functions".

[22]   ETSI GS NFV-IFA027 v0.2.0: "Network Functions Virtualisation (NFV); Management and Orchestration; Performance Measurements Specification".

[23]   ETSI GS NFV IFA008 v2.1.1: "Network Functions Virtualisation (NFV); Management and Orchestration; Ve-Vnfm Reference Point - Interface and Information Model Specification".

[24]   3GPP TS 23.214: "Architecture enhancements for control and user plane separation of EPC nodes".

[25]   3GPP TS 29.244: "Interface between the Control Plane and the User Plane nodes".

3   Measurement family and abbreviations

3.1   Measurement family

The measurement names defined in the present document are all beginning with a prefix containing the measurement family name. This family name identifies all measurements which relate to a given functionality and it may be used for measurement administration (see TS 32.401 [1]).

The list of families currently used in the present document is as follows:

-    EQPT (measurements related to Equipment)

-    MM (measurements related to Mobility Management)

-    GTP (measurements related to GTP Management)

-    IP (measurements related to IP Management)

-    IRATHO (measurements related to Inter-Radio Access Technology Handover)

-    QOS (measurements related to Quality Of Service)

-    SEC (measurements related to Security)

- SM (measurements related to Session Management)

- SUB (measurements related to Subscriber Management)

- VR (measurements related to Virtualized Resource)

3.2　Abbreviations

For the purposes of the present document, the following abbreviations apply:

EQPT	Equipment
EPC	Evolved Packet Core
GTP	GPRS Tunnelling Protocol
MME	Mobility Management Entity
NF	Network Function
NFV	Network Function Virtualization
UMTS	Universal Mobile Telecommunications System
UTRAN	Universal Terrestrial Radio Access Network
Subscr	Subscriber
Tau	Tracking area update
Rau	Routeing area update
VNFM	Virtualized Network Function Manager
VR	Virtualized Resource

4　Measurements related to the MME

4.1　Mobility Management

4.1.1　EPS attach procedures

4.1.1.0　General

The measurements types defined in subclauses 4.1.1.1, 4.1.1.2 and 4.1.1.3 are subject to the "2 out of 3 approach".

4.1.1.1　Attempted EPS attach procedures

a) This measurement provides the number of attempted EPS attach procedures initiated within this MME area.

b) CC.

c) Receipt of "ATTACH REQUEST" message with "Attach type" information element indicating "EPS attach" from the MS (TS 24.301 [3]).

d) A single integer value per measurement type defined in e).

e) MM.EpsAttachAtt.E
   Note: E indicates EPS.

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code).

g) Valid for packet switching.

h) EPS.

4.1.1.2　Successful EPS attach procedures

a) This measurement provides the number of successfully performed EPS attach procedures within this MME area.

b) CC.

c) Transmission of a "ATTACH ACCEPT" message to the MS, in response to a "ATTACH REQUEST" message with the "Attach type" information element indicating "EPS attach". If the "ATTACH ACCEPT" message is caused by a retransmission, this will not cause the counter to be increased. (TS 24.301 [3]).

d) A single integer value per measurement type defined in e).

e) MM.EpsAttachSucc.E
Note: E indicates EPS.

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code).

g) Valid for packet switching.

h) EPS.

4.1.1.3 Failed EPS attach procedures

a) This measurement provides the number of failed EPS attach procedures. The measurement is split into subcounters per the reject cause.

b) CC

c) Transmission by the MME of the ATTACH REJECT message to the MS, in response to a "ATTACH REQUEST" message with the "Attach type" information element indicating "EPS attach", the relevant measurement is incremented according to the reject cause. Possible reject causes are defined within TS 24.301 [3].
The sum of all supported per cause measurements shall be equal to the total number of failed EPS attach procedures. In case only a subset of per cause measurements is supported, a sum subcounter will be provided first.

d) Each measurement (as defined in e) is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the *.sum* suffix.

e) MM.EpsAttachFail.*Cause*.E
where *Cause* identifies the reject cause, E indicates EPS.

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code).

g) Valid for packet switching

h) EPS.

4.1.1.4 Combined EPS/IMSI attach

4.1.1.4.0 General

The measurements defined in subclauses 4.1.1.4.1, 4.1.1.4.2 and 4.1.1.4.3 are subject to the "2 out of 3 approach".

4.1.1.4.1 Attempted combined attach procedures

a) This measurement provides the number of attempted combined attach procedures initiated within this MME area.

b) CC

c) Receipt of "ATTACH REQUEST" message with "Attach type" information element indicating "combined EPS/IMSI attach" from the MS (3GPP TS 24.301 [3]).

d) A single integer value per measurement type defined in e).

e) MM.CombAttachAtt.E
Note: E indicates EPS.

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code).

g) Valid for packet switching.

h) EPS

4.1.1.4.2 Successful combined attach procedures

a) This measurement provides the number of successfully performed combined attach procedures within this MME area.

b) CC

c) Transmission of a "ATTACH ACCEPT" message to the MS, in response to a "ATTACH REQUEST" message with the "Attach type" information element indicating "combined EPS/IMSI attach". If the "ATTACH ACCEPT" message is caused by a retransmission, this will not cause the counter to be increased. (TS 24.301 [3]).

d) A single integer value per measurement type defined in e).

e) MM.CombAttachSucc.E
Note: E indicates EPS.

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code).

g) Valid for packet switching.

h) EPS

4.1.1.4.3 Failed combined attach procedures

a) This measurement provides the number of failed combined attach procedures. The measurement is split into subcounters per the reject cause.

b) CC

c) Transmission by the MME of the ATTACH REJECT message to the MS, in response to a "ATTACH REQUEST" message with the "Attach type" information element indicating "combined EPS/IMSI attach", the relevant measurement is incremented according to the reject cause. Possible reject causes are defined within TS 24.301 [3].
The sum of all supported per cause measurements shall be equal to the total number of failed EPS attach procedures. In case only a subset of per cause measurements is supported, a sum subcounter will be provided first.

d) Each measurement (as defined in e) is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the .sum suffix.

e) MM.CombAttachFail.*Cause*.E
where *Cause* identifies the reject cause, E indicates EPS.

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code).

g) Valid for packet switching

h) EPS

4.1.1.5 EPS emergency attach procedures

4.1.1.5.0 General

The measurements defined in subclauses 4.1.1.5.1, 4.1.1.5.2 and 4.1.1.5.3 are subject to the "2 out of 3 approach".

4.1.1.5.1 Attempted emergency attach procedures

a) This measurement provides the number of attempted EPS emergency attach procedures initiated within this MME area.

b) CC

c) Receipt of "ATTACH REQUEST" message with "Attach type" information element indicating "EPS emergency attach" from the MS (TS 24.301 [3]).

d) A single integer value per measurement type defined in e).

e) MM.EmergAttachAtt.E
Note: E indicates EPS.

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code).

g) Valid for packet switching

h) EPS

4.1.1.5.2 Successful emergency attach procedures

a) This measurement provides the number of successfully performed EPS emergency attach procedures within this MME area.

b) CC

c) Transmission of a "ATTACH ACCEPT" message to the MS, in response to a "ATTACH REQUEST" message with the "Attach type" information element indicating "EPS emergency attach". If the "ATTACH ACCEPT" message is caused by a retransmission, this will not cause the counter to be increased. (TS 24.301 [3]).

d) A single integer value per measurement type defined in e).

e) MM. EmergAttachSucc.E
Note: E indicates EPS.

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code).

g) Valid for packet switching.

h) EPS

4.1.1.5.3 Failed emergency attach procedures

a) This measurement provides the number of failed EPS emergency attach procedures. The measurement is split into subcounters per the reject cause.

b) CC

c) Transmission by the MME of the ATTACH REJECT message to the MS, in response to a "ATTACH REQUEST" message with the "Attach type" information element indicating "EPS emergency attach", the relevant measurement is incremented according to the reject cause. Possible reject causes are defined within 3GPP TS 24.301 [3].
The sum of all supported per cause measurements shall be equal to the total number of failed EPS attach procedures. In case only a subset of per cause measurements is supported, a sum subcounter will be provided first.

d) Each measurement (as defined in e) is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the .sum suffix.

e) MM.EmergAttachFail.*Cause*.E
where *Cause* identifies the reject cause, E indicates EPS.

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code).

g) Valid for packet switching

h) EPS

4.1.2   UE-initiated EPS Detach procedure

4.1.2.1   Attempted EPS detach procedures by UE

a) This measurement provides the number of attempted EPS detach procedures initiated by UE within this MME area.

b) CC.

c) Receipt of "DETACH REQUEST" message with "detach type" information element indicating "EPS detach" from the UE (TS 24.301 [3]).

    Editor notes: Attach type message needs to be changed according to TS24.301.

d) A single integer value.

e) MM.EpsDetachUeAtt

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code)

g) Valid for packet switching.

h) EPS.

4.1.2.2   Successful EPS detach procedures by UE

a) This measurement provides the number of successful EPS detach procedures initiated by UE within this MME area.

b) CC

c) Transmission of "DETACH ACCEPT" message from the MME (TS 24.301 [3]).

d) A single integer value.

e) MM.EpsDetachUeSucc

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code)

g) Valid for packet switching.

h) EPS

4.1.3   MME-initiated EPS Detach procedure

4.1.3.1   Attempted EPS detach procedures by MME

a) This measurement provides the number of attempted EPS detach procedures initiated by MME.

b) CC

c) Transmission of "DETACH REQUEST" message by UE from the MME, not including repeat (TS 24.301 [3]).

d) A single integer value.

e) MM.EpsDetachMMEAtt

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code)

g) Valid for packet switching.

h) EPS

4.1.3.2 Successful EPS detach procedures by MME

a) This measurement provides the number of successful EPS detach procedures initiated by MME.

b) CC

c) Receipt of "DETACH ACCEPT" message by MME from the UE (TS 24.301 [3]).

d) A single integer value.

e) MM.EpsDetachMMESucc

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code)

g) Valid for packet switching.

h) EPS

4.1.4 HSS-initiated EPS Detach procedure

4.1.4.1 Attempted EPS detach procedures by HSS

a) This measurement provides the number of attempted EPS detach procedures initiated by HSS.

b) CC

c) Receipt of "CANCEL LOCATION" message by MME from HSS with "cancel type" information element indicating "delete user", not including repeat (TS 24.301 [3]).

d) A single integer value.

e) MM.EpsDetachHssAtt

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code)

g) Valid for packet switching.

h) EPS

4.1.4.2 Successful EPS detach procedures by HSS

a) This measurement provides the number of successful EPS detach procedures initiated by HSS.

b) CC

c) Transmission of "CANCEL LOCATION ACK" message by HSS from the MME (TS 24.301 [3]).

d) A single integer value.

e) MM.EpsDetachHssSucc

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code)

g) Valid for packet switching.

h) EPS

4.1.5   Tracking area update procedure with Serving GW change

4.1.5.0   General

The measurements defined in subclauses 4.1.5.1, 4.1.5.2 and 4.1.5.3 are subject to the "2 out of 3 approach".

4.1.5.1   Attempted tracking area update procedure with Serving GW change

a) This measurement provides the number of attempted tracking area update procedures with Serving GW change initiated within this MME area.

b) CC.

c) Receipt of "TRACKING AREA UPDATE REQUEST" message from a MS with "Last visited registered TAI" information element indicating to the MME that it wishes to be served by a new Serving GW (different to the old Serving GW (TS 24.301 [3])).

d) A single integer value per measurement type defined in e).

e) MM.TauInterSgwAtt

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code).

g) Valid for packet switching.

h) EPS.

4.1.5.2   Successful tracking area update procedure with Serving GW change

a) This measurement provides the number of successfully performed tracking area update procedures with Serving GW change within this MME area.

b) CC.

c) Transmission of a "TRACKING AREA UPDATE ACCEPT" message to the MS, in response to a "TRACKING AREA UPDATE REQUEST" message in which the "Last visited registered TAI" information element indicated to the MME that it wishes to be served by a new Serving GW (different to the old Serving GW). If the "TRACKING AREA UPDATE ACCEPT" message is caused by a retransmission, this will not cause the counter to be increased. (TS 24.301 [3]).

d) A single integer value per measurement type defined in e).

e) MM.TauInterSgwSucc

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code).

g) Valid for packet switching.

h) EPS.

4.1.5.3   Failed tracking area update procedure with Serving GW change

a) This measurement provides the number of failed tracking area update procedure with Serving GW change. The measurement is split into subcounters per the reject cause.

b) CC

c) Transmission of a "TRACKING AREA UPDATE REJECT" message to the MS, in response to a " TRACKING AREA UPDATE REQUEST" message with in which the "Last visited registered TAI" information element indicated to the MME that it wishes to be served by a new Serving GW (different to the old Serving GW), the relevant measurement is incremented according to the reject cause. Possible reject causes are defined within TS 24.301. The sum of all supported per cause measurements shall be equal to the total number of failed Tracking Area Update procedure with Serving GW change. In case only a subset of per cause measurements is supported, a sum subcounter will be provided first.

d) Each measurement (as defined in e) is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the .sum suffix.

e) MM.TauInterSgwFail.*Cause*
where Cause identifies the reject cause.

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code).

g) Valid for packet switching

h) EPS.

4.1.6 Tracking area update procedure without Serving GW change

4.1.6.0 General

The measurements defined in subclauses 4.1.6.1, 4.1.6.2 and 4.1.6.3 are subject to the "2 out of 3 approach".

4.1.6.1 Attempted tracking area update procedure without Serving GW change

a) This measurement provides the number of attempted tracking area update procedures without Serving GW change initiated within this MME area.

b) CC.

c) Receipt of "TRACKING AREA UPDATE REQUEST" message from a MS with "Last visited registered TAI" information element indicating to the MME that it wishes to be served by the same Serving GW as the old Serving GW (TS 24.301 [3]).

d) A single integer value per measurement type defined in e).

e) MM.TauIntraSgwAtt

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code).

g) Valid for packet switching.

h) EPS.

4.1.6.2 Successful tracking area update procedure without Serving GW change

a) This measurement provides the number of successfully performed tracking area update procedures without Serving GW change within this MME area.

b) CC.

c) Transmission of a "TRACKING AREA UPDATE ACCEPT" message to the MS, in response to a "TRACKING AREA UPDATE REQUEST" message in which the "Last visited registered TAI" information element indicated to the MME that it wishes to be served by the same Serving GW as the old Serving GW. If the "TRACKING AREA UPDATE ACCEPT" message is caused by a retransmission, this will not cause the counter to be increased. (TS 24.301 [3]).

d) A single integer value per measurement type defined in e).

e) MM.TauIntraSgwSucc

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code).

g) Valid for packet switching.

h) EPS.

4.1.6.3 Failed tracking area update procedure without Serving GW change

a) This measurement provides the number of failed tracking area update procedure without Serving GW change. The measurement is split into subcounters per the reject cause.

b) CC

c) Transmission of a "TRACKING AREA UPDATE REJECT" message to the MS, in response to a " TRACKING AREA UPDATE REQUEST" message in which the "Last visited registered TAI" information element indicated to the MME that it wishes to be served by the same Serving GW as the old Serving GW, the relevant measurement is incremented according to the reject cause. Possible reject causes are defined within TS 24.301. The sum of all supported per cause measurements shall be equal to the total number of failed Tracking Area Update procedure with Serving GW change. In case only a subset of per cause measurements is supported, a sum subcounter will be provided first.

d) Each measurement (as defined in e) is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the .sum suffix.

e) MM.TauIntraSgwFail.*Cause*
where Cause identifies the reject cause.

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code).

g) Valid for packet switching

h) EPS.

4.1.7 EPS paging procedures

4.1.7.0 General

The measurements defined in subclauses 4.1.7.1, 4.1.7.2 and 4.1.7.3 are subject to the "2 out of 3 approach".

4.1.7.1 Attempted EPS paging procedures

a) This measurement provides the number of attempted PS paging procedures initiated at the MME. The initial paging procedures as well as the repeated paging procedures are counted.

b) CC.

c) Incremented when an EPS paging procedure is started i.e. at the transmission of the first "Paging" message (TS 36.413 [4]) from the MME to the eNodeB, which are counted when paging area is smaller than or equal to one TA.

d) A single integer value.

e) MM.PagingEpsAtt

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code).

g) Valid for packet switching.

h) EPS.

4.1.7.2 Successful EPS paging procedures

a) This measurement provides the number of successful PS paging procedures initiated at the MME. The initial paging procedures as well as the repeated paging procedures are counted.

b) CC.

c) Incremented when a paging_response is received by the MME from the UE as response to an EPS PS paging procedure (Receipt of "SERVICE REQUEST" message with Service Type = Paging Response from the UE (TS 24.301 [3])), which are counted when paging area is smaller than or equal to one TA.

d) A single integer value.

e) MM.PagingEpsSucc

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code).

g) Valid for packet switching.

h) EPS.

4.1.7.3   Failed EPS paging procedures

a) This measurement provides the number of failed PS paging procedures initiated at the MME, i.e. EPS paging procedures that time out. The initial paging procedures as well as the repeated paging procedures are counted.

b) CC.

c) Incremented when an EPS PS paging procedure times out, which are counted when paging area is smaller than or equal to one TA.

d) A single integer value.

e) MM.PagingEpsFail

f) TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code).

g) Valid for packet switching.

h) EPS.

4.1.8   MME control of overload related measurements for EPC

4.1.8.1   Attempted Overload Start procedure

a) This measurement provides the number of attempted Overload Start procedures.

b) CC.

c) Transmission of "OVERLOAD START" message From MME to each eNodeB(TS 23.401[5], TS 36.413 [11]).

d) A single integer value.

e) NM.OverLoadStartAtt.

f) MMEFunction.

g) Valid for packet switching.

h) EPS.

4.1.8.2   Attempted Overload Stop procedure

a) This measurement provides the number of attempted Overload Stop procedures.

b) CC.

c) Transmission of "OVERLOAD STOP" message From MME to each eNodeB(TS 23.401[5], TS 36.413 [11]).

d) A single integer value.

e) NM.OverLoadStopAtt.

f) MMEFunction.

g) Valid for packet switching.

h) EPS.

4.1.9 EMM-Registered subscribers

4.1.9.1 Mean number of EMM-Registered subscribers

a) This measurement provides the mean number of EMM-Registered state subscribers.

b) SI.

c) This measurement is obtained by sampling at a pre-defined interval the number of EMM-Registered subscribers in a MME and then taking the arithmetic mean.

d) A single integer value.

e) MM. RegisteredSubNbrMean

f) MMEFunction.

g) Valid for packet switching.

h) EPS

4.1.9.2 Maximum number of EMM-Registered subscribers

a) This measurement provides the maximum number of EMM-Registered state subscribers.

b) SI.

c) This measurement is obtained by sampling at a pre-defined interval the number of EMM-Rgistered subscribers in MME and then taking the maximum.

d) A single integer value.

e) MM.RegisteredSubNbrMax

f) MMEFunction.

g) Valid for packet switching.

h) EPS

4.1.10 Handover related measurements

4.1.10.1 Inter RAT handover

4.1.10.1.1 Incoming inter RAT handover

4.1.10.1.1.1 Attempted incoming inter RAT handover

a) This measurement provides the number of attempts incoming inter RAT handover from SGSN to MME. The four measurement types defined in e) are subject to the "3 out of 4 approach".

b) CC

c) Receipt by MME of "Forward Relocation Request" message from SGSN, where the BSSGP Cause or RANAP Cause IE (IE type: F-Cause) indicates handover from GSM or UMTS to EPS respectively (See TS 29.274 [4]), or receipt by MME of "Direct Transfer (S101 Session ID, Attach Request, UE Capabilities, TAI)" message from HRPD access network indicates handover from CDMA2000 to EPS (See TS 32.402 [13])

d) Each measurement is an integer value.

e) IRATHO.IncMMEAtt   Combined;
   IRATHO.IncMMEAtt.G   GSM;
   IRATHO.IncMMEAtt.U   UMTS;
   IRATHO.IncMMEAtt.C   CDMA2000.

f) MMEFunction

g) Valid for packet switching.

h) Combined

4.1.10.1.1.2 Successful incoming inter RAT handover

a) This measurement provides the number of successful incoming inter RAT handover from SGSN to MME.
The four measurement types defined in e) are subject to the "3 out of 4 approach".

b) CC

c) Transmission by MME of "Forward Relocation Complete Notification" message to SGSN, indicates handover to EPS(See TS 29.274 [4]), or transmission by MME of "Direct Transfer (S101 Session ID, Attach Accept, (and Bearer Setup Request))" to HRPD access network indicates handover from CDMA2000 to EPS (See TS 32.402 [13]).

d) Each measurement is an integer value.

e) IRATHO.IncMMESucc   Combined;
   IRATHO.IncMMESucc.G   GSM;
   IRATHO.IncMMESucc.U   UMTS
   IRATHO.IncMMESucc.C   CDMA2000.

f) MMEFunction

g) Valid for packet switching.

h) Combined

4.1.10.1.2 Outgoing inter RAT handover

4.1.10.1.2.1 Attempted outgoing inter RAT handover

a) This measurement provides the number of attempts outgoing inter RAT handover from MME to SGSN.
The four measurement types defined in e) are subject to the "3 out of 4 approach".

b) CC

c) Transmission by MME of "Forward Relocation Request" message to SGSN, where the Target Identification IE indicates handover to UMTS or GSM (See TS 29.274 [4]), or transmission by MME of "Direct Transfer Request message (S101 Session ID, SectorID, PDN GW Address(es), GRE key(s) for uplink traffic, APN(s), HRPD message starting HO access)" message to the HRPD access node indicates handover to CDMA2000 (See TS 32.402 [13]).

d) Each measurement is an integer value.

e) IRATHO.OutMMEAtt   Combined;
   IRATHO.OutMMEAtt.G   GSM;
   IRATHO.OutMMEAtt.U   UMTS;
   IRATHO.OutMMEAtt.C   CDMA2000.

f) MMEFunction

g) Valid for packet switching.

h) Combined

4.1.10.1.2.2 Successful outgoing inter RAT handover

a) This measurement provides the number of successful outgoing inter RAT handover from MME to SGSN.
The four measurement types defined in e) are subject to the "3 out of 4 approach".

b) CC

c) Receipt by MME of "Forward Relocation Complete Notification" message from SGSN, indicates handover to UMTS or GSM (See TS 29.274 [4]), or receipt by MME of "Direct Transfer Request message (S101 Session ID, HRPD message with HO access information, Hs-GW Address and GRE key(s) for forwarded traffic, CDMA2000 HO Status)" message from HRPD access network indicates handover to CDMA2000 (See TS 32.402 [13]).

d) Each measurement is an integer value.

e) IRATHO.OutMMESucc   Combined;
  IRATHO.OutMMESucc.G   GSM;
  IRATHO.OutMMESucc.U   UMTS;
  IRATHO.OutMMESucc.C   CDMA2000.

f) MMEFunction

g) Valid for packet switching.

h) Combined

4.1.11 Routeing area update with MME interaction

4.1.11.0 General

The measurements defined in subclauses 4.1.11.1, 4.1.11.2, 4.1.11.3, 4.1.11.4 and 4.1.11.5, are subject to the "4 out of 5 approach".

4.1.11.1 Attempted routeing area update with MME interaction

a) This measurement provides the number of attempted routeing area update with MME interaction initiated within this MME area.

b) CC

c) Receipt of "Context Request" message from a SGSN (TS 29.274 [6]).

d) A single integer value.

e) MM.RauAtt

f) MMEFunction

g) Valid for packet switching.

h) EPS.

4.1.11.2 Successful routeing area update with MME interaction and without S-GW change

a) This measurement provides the number of successfully performed routeing area update with MME interaction and without S-GW change within this MME area.

b) CC.

c) Transmission of a "Context Response" message to the SGSN, IE Cause value is "Request Accepted", with following receipt of "Context Acknowledge" message, IE Indication flags indicate that SGW is not changed (TS 29.274 [6]).

d) A single integer value.

e) MM.RauIntraSgwSucc

f) MMEFunction

g) Valid for packet switching.

h) EPS.

4.1.11.3 Failed routeing area update with MME interaction and without S-GW change

a) This measurement provides the number of failed routeing area update with MME interaction and without S-GW change. The measurement is split into subcounters per the reject cause.

b) CC

c) Transmission of a "Context Response" message to the SGSN, IE Cause value is except "Request Accepted", with following receipt of "Context Acknowledge" message, IE Indication flags indicate that SGW is not changed. The relevant measurement is incremented according to the failure cause. Possible failure causes are defined within TS 29.274 [6]. The sum of all supported per cause measurements shall be equal to the total number of failed routeing area update with MME interaction and without S-GW change. In case only a subset of per cause measurements is supported, a sum subcounter will be provided first.

d) Each measurement is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the .sum suffix.

e) MM.RauIntraSgwFail.*Cause*
where Cause identifies the failure cause.

f) MMEFunction

g) Valid for packet switching

h) EPS.

4.1.11.4 Successful routeing area update with MME interaction and with S-GW change

a) This measurement provides the number of successfully performed routeing area update with MME interaction and with S-GW change within this MME area.

b) CC.

c) Transmission of a "Context Response" message to the SGSN, IE Cause value is "Request Accepted", with following receipt of "Context Acknowledge" message, IE Indication flags indicate that SGW is changed (TS 29.274 [6]).

d) A single integer value.

e) MM.RauInterSgwSucc

f) MMEFunction

g) Valid for packet switching.

h) EPS

4.1.11.5 Failed routeing area update with MME interaction and with S-GW change

a) This measurement provides the number of failed routeing area update with MME interaction and with S-GW change. The measurement is split into subcounters per the reject cause.

b) CC

c) Transmission of a "Context Response" message to the SGSN, IE Cause value is except "Request Accepted", with following receipt of "Context Acknowledge" message, IE Indication flags indicate that SGW is changed. The relevant measurement is incremented according to the failure cause. Possible failure causes are defined within TS 29.274 [6]. The sum of all supported per cause measurements shall be equal to the total number of failed routeing area update with MME interaction and without S-GW change. In case only a subset of per cause measurements is supported, a sum subcounter will be provided first.

d) Each measurement is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the .sum suffix.

e) MM.RauInterSgwFail.*Cause*
where Cause identifies the failure cause.

f) MMEFunction

g) Valid for packet switching.

h) EPS

4.1.12 Combined TA/LA update procedure

4.1.12.0 General

The measurements defined in subclauses 4.1.12.1, 4.1.12.2 and 4.1.12.3 are subject to the "2 out of 3 approach".

4.1.12.1 Attempted Combined TA/LA update

a) This measurement provides the number of attempted Combined TA/LA update procedures.

b) CC.

c) Receipt of "TRACKING AREA UPDATE REQUEST" message from a UE with the Update Type indicates that this is a combined Tracking Area/Location Area Update Request or a combined Tracking Area/Location Area Update with IMSI attach Request (TS 23.272 [17]).

d) A single integer value per measurement type defined in e).

e) MM.CmbTauLauAtt

f) MMEFunction

g) Valid for packet switching.

h) EPS.

4.1.12.2 Successful Combined TA/LA update

a) This measurement provides the number of successfully performed Combined TA/LA update procedure.

b) CC.

c) Transmission of a "TRACKING AREA UPDATE ACCEPT" message with the LAI information element and without EMM cause information element to the UE, in response to a "TRACKING AREA UPDATE REQUEST" message in which the Update Type information element indicated to the MME that it is a Combined TA/LA update. If the "TRACKING AREA UPDATE ACCEPT" message is caused by a retransmission, this will not cause the counter to be increased. (TS 24.301 [3]).

d) A single integer value per measurement type defined in e).

e) MM. CmbTauLauSucc

f) MMEFunction

g) Valid for packet switching.

h) EPS.

4.1.12.3 Failed Combined TA/LA update

a) This measurement provides the number of failed Combined TA/LA update procedure. The measurement is split into subcounters per the reject cause.

b) CC

c) Transmission of a "TRACKING AREA UPDATE REJECT" message to the UE; or Transmission of a "TRACKING AREA UPDATE ACCEPT" message with no EMM cause and LAI information element or with EMM cause information element to the UE, in response to a "TRACKING AREA UPDATE REQUEST"

message in which the Update Type information element indicated to the MME that it is a Combined TA/LA update (TS 24.301 [3])

d) A single integer value per measurement type defined in e).

e) MM. CmbTauLauFail

f) MMEFunction

g) Valid for packet switching

h) EPS.

4.1.13 Number of implicit detach related measurements

a) This measurement provides the number of implicit detach procedures initiated by MME.

b) CC.

c) MME initiates "Implicit detach" in order to return the EMM context to EMM-DEREGISTERED state. (TS 24.301[3]).

d) A single integer value.

e) MM. EpsImplicitDetach

f) MMEFunction.

g) Valid for packet switching.

h) EPS

4.2 Session Management

4.2.1 Number of dedicated EPS bearers in active mode (Mean)

a) This measurement provides the mean number of dedicated EPS bearers.

b) SI

c) The measurement is obtained by sampling at a pre-defined interval, the number of dedicated EPS bearer established by MME in active mode and then taking the arithmetic mean.

d) A single integer value

e) SM.MeanNbrActDedicatedBearer

f) MMEFunction

g) Valid for packet switching

h) EPS

4.2.2 Number of dedicated EPS bearers in active mode (Maximum)

a) This measurement provides the maximum number of dedicated EPS bearers in active mode.

b) SI

c) The measurement is obtained by sampling at a pre-defined interval, the number of dedicated EPS bearer established by MME in active mode and then taking the.maximum

d) A single integer value

e) SM.MaxNbrActDedicatedBearer

f) MMEFunction

g) Valid for packet switching

h) EPS

4.2.3   Dedicated bearer set-up time by MME (Mean)

a) The measurement provides the valid time per dedicated bearer set-up procedure by MME, (unit: second).

b) DER (n=1)

c) This measurement is obtained by accumulating the time intervals for every successful dedicated bearer setup by MME between the transmission by the MME of a "ACTIVATE DEDICATED EPS BEARER CONTEXT REQUEST" and the corresponding "ACTIVATE DEDICATED EPS BEARER CONTEXT ACCEPT" message receipt by the MME the over a granularity period using DER. If the dedicated bearer setup procedure is beyond one granularity period, only the set-up time for procedures whose message "ACTIVATE DEDICATED EPS BEARER CONTEXT ACCEPT" is received in the granularity period can be accumulated. The end value of this time will then be divided by the number of successful dedicated bearer set-up procedures in the granularity period to give the arithmetic mean, the accumulator shall be reinitialised at the beginning of each granularity period.

d) A single integer value

e) SM.EstabActDedicatedEpsBearerTimeMean

f) MMEFunction

g) Valid for packet switching

h) EPS

4.2.4   MME initiated dedicated bearer activation

4.2.4.1 Attempted dedicated bearer activation procedures by MME

a) The measurement provides the number of attempted dedicated bearer activation procedures by MME.

b) CC

c) Transmission of "ACTIVATE DEDICATED EPS BEARER CONTEXT REQUEST" message by MME (TS 24.301 [3])

d) A single integer value

e) SM.ActDedicatedEpsBearerAtt

f) MMEFunction

g) Valid for packet switching

h) EPS

4.2.4.2   Successful dedicated bearer activation procedures by MME

a) The measurement provides the number of successful dedicated bearer activation procedures by MME

b) CC

c) Receipt of "ACTIVATE DEDICATED EPS BEARER CONTEXT ACCEPT" message by MME (TS 24.301 [3]).

d) A single integer value

e) SM.ActDedicatedEpsBearerSucc

f) MMEFunction

g) Valid for packet switching

h) EPS

4.2.4.3 Failed dedicated bearer activation procedures by MME

a) The measurement provides the number of failed dedicated bearer activation procedures by MME, which is incremented according to the reject cause.

b) CC

c) Receipt of "ACTIVATE DEDICATED EPS BEARER CONTEXT REJECT" message by MME from UE with "ESM Cause" indicating the cause of failure. Each measurement type defined in e) is corresponding to a reject cause, possible reject causes are defined within TS 24.301 [3].

d) A single integer value per measurement type defined in e)

e) SM.ActDedicatedEpsBearerFail.*Cause*
where *Cause* identifies the reject cause.

f) MMEFunction

g) Valid for packet switching

h) EPS

4.2.5 MME initiated dedicated bearer deactivation

4.2.5.1 Attempted dedicated bearer deactivation procedures by MME

a) The measurement provides the number of attempted dedicated bearer deactivation procedures by MME

b) CC

c) Transmission of "DEACTIVATE EPS BEARER CONTEXT REQUEST" message by MME (TS 24.301 [3])

d) A single integer value per measurement type defined in e).

e) SM.DeactEpsDedicatedBearerAtt

f) MMEFunction

g) Valid for packet switching

h) EPS

4.2.5.2 Successful dedicated bearer deactivation procedures by MME

a) The measurement provides the number of successful dedicated bearer deactivation procedures by MME.

b) CC

c) Receipt of "DEACTIVATE EPS BEARER CONTEXT ACCEPT" message by MME (TS 24.301 [3]).

d) A single integer value

e) SM.DeactEpsDedicatedBearerSucc

f) MMEFunction

g) Valid for packet switching

h) EPS

4.2.6. MME initiated EPS bearer modification

4.2.6.1 Attempted EPS bearer modification procedures by MME

a) The measurement provides the number of attempted EPS bearer modification procedures by MME

b) CC

c) Transmission of "MODIFY EPS BEARER CONTEXT REQUEST" message by MME (TS 24.301 [3])

d) A single integer value

e) SM.ModEpsBearerAtt

f) MMEFunction

g) Valid for packet switching

h) EPS

4.2.6.2 Successful EPS bearer modification procedures by MME

a) The measurement provides the number of successful EPS bearer modification procedures by MME.

b) CC

c) Receipt of "MODIFY EPS BEARER CONTEXT ACCEPT" message by MME (TS 24.301 [3]).

d) A single integer value

e) SM.ModEpsBearerSucc

f) MMEFunction

g) Valid for packet switching

h) EPS

4.2.6.3 Failed EPS bearer modification procedures by MME

a) The measurement provides the number of failed EPS bearer modification procedures by MME, which is incremented according to the reject cause.

b) CC

c) Receipt of "MODIFY EPS BEARER CONTEXT REJECT" message by MME from UE with "ESM Cause" taking the reject cause. (TS 24.301 [3]).

d) A single integer value per measurement type defined in e).

e) SM.ModEpsBearerFail.*Cause*
where Cause identifies the reject cause

f) MMEFunction

g) Valid for packet switching

h) EPS

4.2.7 Total EPS Service Request

4.2.7.0 General

The total service requests include both UE initiated and Network initiated service requests.

The measurements defined in subclauses 4.2.7.1, 4.2.7.2 and 4.2.7.3 are subject to the "2 out of 3 approach".

4.2.7.1 Total Attempted EPS Service Request procedures.

a) This measurement provides the total number of attempted EPS Service Request procedures.

b) CC.

c) Receipt of "SERVICE REQUEST" message from the MS (TS 24.301 [3]).

d) A single integer value.

e) SM.EpsServiceReqAtt

f) MMEFunction

g) Valid for packet switching.

h) EPS

4.2.7.2 Total Successful EPS Service Request procedures.

a) This measurement provides the total number of successful EPS Service Request procedures.

b) CC.

c) Transmission of "INITIAL CONTEXT SETUP RESPONSE" message to the eNB as a result of Service Request procedure. (see3GPP TS36.413[11])

d) A single integer value.

e) SM.EpsServiceReqSucc.

f) MMEFunction

g) Valid for packet switching.

h) EPS

4.2.7.3 Total failed EPS Service Request procedures.

a) This measurement provides the total number of failed EPS Service Request procedures.

b) CC.

c) Transmission of "SERVICE REJECT" message to the eNB as a result of Service Request procedure. Possible reject causes are defined within TS 24.301 [3].
The sum of all supported per cause measurements shall be equal to the total number of failed Service Request procedures. In case only a subset of per cause measurements is supported, a sum subcounter will be provided first.

d) Each measurement is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the .sum suffix

e) SM.EpsServiceReqFail.*Cause*
where *Cause* identifies the reject cause.

f) MMEFunction

g) Valid for packet switching.

h) EPS

4.3 Subscriber management for MME

4.3.1 Attempted insert subscriber data requests received from a HSS

a) This measurement provides the number of attempted insert subscriber data requests received from a HSS.

b) CC

c) On receipt by the MME of an Insert Subscriber Data Request message from HSS (see TS 29.272 [9]),

d) A single integer value.

    e) SUB.InsertSubscrDataHssAtt

    f) MMEFunction

    g) Valid for packet switched traffic.

    h) EPS

4.3.2 Attempted delete subscriber data requests received from a HSS

    a) This measurement provides the number of attempted delete subscriber data requests received from a HSS.

    b) CC

    c) On receipt by the MME of a Delete Subscriber Data Request message from HSS (see TS 29.272 [9]),

    d) A single integer value.

    e) SUB.DeleteSubscrDataHssAtt

    f) MMEFunction

    g) Valid for packet switched traffic.

    h) EPS

4.3.3 Number of subscribers in ECM-IDLE state

a) This measurement provides the number of subscribers in ECM-IDLE state. The measurement is split into subcounters per track area (TA). If a TAList contains multi-TA, this subcounter can be measured in current TA in which subscribers were in ECM-CONNECTED state last time.

b) GAUGE.

c) This measurement is obtained at the end of measurement period in a MME.

d) A single integer value.

e) SUB.NbrSubEcmIdle

f) MMEFunction
    TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code)

g) Valid for packet switching.

h) EPS

4.3.4 Number of subscribers in ECM-CONNECTED state

a) This measurement provides the number of subscribers in ECM-CONNECTED state. The measurement is split into subcounters per track area (TA).

b) GAUGE.

c) This measurement is obtained at the end of measurement period in a MME.

d) A single integer value.

e) SUB.NbrSubEcmConnected

f) MMEFunction
    TA, specified by a concatenation of the MCC (Mobile Country Code), MNC (Mobile Network Code), TAC (Tracking Area Code)

g) Valid for packet switching.

h) EPS

4.4 S1-MME data volume related measurements

4.4.1 Number of incoming IP data packets on the S1-MME interface from eNodeB to MME

a) This measurement provides the number of incoming IP data packets on the S1-MME interface from eNodeB to MME.

b) CC.

c) Reception by the MME of an IP data packet on the S1-MME interface from the eNodeB. See TS 36.412 [12].

d) A single integer value.

e) IP.IncDataPktS1MME

f) EP_RP_EPS

g) Valid for packet switching.

h) EPS

4.4.2 Number of outgoing IP data packets on the S1-MME interface from MME to eNodeB

a) This measurement provides the number of outgoing IP data packets on the S1-MME interface from MME to eNodeB.

b) CC.

c) Transmission by the MME of an IP data packet on the S1-MME interface from the MME. See TS 36.412 [12].

d) A single integer value.

e) IP.OutDataPktS1MME

f) EP_RP_EPS

g) Valid for packet switching.

h) EPS

4.4.3 Number of octets of incoming IP data packets on the S1-MME interface from eNodeB to MME

a) This measurement provides the number of octets of incoming IP data packets on the S1-MME interface from eNodeB to MME.

b) CC.

c) Reception by the MME of an IP data packet on the S1-MME interface from the eNodeB, the data packet size is extracted from the IP header and added on to the measurement value. See TS 36.412[5].

d) A single integer value.

e) IP.IncDataOctS1MME

f) EP_RP_EPS

g) Valid for packet switching.

h) EPS

4.4.4 Number of octets of outgoing IP data packets on the S1-MME interface from MME to eNodeB

a) This measurement provides the number of octets of outgoing IP data packets on the S1-MME interface from MME to eNodeB.

b) CC.

c) Transmission by the MME of an IP data packet on the S1-MME interface from the MME, the data packet size is extracted from the IP header and added on to the measurement value. See TS 36.412[5].

d) A single integer value.

e) IP.OutDataOctS1MME

f) EP_RP_EPS

g) Valid for packet switching.

h) EPS

4.5 Void

4.6   S6a related measurements

4.6.1   Update location related measurements

4.6.1.1   General

The measurements defined in subclauses 4.6.1.2, 4.6.1.3 and 4.6.1.4 are subject to the "2 out of 3 approach".

4.6.1.2   Attempted update location procedure

a) This measurement provides the number of attempted update location procedures on S6a interface.

b) CC

c) On transmission of "Update-Location-Request" command by MME to HSS on S6a interface to update location information in the HSS (TS 29.272[9]).

d) A single integer value.

e) MM.UpdLocHSSAtt

f) EP_RP_EPS
   MMEFunction

g) Valid for packet switching.

h) EPS

4.6.1.3   Successful update location procedure

a) This measurement provides the number of successful update location procedures on S6a interface.

b) CC

c) On receipt of "Update-Location-Answer" message by MME from HSS on S6a interface to indicate that update location information is successful in the HSS (TS 29.272 [9]).

d) A single integer value.

e) MM.UpdLocHssSucc

f) EP_RP_EPS
   MMEFunction

g) Valid for packet switching.

h) EPS

4.6.1.4   Failed update location procedure

a) This measurement provides the number of failed update location procedures on S6a interface. The measurement is split into subcounters per cause.

b) CC

c) On receipt of "Update-Location-Answer" message by MME from HSS on S6a interface, where Experimental-Result AVP is used to indicate S6a error. Each failed update location procedure will be added to the relevant measurement according to the failure cause. Possible failure causes are included in 3GPP TS 29.272[9]. The sum of all supported per cause measurements shall equal the total number of failed update location procedures. In case only a subset of per cause measurements is supported, a sum subcounter will be provided first.

d) Each measurement (as defined in e) is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the *.sum* suffix.

e) MM.UpdLocHssFail.*Cause*
   where *Cause* identifies the cause of failure.

f) EP_RP_EPS
    MMEFunction

g) Valid for packet switching.

h) EPS

4.7   S6a related measurements

4.7.1   Authentication related measurements

4.7.1.1   General

The measurements defined in subclauses 4.7.1.2, 4.7.1.3 and 4.7.1.4 are subject to the "2 out of 3 approach".

4.7.1.2   Attempted authentication information retrieval procedure

   a) This measurement provides the number of attempted authentication information retrieval procedures on S6a interface.

   b) CC

   c) On transmission of "Authentication-Information-Request (AIR)" command by MME to HSS on S6a interface to indicate to request authentication information from HSS (TS 29.272[9]).

   d) A single integer value.

   e) SEC.AuthInfoHssAtt

   f) EP_RP_EPS
      MMEFunction

   g) Valid for packet switching.

   h) EPS

4.7.1.3   Successful authentication information retrieval procedure

   a) This measurement provides the number of successful authentication information retrieval procedures on S6a interface.

   b) CC

   c) On receipt of "Authentication-Information-Answer (AIA)" message by MME from HSS on S6a interface to indicate that authentication information retrieval is successful from the HSS (TS 29.272 [9]).

   d) A single integer value.

   e) SEC.AuthInfoHssSucc

   f) EP_RP_EPS
      MMEFunction

   g) Valid for packet switching.

   h) EPS

4.7.1.4   Failed authentication information retrieval procedure

   a) This measurement provides the number of failed authentication information retrieval procedures on S6a interface. The measurement is split into subcounters per cause.

   b) CC

   c) On receipt of "Authentication-Information-Answer" message by MME from HSS on S6a interface, where Experimental-Result AVP is used to indicate S6a error. Each failed authentication information retrieval procedure will be added to the relevant measurement according to the failure cause. Possible failure causes are included in 3GPP TS 29.272[9]. The sum of all supported per cause measurements shall equal the total number of failed authentication information retrieval procedures. In case only a subset of per cause measurements is supported, a sum subcounter will be provided first.

d) Each measurement is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the *.sum* suffix.

e) SEC.AuthInfoHssFail.*Cause*
where *Cause* identifies the cause of failure.

f) EP_RP_EPS
MMEFunction

g) Valid for packet switching.

h) EPS

5 Measurements related to the PDN-GW for a GTP based S5/S8

5.1 Session Management

5.1.1 PDN-GW initiated Dedicated Bearer Creation

5.1.1.0 General

The measurements defined in subclauses 5.1.1.1, 5.1.1.2 and 5.1.1.3 are subject to the "2 out of 3 approach".

The measurements defined in subclauses 5.1.1.1, 5.1.1.2 and 5.1.1.3 are applicable to PGW-C for EPC CUPS situation as specified in [xx].

5.1.1.1 Attempted number of PDN-GW initiated Dedicated Bearer Creation

a) This measurement provides the number of attempted PDN-GW initiated Dedicated Bearer Creation

b) CC

c) Transmission of "Create Bearer REQUEST" message From PDN-GW, this message may contains multiple Bearer IDs, each bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.CreationPGWInitBearerAtt

f) PGWFunction

g) Valid for packet switching.

h) EPS

5.1.1.2 Successful number of PDN-GW initiated Dedicated Bearer Creation

a) This measurement provides the number of successfully performed PDN-GW initiated Dedicated Bearer Creation.

b) CC

c) Receipt of "Create Bearer Response" message by PDN-GW where "Cause" IE identifies a successful bearer handling with "Acceptance Response" from "Cause" IE for each Bearer ID in the table 8.4-1 of TS 29.274, each bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.CreatationPGWInitBearerSucc

f) PGWFunction

g) Valid for packet switching.

h) EPS

5.1.1.3 Failed number of PDN-GW initiated Dedicated Bearer Creation

a) This measurement provides the number of failed PDN-GW initiated Dedicated Bearer Creation. The measurement is split into subcounters per the reject cause.

b) CC

c) Receipt of "Create Bearer Response" message by PDN-GW where "Cause" IE identifies a failed bearer handling with "Rejection Response" which indicates the reason of failure from "Cause" IE for each bearer ID in the table 8.4-1 of TS 29.274, each bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) Each measurement (as defined in e) is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the .sum suffix.

e) SM.CreatationPGWInitBearerFail.*Cause*
where Cause identifies the cause of failure.

f) PGWFunction

g) Valid for packet switching

h) EPS

5.1.2 PDN-GW initiated Dedicated Bearer Deletion

5.1.2.0 General

The measurements defined in subclauses 5.1.2.1, 5.1.2.2 and 5.1.2.3 are subject to the "2 out of 3 approach".

The measurements defined in subclauses 5.1.2.1, 5.1.2.2 and 5.1.2.3 are applicable to PGW-C for EPC CUPS situation as specified in [24].

5.1.2.1 Attempted number of PDN-GW initiated Dedicated Bearer Deletion

a) This measurement provides the number of attempted PDN-GW initiated Dedicated Bearer Deletion

b) CC

c) Transmission of "Delete Bearer REQUEST" message From PDN-GW, this message may contains multiple Bearer IDs, each bearer shall be cumulated to the counter (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.DelPGWInitBearerAtt

f) PGWFunction

g) Valid for packet switching.

h) EPS

5.1.2.2 Successful number of PDN-GW initiated Dedicated Bearer Deletion

a) This measurement provides the number of successfully performed PDN-GW initiated Dedicated Bearer Deletion.

b) CC

c) Receipt of "Delete Bearer Response" message by PDN-GW where "Cause" IE identifies a successful bearer handling with "Acceptance Response" from "Cause" IE for each Bearer ID in the table 8.4-1 of TS 29.274, each bearer shall be cumulated to the counter (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.DelPGWInitBearerSucc

f) PGWFunction

g) Valid for packet switching.

h) EPS

5.1.2.3 Failed number of PDN-GW initiated Dedicated Bearer Deletion

a) This measurement provides the number of failed PDN-GW initiated Dedicated Bearer Deletion. The measurement is split into subcounters per the reject cause.

b) CC

c) Receipt of "Delete Bearer Response" message by PDN-GW where "Cause" IE identifies a failed bearer handling with "Rejection Response" which indicates the reason of failure from "Cause" IE for each bearer ID in the table 8.4-1 of TS 29.274, each bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) Each measurement (as defined in e) is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the .sum suffix.

e) SM.DelPGWInitBearerFail.*Cause*
where Cause identifies the cause of failure.

f) PGWFunction

g) Valid for packet switching

h) EPS

5.1.3 PDN-GW initiated Dedicated Bearer Modification with QoS update procedure

5.1.3.0 General

The measurements defined in subclauses 5.1.3.1, 5.1.3.2 and 5.1.3.3 are subject to the "2 out of 3 approach".

The measurements defined in subclauses 5.1.3.1, 5.1.3.2 and 5.1.3.3 are applicable to PGW-C for EPC CUPS situation as specified in [24].

5.1.3.1 Attempted number of PDN-GW initiated Dedicated Bearer Modification with QoS update

a) This measurement provides the number of attempted PDN-GW initiated Dedicated Bearer Modification with QoS update.

b) CC

c) Transmission of "Update Bearer REQUEST" message From PDN-GW with "Bearer Level QoS" IE, this message may contains multiple Bearer IDs, each bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.ModPGWInitBearerQoSUpdateAtt

f) PGWFunction

g) Valid for packet switching.

h) EPS

5.1.3.2 Successful PDN-GW initiated Dedicated Bearer Modification with QoS update

a) This measurement provides the number of successfully performed PDN-GW initiated Dedicated Bearer Modification with QoS update.

b) CC

c) Receipt of "Update Bearer Response" message by PDN-GW with "Bearer Level QoS" IE in the "Update Bearer Request" message which contains the same EPS Bearer ID and where "Cause" IE identifies a successful bearer handling with "Acceptance Response" from "Cause" IE for each Bearer ID in the table 8.4-1 of TS 29.274, each bearer shall be cumulated to the counter (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.ModPGWInitBearerQoSUpdateSucc

f) PGWFunction

g) Valid for packet switching.

h) EPS

5.1.3.3 Failed PDN-GW initiated Dedicated Bearer Modification with QoS update

a) This measurement provides the number of failed PDN-GW initiated Dedicated Bearer Modification with QoS update procedures. The measurement is split into subcounters per the reject cause.

b) CC

c) Receipt of "Update Bearer Response" message by PDN-GW with "Bearer Level QoS" IE in the "Update Bearer Request" message which contains the same EPS Bearer ID and where "Cause" IE identifies a failed bearer handling with "Rejection Response" which indicates the reason of failure from "Cause" IE for each bearer ID in the table 8.4-1 of TS 29.274, each bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) Each measurement (as defined in e) is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the .sum suffix.

e) SM.ModPGWInitBearerQoSUpdateFail.*Cause*
where Cause identifies the cause of failure.

f) PGWFunction

g) Valid for packet switching

h) EPS

5.1.4 PDN-GW initiated Dedicated Bearer Modification without QoS update procedure

5.1.4.0 General

The measurements defined in subclauses 5.1.4.1, 5.1.4.2 and 5.1.4.3 are subject to the "2 out of 3 approach".

The measurements defined in subclauses 5.1.4.1, 5.1.4.2 and 5.1.4.3 are applicable to PGW-C for EPC CUPS situation as specified in [24].

5.1.4.1 Attempted number of PDN-GW initiated Dedicated Bearer Modification without QoS update

a) This measurement provides the number of attempted PDN-GW initiated Dedicated Bearer Modification without QoS update.

b) CC

c) Transmission of "Update Bearer REQUEST" message From PDN-GW without "Bearer Level QoS" IE, this message may contains multiple Bearer IDs, each bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.ModPGWInitBearerNoQoSUpdateAtt

f) PGWFunction

g) Valid for packet switching.

h) EPS

5.1.4.2 Successful number of PDN-GW initiated Dedicated Bearer Modification without QoS update

a) This measurement provides the number of successfully performed PDN-GW initiated Dedicated Bearer Modification without QoS update.

b) CC

c) Receipt of "Update Bearer Response" message by PDN-GW without "Bearer Level QoS" IE in the "Update Bearer Request" message which contains the same EPS Bearer ID and where "Cause" IE identifies a successful bearer handling with "Acceptance Response" from "Cause" IE for each Bearer ID in the table 8.4-1 of TS 29.274, each bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.ModPGWInitBearerNoQoSUpdateSucc

f) PGWFunction

g) Valid for packet switching.

h) EPS

5.1.4.3 Failed number of PDN-GW initiated Dedicated Bearer Modification without QoS update

a) This measurement provides the number of failed PDN-GW initiated Dedicated Bearer Modification without QoS update. The measurement is split into subcounters per the reject cause.

b) CC

c) Receipt of "Update Bearer Response" message by PDN-GW without "Bearer Level QoS" IE in the "Update Bearer Request" message which contains the same EPS Bearer ID and where "Cause" IE identifies a failed bearer handling with "Rejection Response" which indicates the reason of failure from "Cause" IE for each bearer ID in the table 8.4-1 of TS 29.274, each bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) Each measurement (as defined in e) is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the .sum suffix.

e) SM.ModPGWInitBearerNoQoSUpdateFail.*Cause*
where Cause identifies the cause of failure.

f) PGWFunction

g) Valid for packet switching

h) EPS

5.1.5 Active EPS Bearers related measurements for EPC

5.1.5.0 General

The measurements defined in subclauses 5.1.5.1 and 5.1.5.2 are applicable to PGW-C for EPC CUPS situation as specified in [24]

5.1.5.1 Mean Number of Active EPS Bearers

a) This measurement provides the mean number of simultaneous active EPS Bearers.

b) SI.

c) The measurement is obtained by sampling at a pre-defined interval, the number of Active EPS Bearers in PDN GW and then taking the arithmetic mean.
The measurement is split into subcounters per QCI, and the possible QCIs are included in TS 23.203[10].

d) A single integer value per measurement type defined in e).

e) SM.ActEPSBearNbrMean.*QCI*
where *QCI* identifies the EPS Bearer level quality of service class.

f) PGWFunction

g) Valid for packet switching.

h) EPS.

5.1.5.2   Max Number of Active EPS Bearers

a) This measurement provides the peak number of active EPS Bearers in PDN GW.

b) SI.

c) This measurement is obtained by sampling at a pre-defined interval, the number of Active EPS Bearers and then taking the maximum.
The measurement is split into subcounters per QCI, and the possible QCIs are included in TS 23.203[10].

d) A single integer value per measurement type defined in e).

e) SM.ActEPSBearNbrMax.*QCI*.

f) Where *QCI* identifies the EPS Bearer level quality of service class.

g) PGWFunction

h) Valid for packet switching.

i) EPS.

5.1.6   UE requested bearer resource modification related measurements for EPC

5.1.6.0   General

The measurements defined in subclauses 5.1.6.1, 5.1.6.2 and 5.1.6.3 are subject to the "2 out of 3 approach".

The measurements defined in subclauses 5.1.6.1, 5.1.6.2 and 5.1.6.3 are applicable to PGW-C for EPC CUPS situation as specified in [24].

5.1.6.1   Attempted UE requested bearer resource modification procedure

a) This measurement provides the number of attempted UE requested bearer resource modification procedures.

b) CC.

c) Receipt of "Bearer Resource Command" message by PDN GW (TS 23.401[5], TS 29.274 [4]).

d) A single integer value.

e) SM.UEReqBearerResModiAtt.

f) PGWFunction.

g) Valid for packet switching.

h) EPS.

5.1.6.2   Successful UE requested bearer resource modification procedure

a) This measurement provides the number of successfully performed UE requested bearer resource modification procedures.

b) CC.

   c) Transmission of "Update Bearer REQUEST", "Create Bearer REQUEST" or "Delete Bearer REQUEST" message From PDN-GW, the message shall contain the "PTI" IE allocated by the UE to correlate to the UE requested bearer resource modification procedure (TS 23.401[5], TS 29.274 [4]).

   d) A single integer value.

   e) SM.UEReqBearerResModiSucc.

   f) PGWFunction.

   g) Valid for packet switching.

   h) EPS.

5.1.6.3 Failed UE requested bearer resource modification procedure

   a) This measurement provides the number of failed UE requested bearer resource modification procedures.

   b) CC.

   c) Transmission of "Bearer Resource Failure Indication" From PDN GW which may contain the "Cause" IE that indicates the failure cause (TS 23.401[5], TS 29.274 [4]).

   d) Each measurement (as defined in e) is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the .sum suffix.

   e) SM.UEReqBearerResModiFail.*Cause*

   Where *Cause* identifies the failure cause.

   f) PGWFunction.

   g) Valid for packet switching.

   h) EPS.

5.1.7 PDN Connections related measurements for EPC

5.1.7.0 General

The measurements defined in subclauses 5.1.7.1, and 5.1.7.2 are applicable to PGW-C for EPC CUPS situation as specified in [24].

5.1.7.1 Mean Number of PDN Connections, per APN

   a) This measurement provides the mean number of PDN Connections per APN.

   b) SI.

   c) This measurement is obtained by sampling at a pre-defined interval, the number of PDN Connections in PDN GW and then taking the arithmetic mean.

   The measurement is split into subcounters per APN.

   d) Each measurement is an integer value.

   e) SM.PDNConnNbrMean.*APN*

   Where the *APN* identifies the Access Point Name.

   f) PGWFunction.

   g) Valid for packet switching.

   h) EPS.

5.1.7.2   Max Number of PDN Connections, per APN

a) This measurement provides the maximum number of PDN Connections per APN.

b) SI.

c) This measurement is obtained by sampling at a pre-defined interval, the number of PDN Connections in PDN GW and then taking the maximum.

   The measurement is split into subcounters per APN.

d) Each measurement is an integer value.

e) SM.PDNConnNbrMax.*APN*

   Where the *APN* identifies the Access Point Name.

f) PGWFunction.

g) Valid for packet switching.

h) EPS.

5.1.8 Number of EPS bearer

5.1.8.0   General

The measurements defined in subclauses 5.1.8.1 and 5.1.8.2 are applicable to PGW-U for EPC CUPS situation as specified in [24].

5.1.8.1   Mean number of EPS bearers

a) This measurement provides the mean number of EPS bearers in PDN GW.

b) SI

c) The measurement is obtained by sampling at a pre-defined interval, the number of EPS bearer established by PGW and then taking the arithmetic mean. The measurement is split into subcounters for both dedicated bearer and default bearer.

d) A single integer value

e) SM.MeanNbrBearerPgw.Dedicated
   SM.MeanNbrBearerPgw.Default

f) PGWFunction

g) Valid for packet switching

h) EPS

5.1.8.2   Maximum number of EPS bearers

a) a) This measurement provides the maximum number of EPS bearers in PDN GW.

b) b) SI

c) c) The measurement is obtained by sampling at a pre-defined interval, the number of EPS bearer established by PGW and then taking the maximum. The measurement is split into subcounters for both dedicated bearer and default bearer.

d) d) A single integer value

  e) e) SM.PeakNbrBearerPgw.Dedicated
     SM.PeakNbrBearerPgw.Default

  f) f) PGWFunction

  g) g) Valid for packet switching

  h) h) EPS

5.2   SGi related measurements

5.2.0   General

The measurements defined in subclauses 5.2.1 and 5.2.2 are applicable to PGW-U for EPC CUPS situation as specified in [24].

5.2.1   SGi incoming link usage

  a) This measurement provides the IP-layer incoming link usage of SGi interface.

  b) CC

  c) See clause 2.3.4. Definition: IP-type-P (broad spectrum of packet types) Link Usage in IETF RFC 5136 [14].

  d) Each measurement is an integer value.

  e) IP.SGiIncLinkUsage.*SGiRP*
     where *SGiRP* identifies the SGi reference point of this PGWFunction, the format of *SGiRP* is vendor specific.

  f) PGWFunction

  g) Valid for packet switched traffic.

  h) EPS

5.2.2   SGi outgoing link usage

  a) This measurement provides the IP-layer outgoing link usage of SGi interface.

  b) CC

  c) See clause 2.3.4. Definition: IP-type-P (broad spectrum of packet types) Link Usage in IETF RFC 5136 [14].

  d) Each measurement is an integer value.

  e) IP.SGiOutLinkUsage.*SGiRP*
     where *SGiRP* identifies the SGi reference point of this PGWFunction, the format of *SGiRP* is vendor specific.

  f) PGWFunction

  g) Valid for packet switched traffic.

  h) EPS

5.3   PFCP session related measurements

5.3.1   PCFP session establishment procedure

5.3.1.0   General

The three measurement types defined in this clause are subject to the "2 out of 3 approach".

PFCP session establishment procedures for PGW are specified in TS 23.214 [24] and TS 29.244 [25].

5.3.1.1 Attempted number of PFCP session establishment

a) This measurement provides the number of attempted PFCP session establishment..

b) CC.

c) Transmission of "PFCP Session Establishment Request" message from PDN-GW Control Plane, this counter is cumulated by different PFCP Session Establishment message sent by PGW-C as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.EstablishPFCPSessionAtt.

f) PGWCFunction.

g) Valid for packet switching.

h) EPS.

5.3.1.2 Successful number of PFCP session establishment

a) This measurement provides the successful number of PFCP session establishment.

b) CC

c) Receipt of "PFCP Session Establishment Response" message with cause IE "success" from PDN-GW User Plane, PGW-C identifies a successful PFCP session establishment as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.EstablishPFCPSessionSucc.

f) PGWCFunction

g) Valid for packet switching

h) EPS.

5.3.1.3 Failed number of PFCP session establishment

a) This measurement provides the failed number of PFCP session establishment.

b) CC

c) Receipt of "PFCP Session Establishment Response" message with appropriate error cause value from PDN-GW User Plane, PGW-C identifies a failed PFCP session establishment as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.EstablishPFCPSessionFail.*Cause* where Cause identifies the reject cause.

f) PGWCFunction.

g) Valid for packet switching

h) EPS.

5.3.2 PCFP session modification procedure

5.3.2.0 General

The three measurement types defined in this clause are subject to the "2 out of 3 approach".

PFCP session modification procedures for PGW are specified in TS 23.214 [24] and TS 29.244 [25].

5.3.2.1 Attempted number of PFCP session modification

a) This measurement provides the number of attempted PFCP session modification.

b) CC

c) Transmission of "PFCP Session Modification Request" message from PDN-GW Control Plane, this counter is cumulated by different PFCP Session Modification Request messages sent by PGW-C as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.ModifyPFCPSessionAtt.

f) PGWCFunction

g) Valid for packet switching

h) EPS.

5.3.2.2 Successful number of PFCP session modification

a) This measurement provides the successful number of PFCP session modification.

b) CC

c) Receipt of "PFCP Session Modification Response" message with cause IE "success" from PDN-GW User Plane, PGW-C identifies a successful PFCP session modification as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.ModifyPFCPSessionSucc.

f) PGWCFunction

g) Valid for packet switching

h) EPS.

5.3.2.3 Failed number of PFCP session modification

a) This measurement provides the failed number of PFCP session modification.

b) CC

c) Receipt of "PFCP Session Modification Response" message with appropriate error cause value from PDN-GW User Plane, PGW-C identifies a failed PFCP session modification as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.ModifyPFCPSessionFail.*Cause* where Cause identifies the reject cause.

f) PGWCFunction

g) Valid for packet switching

h) EPS.

5.3.3 PCFP session deletion procedure

5.3.3.0 General

The three measurement types defined in this clause are subject to the "2 out of 3 approach".

PFCP session deletion procedures for PGW are specified in TS 23.214 [24] and TS 29.244 [25].

5.3.3.1 Attempted number of PFCP session deletion

a) This measurement provides the number of attempted PFCP session deletion.

b) CC

c) Transmission of "PFCP Session Deletion Request" message from PDN-GW Control Plane, this counter is cumulated by different PFCP Session Deletion Request sent by PGW-C as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.DeletionPFCPSessionAtt.

f) PGWCFunction

g) Valid for packet switching

h) EPS.

5.3.3.2 Successful number of PFCP session deletion

a) This measurement provides the successful number of PFCP session deletion.

b) CC

c) Receipt of "PFCP Session Deletion Response" message with an acceptance cause from PDN-GW User Plane, PGW-C identifies a successful PFCP session deletion as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.DeletionPFCPSessionSucc.

f) PGWCFunction

g) Valid for packet switching

h) EPS.

5.3.3.3 Failed number of PFCP session deletion

a) This measurement provides the failed number of PFCP session deletion.

b) CC

c) Receipt of "PFCP Session Deletion Response" message with a rejection cause from PDN-GW User Plane, PGW-C identifies a failed PFCP session deletion as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.DeletionPFCPSessionFail.*Cause* where Cause identifies the reject cause.

f) PGWCFunction

g) Valid for packet switching

h) EPS.

5.3.4 PFCP session report procedure

5.3.4.0 General

PFCP session report procedures and PGW-C and PGW-U behaviours are specified in TS 29.244 [25] and TS 23.214 [24].

5.3.4.1 Attempted number of PFCP session report

a) This measurement provides the number of attempted PFCP session report related to the PFCP session to the PGW-C function.

b) CC

c) Transmission of "PFCP Session Report" message from PDN-GW User Plane, this counter is cumulated by different PFCP Session Report messages sent by PGW-U as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.ReportPFCPSessionAtt.

f) PGWUFunction

g) Valid for packet switching

h) EPS.

5.3.4.2 Successful number of PFCP session report

a) This measurement provides the number of successful PFCP session report related to the PFCP session to the PGW-C function.

b) CC

c) Receipt of "PFCP Session Report" message from PGW-U and PGW-C sends the PFCP Session Report Response message with cause "success", PGW-C identifies PFCP session report successfully received as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.ReportPFCPSessionSucc.

f) PGWCFunction

g) Valid for packet switching

h) EPS.

5.3.4.3 Failed number of PFCP session report

a) This measurement provides the failed number of PFCP session report related to the PFCP session to the PGW-C function.

b) CC

c) Receipt of "PFCP Session Report" message from PGW-U and PGW-C sends the PFCP Session Report Response message with a rejection cause, PGW-C identifies PFCP session report failed as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.ReportPFCPSessionFail.*Cause* where Cause identifies the reject cause.

f) PGWCFunction

g) Valid for packet switching

h) EPS.

6 Measurements related to the S-GW

6.1 GTP related measurements

6.1.1 GTP S5/S8

6.1.1.1 Number of outgoing GTP data packets on the S5/S8 interface, from S-GW to PDN-GW

a) This measurement provides the number of GTP data PDUs which have been generated by the GTP protocol entity on the S5/S8 interface.

b) CC.

c) Transmission by the S-GW of a GTP data PDU on the S5/S8 interface to the PDN-GW. See TS 29.274 [6] and 29.281 [7].

d) A single integer value.

e) GTP.OutDataPktS5S8SGW

f) EP_RP_EPS

g) Valid for packet switching.

h) EPS

6.1.1.2 Number of incoming GTP data packets on the S5/S8 interface, from PDN-GW to S-GW

a) This measurement provides the number of GTP Data PDUs which have been accepted and processed by the GTP protocol entity on the S5/S8 interface.

b) CC.

c) Reception by the S-GW of a GTP data PDU on the S5/S8 interface from the PDN-GW. See TS 29.274 [6] and 29.281 [7].

d) A single integer value.

e) GTP.IncDataPktS5S8SGW

f) EP_RP_EPS

g) Valid for packet switching.

h) EPS

6.1.1.3 Number of octets of outgoing GTP data packets on the S5/S8 interface, from S-GW to PDN-GW

a) This measurement provides the number of octets of outgoing GTP data packets on the S5/S8 interface.

b) CC.

c) Transmission by the S-GW of a GTP Data PDU (T-PDU) on the S5/S8 interface to the PDN-GW.
The mandatory part of the GTP header is not counted, i.e., the counted number of octets is indicated by the length field of the GTP header. See TS 29.274 [6] and 29.281 [7].

d) A single integer value.

e) GTP.OutDataOctS5S8SGW

f) EP_RP_EPS

g) Valid for packet switching.

h) EPS

6.1.1.4 Number of octets of incoming GTP data packets on the S5/S8 interface, from PDN-GW to S-GW

a) This measurement provides the number of octets of incoming GTP data packets on the S5/S8 interface.

b) CC.

c) Reception by the S-GW of a GTP Data PDU (T-PDU) on the S5/S8 interface from the PDN-GW.
   The mandatory part of the GTP header is not counted, i.e., the counted number of octets is indicated by the length field of the GTP header. See TS 29.274 [6] and 29.281 [7].

d) A single integer value.

e) GTP.IncDataOctS5S8SGW

f) EP_RP_EPS

g) Valid for packet switching.

h) EPS

6.1.1.5 Number of outgoing GTP signalling packets on the S5/S8 interface, from S-GW to PDN-GW

a) This measurement provides the number of GTP signalling PDUs which have been generated by the GTP protocol entity on the S5/S8 interface.

b) CC

c) Transmission by the S-GW of a GTP signalling PDU on the S5/S8 interface to the PDN-GW. See TS 29.274 [6].

d) A single integer value.

e) GTP.OutSigPktS5S8SGW

f) EP_RP_EPS

g) Valid for packet switching.

h) EPS

6.1.1.6 Number of incoming GTP signalling packets on the S5/S8 interface, from PDN-GW to S-GW

a) This measurement provides the number of GTP signalling PDUs which have been accepted and processed by the GTP protocol entity on the S5/S8 interface.

b) CC.

c) Reception by the S-GW of a GTP signalling PDU on the S5/S8 interface from the PDN-GW. See TS 29.274 [6].

d) A single integer value.

e) GTP.IncSigPktS5S8SGW

f) EP_RP_EPS

g) Valid for packet switching.

h) EPS

6.1.1.7 Number of octets of outgoing GTP signalling packets on the S5/S8 interface, from S-GW to PDN-GW

a) This measurement provides the number of octets of outgoing GTP signalling packets on the S5/S8 interface.

b) CC.

c) Transmission by the S-GW of a GTP Signalling PDU on the S5/S8 interface to the PDN-GW.
The mandatory part of the GTP header is not counted, i.e., the counted number of octets is indicated by the length field of the GTP header. See TS 29.274 [6].

d) A single integer value.

e) GTP.OutSigOctS5S8SGW

f) EP_RP_EPS

g) Valid for packet switching.

h) EPS

6.1.1.8 Number of octets of incoming GTP signalling packets on the S5/S8 interface, from PDN-GW to S-GW

a) This measurement provides the number of octets of incoming GTP signalling packets on the S5/S8 interface.

b) CC

c) Reception by the S-GW of a GTP Signalling PDU on the S5/S8 interface from the PDN-GW.
The mandatory part of the GTP header is not counted, i.e., the counted number of octets is indicated by the length field of the GTP header. See TS 29.274 [6].

d) A single integer value.

e) GTP.IncSigOctS5S8SGW

f) EP_RP_EPS

g) Valid for packet switching.

h) EPS

6.1.2 GTP S4 data volume related measurements

6.1.2.1 Number of octets of outgoing GTP packets on the S4 interface, from S-GW to SGSN

a) This measurement provides the number of octets of outgoing GTP packets on the S4 interface.

b) CC.

c) Transmission by the S-GW of a GTP PDU on the S4 interface to the SGSN including the GTP header. See TS 29.274 [6] and 29.281 [7].

d) A single integer value.

e) GTP.OutOctS4SGW

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.1.2.2 Number of octets of incoming GTP packets on the S4 interface, from SGSN to S-GW

a) This measurement provides the number of octets of incoming GTP packets on the S4 interface.

b) CC.

c) Reception by the S-GW of a GTP PDU on the S4 interface from the SGSN including the GTP header. See TS 29.274 [6] and 29.281 [7].

d) A single integer value.

e) GTP.IncOctS4SGW

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.1.3 GTP S12 data volume related measurements

6.1.3.1 Number of octets of outgoing GTP data packets on the S12 interface, from S-GW to UTRAN

a) This measurement provides the number of octets of outgoing GTP data packets on the S12 interface which have been generated by the GTP-U protocol entity on the S12 interface.

b) CC

c) Transmission by the S-GW of a GTP-U Data PDU on the S12 interface to the UTRAN including the GTP-U header. See TS 29.274 [6] and 29.281 [7].

d) A single integer value.

e) GTP.OutDataOctS12SGW

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.1.3.2 Number of octets of incoming GTP data packets on the S12 interface, from UTRAN to S-GW

a) This measurement provides the number of octets of incoming GTP data packets on the S12 interface which have been accepted and processed by the GTP-U protocol entity on the S12 interface.

b) CC

c) Reception by the S-GW of a GTP-U Data PDU on the S12 interface from the UTRAN including the GTP-U header. See TS 29.274 [6] and 29.281 [7].

d) A single integer value.

e) GTP.InDataOctS12SGW

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.2 S1-U data volume related measurements

6.2.1 Number of outgoing GTP data packets on the S1-U interface, from S-GW to eNodeB

a) This measurement provides the number of GTP data PDUs on the S1-U interface which have been generated by the GTP-U protocol entity on the S1-U interface.

b) CC

c) Transmission by the S-GW of a GTP-U data PDU on the S1-U interface to the eNodeB. See TS 36.414 [8].

d) A single integer value.

e) GTP.OutDataPktS1USGW

f) EP_RP_EPS

g) Valid for packet switching.

h) EPS

6.2.2 Number of incoming GTP data packets on the S1-U interface, from eNodeB to S-GW

a) This measurement provides the number of GTP Data PDUs which have been accepted and processed by the GTP-U protocol entity on the S1-U interface.

b) CC

c) Reception by the S-GW of a GTP-U data PDU on the S1-U interface from the eNodeB. See TS 36.414 [8].

d) A single integer value.

e) GTP.InDataPktS1USGW

f) EP_RP_EPS

g) Valid for packet switching.

h) EPS

6.2.3 Number of octets of outgoing GTP data packets on the S1-U interface, from S-GW to eNodeB

a) This measurement provides the number of octets of outgoing GTP data packets on the S1-U interface which have been generated by the GTP-U protocol entity on the S1-U interface.

b) CC

c) Transmission by the S-GW of a GTP-U Data PDU on the S1-U interface to the eNodeB.
 The mandatory part of the GTP-U header is not counted, i.e., the counted number of octets is indicated by the length field of the GTP-U header. See TS 36.414 [8] and 29.281 [7].

d) A single integer value.

e) GTP.OutDataOctS1USGW

f) EP_RP_EPS

g) Valid for packet switching.

h) EPS

6.2.4 Number of octets of incoming GTP data packets on the S1-U interface, from eNodeB to S-GW

a) This measurement provides the number of octets of incoming GTP data packets on the S1-U interface which have been accepted and processed by the GTP-U protocol entity on the S1-U interface.

b) CC

c) Reception by the S-GW of a GTP-U Data PDU on the S1-U interface from the eNodeB.
The mandatory part of the GTP-U header is not counted, i.e., the counted number of octets is indicated by the length field of the GTP-U header. See TS 36.414[8] and 29.281 [7].

d) A single integer value.

e) GTP.InDataOctS1USGW

f) EP_RP_EPS

g) Valid for packet switching.

h) EPS

6.3 Session Management

6.3.1 Related to S4/S11

6.3.1.1 EPS bearer creation related measurements

6.3.1.1.1 Attempted number of default bearer creation

a) This measurement provides the number of attempted default bearer creation.

b) CC

c) Receipt of "Create Session Request" message by SGW from MME on the S11 interface or from SGSN on the S4 interface, this message may contains multiple default bearer IDs, each default bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.CreationDefaultBearerS4Att
SM.CreationDefaultBearerS11Att

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.3.1.1.2 Successful number of default bearer creation

a) This measurement provides the number of successful default bearer creation.

b) CC

c) Transmission of "Create Session Response" message by SGW to MME on the S11 interface or to SGSN on the S4 interface, where "Cause" IE identifies a successful default bearer handling with "Acceptance Response" from "Cause" IE for each default bearer ID in the table 8.4-1 of TS 29.274, each default bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.CreationDefaultBearerS4Succ.
SM.CreationDefaultBearerS11Succ

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.3.1.1.3　　　Attempted number of dedicated bearer creation

a) This measurement provides the number of attempted dedicated bearer creation.

b) CC

c) Transmission of "Create Bearer Request" message by SGW to MME on the S11 interface or to SGSN on the S4 interface, this message may contains multiple dedicated bearer IDs, each dedicated bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.CreationDedicatedBearerS4Att
SM.CreationDedicatedBearerS11Att

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.3.1.1.4　　　Successful number of dedicated bearer creation

a) This measurement provides the number of successful dedicated bearer creation.

b) CC

c) Receipt of "Create Bearer Response" message by SGW from MME on the S11 interface or from SGSN on the S4 interface, where "Cause" IE identifies a successful dedicated bearer handling with "Acceptance Response" from "Cause" IE for each dedicated bearer ID in the table 8.4-1 of TS 29.274, each dedicated bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.CreationDedicatedBearerS4Succ
SM.CreationDedicatedBearerS11Succ

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.3.1.2　　　EPS bearer modification related measurements

6.3.1.2.1　　　Attempted number of bearer modification

a) This measurement provides the number of attempted EPS bearer modification.

b) CC

c) Transmission of "Update Bearer Request" message by SGW to MME on the S11 interface or to SGSN on the S4 interface, this message may contains multiple Bearer IDs, each bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.ModBearerS4Att
SM.ModBearerS11Att

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.3.1.2.2 Successful number of bearer modification

a) This measurement provides the number of successfully performed EPS bearer modification.

b) CC

c) Receipt of "Update Bearer Response" message by SGW from MME on the S11 interface or from SGSN on the S4 interface where "Cause" IE identifies a successful bearer modification handling with "Acceptance Response" from "Cause" IE for each Bearer ID in the table 8.4-1 of TS 29.274, each bearer shall be cumulated to the counter (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.ModBearerS4Succ
SM.ModBearerS11Succ

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.3.2 Related to S5/S8

6.3.2.1 EPS bearer creation related measurements

6.3.2.1.1 Attempted number of default bearer creation

a) This measurement provides the number of attempted default bearer creation.

b) CC

c) Transmission of "Create Session Request" message by SGW to PGW, this message may contains multiple default bearer IDs, each default bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.CreationDefaultBearerS5S8Att

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.3.2.1.2 Successful number of default bearer creation

a) This measurement provides the number of successful default bearer creation.

b) CC

c) Receipt of "Create Session Response" message by SGW from PGW, where "Cause" IE identifies a successful default bearer handling with "Acceptance Response" from "Cause" IE for each default Bearer ID in the table 8.4-1 of TS 29.274, each default bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.CreationDefaultBearerS5S8Succ

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.3.2.1.3 Attempted number of dedicated bearer creation

a) This measurement provides the number of attempted dedicated bearer creation.

b) CC

c) Receipt of "Create Bearer Request" message by SGW from PGW, the message may contains multiple dedicated bearer IDs, each dedicated bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.CreationDedicatedBearerS5S8Att

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.3.2.1.4 Successful number of dedicated bearer creation

a) This measurement provides the number of successful dedicated bearer creation.

b) CC

c) Transmission of "Create Bearer Response" message by SGW to PGW, where "Cause" IE identifies a successful bearer handling with "Acceptance Response" from "Cause" IE for each dedicated Bearer ID in the table 8.4-1 of TS 29.274, each dedicated bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.CreationDedicatedBearerS5S8Succ

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.3.2.2 EPS bearer modification related measurements

6.3.2.2.1 Attempted number of bearer modification

a) This measurement provides the number of attempted EPS bearer modification.

b) CC

c) Receipt of "Update Bearer Request" message by SGW from PGW, this message may contains multiple Bearer IDs, each bearer shall be cumulated to the counter. (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.ModBearerS5S8Att

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.3.2.2.2 Successful number of bearer modification

a) This measurement provides the number of successfully performed EPS bearer modification.

b) CC

c) Transmission of "Update Bearer Response" message by SGW to PGW where "Cause" IE identifies a successful bearer modification handling with "Acceptance Response" from "Cause" IE for each Bearer ID in the table 8.4-1 of TS 29.274, each bearer shall be cumulated to the counter (TS 29.274 [4], TS 23.401[5]).

d) A single integer value per measurement type defined in e).

e) SM.ModBearerS5S8Succ

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.3.3 EPS bearer deletion related measurements

6.3.3.0 General

The measurements defined in subclauses 6.3.3.1, 6.3.3.2 and 6.3.3.3 are subject to the "2 out of 3 approach".

6.3.3.1 Attempted number of bearer deletion

a) This measurement provides the number of attempted bearer deletion.

b) CC

c) Receipt of "Delete Bearer Request" message by SGW, this message may contains multiple bearer IDs, each bearer shall be cumulated to the counter (TS 29.274 [4], TS 23.401[5]).

d) A single integer value.

e) SM.DelSGWBearerAtt

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.3.3.2 Successful number of bearer deletion

a) This measurement provides the number of successful bearer deletion.

b) CC

c) Transmission of "Delete Bearer Response" message by SGW where "Cause" IE identifies a successful bearer handling with "Acceptance Response" from "Cause" IE for each bearer ID in the table 8.4-1 of TS 29.274, each bearer shall be cumulated to the counter (TS 29.274 [4], TS 23.401[5]).

d) A single integer value.

e) SM.DelSGWBearerSucc.

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.3.3.3 Failed number of bearer deletion

a) This measurement provides the number of failed bearer deletion. The measurement is split into subcounters per the reject cause.

b) CC

c) Transmission of "Delete Bearer Response" message by SGW where "Cause" IE identifies a failed bearer handling with "Rejection Response" which indicates the reason of failure from "Cause" IE for each bearer ID in the table 8.4-1 of TS 29.274, each bearer shall be cumulated to the counter (TS 29.274 [4], TS 23.401[5]).

d) Each measurement (as defined in e) is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the *.sum* suffix.

e) SM.DelSGWBearerFail.*Cause*
   where *Cause* identifies the cause of failure.

f) ServingGWFunction

g) Valid for packet switching

h) EPS

6.3.4 Bearer resource Usage related measurements

6.3.4.1 Max number of Active EPS bearers

a) This measurement provides the max number of Active EPS bearers.

b) SI

c) This measurement is obtained by sampling at a pre-defined interval, the number of Active EPS Bearers established by SGW and then taking the maximum.

d) A single integer value.

e) SM. MaxNbrActEPSBearer.

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.3.4.2 Mean number of Active EPS bearers

a) This measurement provides the mean number of Active EPS bearers.

b) SI

c) The measurement is obtained by sampling at a pre-defined interval, the number of Active EPS Bearers established by SGW and then taking the arithmetic mean.

d) A single integer value.

e) SM. MeanNbrActEPSBearer.

f) ServingGWFunction

g) Valid for packet switching.

h) EPS

6.4 PFCP session related measurements

6.4.1 PCFP session establishment procedure

6.4.1.0 General

The three measurement types defined in this clause are subject to the "2 out of 3 approach".

PFCP session establishment procedures for SGW are specified in TS 23.214 [24] and TS 29.244 [25].

6.4.1.1 Attempted number of PFCP session establishment

a) This measurement provides the number of attempted PFCP session establishment.

b) CC

c) Transmission of "PFCP Session Establishment Request" message from SGW control plane function, this counter is cumulated by different PFCP Session Establishment message sent by SGW-C as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.EstablishPFCPSessionAtt.

f) SGWCFunction

g) Valid for packet switching

h) EPS

6.4.1.2 Successful number of PFCP session establishment

a) This measurement provides the successful number of PFCP session establishment.

b) CC

c) Receipt of "PFCP Session Establishment Response" message with cause IE "success" from SGW control plane function, SGW-C identifies a successful PFCP session establishment as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.EstablishPFCPSessionSucc.

f) SGWCFunction

g) Valid for packet switching

h) EPS.

6.4.1.3 Failed number of PFCP session establishment

a) This measurement provides the failed number of PFCP session establishment.

b) CC

c) Receipt of "PFCP Session Establishment Response" message with appropriate error cause value from SGW control plane function, SGW-C identifies a failed PFCP session establishment as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.EstablishPFCPSessionFail.*Cause* where Cause identifies the reject cause.

f) SGWCFunction

g) Valid for packet switching

h) EPS.

6.4.2 PCFP session modification procedure

6.4.2.0 General

The three measurement types defined in this clause are subject to the "2 out of 3 approach".

PFCP session modification procedures for SGW are specified in TS 23.214 [24] and TS 29.244 [25].

6.4.2.1 Attempted number of PFCP session modification

a) This measurement provides the number of attempted PFCP session modification.

b) CC

c) Transmission of "PFCP Session Modification Request" message from SGW control plane function, this counter is cumulated by different PFCP Session Modification Request messages sent by SGW-C as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.ModifyPFCPSessionAtt.

f) SGWCFunction

g) Valid for packet switching

h) EPS.

6.4.2.2 Successful number of PFCP session modification

a) This measurement provides the successful number of PFCP session modification.

b) CC

c) Receipt of "PFCP Session Modification Response" message with cause IE "success" from SGW control plane function, SGW-C identifies a successful PFCP session modification as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.ModifyPFCPSessionSucc.

f) SGWCFunction

g) Valid for packet switching

h) EPS.

6.4.2.3 Failed number of PFCP session modification

a) This measurement provides the failed number of PFCP session modification.

b) CC

c) Receipt of "PFCP Session Modification Response" message with appropriate error cause value from SGW control plane function, SGW-C identifies a failed PFCP session modification as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.ModifyPFCPSessionFail.*Cause* where Cause identifies the reject cause.

f) SGWCFunction

g) Valid for packet switching

h) EPS.

6.4.3   PCFP session deletion procedure

6.4.3.0   General

The three measurement types defined in this clause are subject to the "2 out of 3 approach".

PFCP session deletion procedures for SGW are specified in TS 23.214 [24] and TS 29.244 [x].

6.4.3.1   Attempted number of PFCP session deletion

a) This measurement provides the number of attempted PFCP session deletion.

b) CC

c) Transmission of "PFCP Session Deletion Request" message from SGW control plane function, this counter is cumulated by different PFCP Session Deletion Request sent by SGW-C as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.DeletionPFCPSessionAtt.

f) SGWCFunction

g) Valid for packet switching

h) EPS.

6.4.3.2   Successful number of PFCP session deletion

a) This measurement provides the successful number of PFCP session deletion.

b) CC

c) Receipt of "PFCP Session Deletion Response" message with an acceptance cause from SGW control plane function, SGW-C identifies a successful PFCP session deletion as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.DeletionPFCPSessionSucc.

f) SGWCFunction

g) Valid for packet switching

h) EPS.

6.4.3.3   Failed number of PFCP session deletion

a) This measurement provides the failed number of PFCP session deletion.

b) CC

c) Receipt of "PFCP Session Deletion Response" message with a rejection cause from SGW control plane function, SGW-C identifies a failed PFCP session deletion as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.DeletionPFCPSessionFail.*Cause* where Cause identifies the reject cause.

f) PGWCFunction

g) Valid for packet switching

h) EPS.

6.4.4 PFCP session report procedure

6.4.4 General

PFCP session report procedures and PGW-C and PGW-U behaviours are specified in TS 29.244 [25] and TS 23.214 [24].

6.4.4.1 Attempted number of PFCP session report

a) This measurement provides the number of attempted PFCP session report related to the PFCP session to the PGW-C function.

b) CC

c) Transmission of "PFCP Session Report" message from SGW user plane function, this counter is cumulated by different PFCP Session Report messages sent by SGW-U as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.ReportPFCPSessionAtt.

f) SGWUFunction

g) Valid for packet switching

h) EPS.

6.4.4.2 Successful number of PFCP session report

a) This measurement provides the number of successful PFCP session report related to the PFCP session to the PGW-C function.

b) CC

c) Receipt of "PFCP Session Report" message from SGW-U and SGW-C sends the PFCP Session Report Response message with cause "success", SGW-C identifies PFCP session report successfully received as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.ReportPFCPSessionSucc.

f) SGWCFunction

g) Valid for packet switching

h) EPS.

6.4.4.3 Failed number of PFCP session report

a) This measurement provides the failed number of PFCP session report related to the PFCP session to the PGW-C function.

b) CC

c) Receipt of "PFCP Session Report" message from SGW-U and SGW-C sends the PFCP Session Report Response message with a rejection cause, SGW-C identifies PFCP session report failed as defined in TS 29.244 [25] and TS 23.214 [24].

d) A single integer value.

e) SM.ReportPFCPSessionFail.*Cause* where Cause identifies the reject cause.

f) SGWCFunction

g) Valid for packet switching

h) EPS.

7 Measurements related to the MBMS GW

7.1 Session Management

7.1.1. MBMS session creation related measurements

7.1.1.1 Measurement types

The three measurement types defined in this clause are subject to the "2 out of 3 approach".

7.1.1.2 Attempted number of session creation

a) This measurement provides the number of attempted MBMS session creation.

b) CC

c) Transmission of "Session Start Request" message by MBMS GW to MME or SGSN, per session shall be cumulated to the counter. (TS 23.246 [15]).

d) A single integer value.

e) SM.CreationSessionAtt.

f) MBMSGWFunction

g) Valid for packet switching.

h) EPS

7.1.1.3 Successful number of session creation

a) This measurement provides the number of successful MBMS session creation.

b) CC

c) Receipt of "Session Start Response" message by MBMS GW from MME or SGSN, where "Cause" IE identifies a successful session, the possible causes are defined within TS 29.274 [4]. Each session shall be cumulated to the counter (TS 23.246 [15]).

d) A single integer value.

e) SM.CreationSessionSucc.

f) MBMSGWFunction

g) Valid for packet switching.

h) EPS

7.1.1.4 Failed number of session creation

a) This measurement provides the number of failed MBMS session creation.

b) CC

c) Receipt of "Session Start Response" message by MBMS GW from MME or SGSN, where "Cause" IE identifies a failed session, the possible causes are defined within TS 29.274 [4]. Each expected "Session Start Response" not received by the MBMS GW is added to the measurement cause 'No Reply' (not specified in TS 29.274 [4]). Each failed session shall be cumulated to the counter (TS 23.246 [15]).

d) Each measurement (as defined in e) is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the *.sum* suffix.

e) SM.CreationSessionFail.*Cause*.

where *Cause* identifies the cause of failure.

The cause 'No Reply' is identified by the *.NoReply* suffix.

f) MBMSGWFunction

g) Valid for packet switching.

h) EPS

7.2 M1 data volume related measurements

7.2.1 Number of octets of outgoing GTP data packets on the M1 interface

a) This measurement provides the number of octets of outgoing GTP-U data packets on the M1 interface which have been generated by the GTP-U protocol entity on the M1 interface.

b) CC

c) Transmission by the MBMS GW of a GTP-U Data PDUon the M1 interface to the eNodeB including GTP-U header (See TS 36.445 [16]).

d) A single integer value.

e) GTP.OutDataOctM1MBMSGW

f) MBMSGWFunction

g) Valid for packet switching.

h) EPS

7.2.2 Number of octets of incoming GTP data packets on the M1 interface

a) This measurement provides the number of octets of incoming GTP data packets on the M1 interface which have been accepted and processed by the GTP-U protocol entity on the M1 interface.

b) CC

c) Reception by the MBMS GW of a GTP-U Data PDU on the M1 interface from the eNodeB including GTP-U header (See TS 36.445[16]).

d) A single integer value.

e) GTP.InDataOctM1MBMSGW

f) MBMSGWFunction

g) Valid for packet switching.

h) EPS

8 Measurements related to PCRF

8.1 IP-CAN session establishment related measurements

8.1.0 General

The measurements defined in subclauses 8.1.1, 8.1.2 and 8.1.3 are subject to the "2 out of 3 approach".

8.1.1 Attempted IP-CAN session establishment

    a) This measurement provides the number of attempted IP-CAN session establishment procedures.

    b) CC.

    c) On receipt by the PCRF of a Credit-Control-Request(CCR) Diameter command with a CC-Request-Type AVP set to the value "INITIAL_REQUEST" from PCEF to establish a IP-CAN session on Gx interface (PCC Rule Provisioning in PULL Mode) (see 3GPP TS 29.212 [18], 3GPP TS 29.213[19]).

    d) A single integer value.

    e) QoS.EstabCCRAtt.

    f) EP_RP_EPS.

    g) Valid for packet switched traffic.

    h) EPS.

8.1.2 Successful IP-CAN session establishment

    a) This measurement provides the number of successful IP-CAN session establishment procedures.

    b) CC.

    c) On transmission by the PCRF of a Credit-Control-Answer(CCA) Diameter command to PCEF with a CC-Request-Type AVP set to the value "INITIAL_REQUEST" and "2001" result-code in the UE-Initiated IP-CAN session establishment procedures on Gx interface (PCC Rule Provisioning in PULL Mode) (see 3GPP TS 29.212[18], 3GPP TS 29.213[19], RFC 3588 [20]).

    d) A single integer value.

    e) QoS.EstabCCASucc.

    f) EP_RP_EPS.

    g) Valid for packet switched traffic.

    h) EPS.

8.1.3 Failed IP-CAN session establishment

    a) This measurement provides the number of failed IP-CAN session establishment procedures. The measurement is split into subcounters per the failure cause.

    b) CC.

    c) On transmission by the PCRF of a Credit-Control-Answer(CCA) Diameter command to PCEF with non-2001 result-code in the UE-Initiated IP-CAN session establishment procedures on Gx interface (PCC Rule Provisioning in PULL Mode) (see 3GPP TS 29.212 [18], 3GPP TS 29.213[19], RFC 3588 [20]). Each failed IP-CAN session establishment will be added to the relevant measurement according to the failure cause. Possible failure causes are included in RFC 3588 [20]. The sum of all supported per cause measurements shall equal the total number of failed resource authorization procedures. In case only a subset of per cause measurements is supported, a sum subcounter will be provided first.

d) Each measurement is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the .sum suffix.

e) QoS.EstabCCAFail.*Cause*
where *Cause* identifies the failure cause.

f) EP_RP_EPS.

g) Valid for packet switched traffic.

h) EPS.

8.2 IP-CAN session modification related measurements

8.2.1 General

The measurements defined in subclauses 8.2.2, 8.2.3 and 8.2.4 are subject to the "2 out of 3 approach".

8.2.2 Attempted IP-CAN session modification

a) This measurement provides the number of attempted IP-CAN session modification procedures initiated by UE.

b) CC.

c) On receipt by the PCRF of a Credit-Control-Request(CCR) Diameter command from PCEF to modify an existing IP-CAN session initiated by UE (PCC Rule Provisioning in PULL Mode) (see 3GPP TS 29.213 [19], 3GPP TS 29.212[18]).

d) A single integer value.

e) QOS.ModfAttCCR.

f) PCRFFunction.

g) Valid for packet switched traffic.

h) EPS.

8.2.3 Successful IP-CAN session modification

a) This measurement provides the number of successful IP-CAN session modifications procedures initiated by UE.

b) CC.

c) On transmission by the PCRF of a Credit-Control-Answer(CCA) Diameter command to PCEF with an existing session ID and "2xxx" result-code in the UE-Initiated IP-CAN session modification procedures(PCC Rule Provisioning in PULL Mode) (see 3GPP TS 29.212[18], 3GPP TS 29.213[19], RFC 3588 [20]).

d) A single integer value.

e) QOS.ModfSuccCCA.

f) PCRFFunction.

g) Valid for packet switched traffic.

h) EPS.

8.2.3 Failed IP-CAN session modification

a) This measurement provides the number of failed IP-CAN session modifications procedures initiated by UE. The measurement is split into subcounters per the reject cause.

b) CC.

c) On transmission by the PCRF of a Credit-Control-Answer(CCA) Diameter command to PCEF with non-2xxx result-code in the UE-Initiated IP-CAN session modification procedures (PCC Rule Provisioning in PULL Mode) (see 3GPP TS 29.212 [18], 3GPP TS 29.213[19], RFC 3588 [20]). Each failed IP-CAN session modification will be added to the relevant measurement according to the failure cause. Possible failure causes are included in RFC 3588 [20]. The sum of all supported per cause measurements shall equal the total number of failed resource authorization procedures. In case only a subset of per cause measurements is supported, a sum subcounter will be provided first.

d) Each measurement is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the .sum suffix.

e) QOS.ModfFailCCA.*Cause*
   where *Cause* identifies the failure cause.

f) PCRFFunction.

g) Valid for packet switched traffic.

h) EPS.

8.3 Authorization of QoS resources related measurements

8.3.1 General

The five measurement types defined in clauses 8.3.3, 8.3.4, 8.3.5, 8.3.6 and 8.3.7 are subject to the "4 out of 5 approach".

8.3.2 Overview

The measurements defined in subclause 8.3 are related to procedures of QoS resource authorization. AF initiates a Diameter transaction to PCRF for authorizing the resources in the session establishment or modification. PCRF authorizes the resources based on binding mechanism and service information.

The procedure is shown in figure 8.3-1.
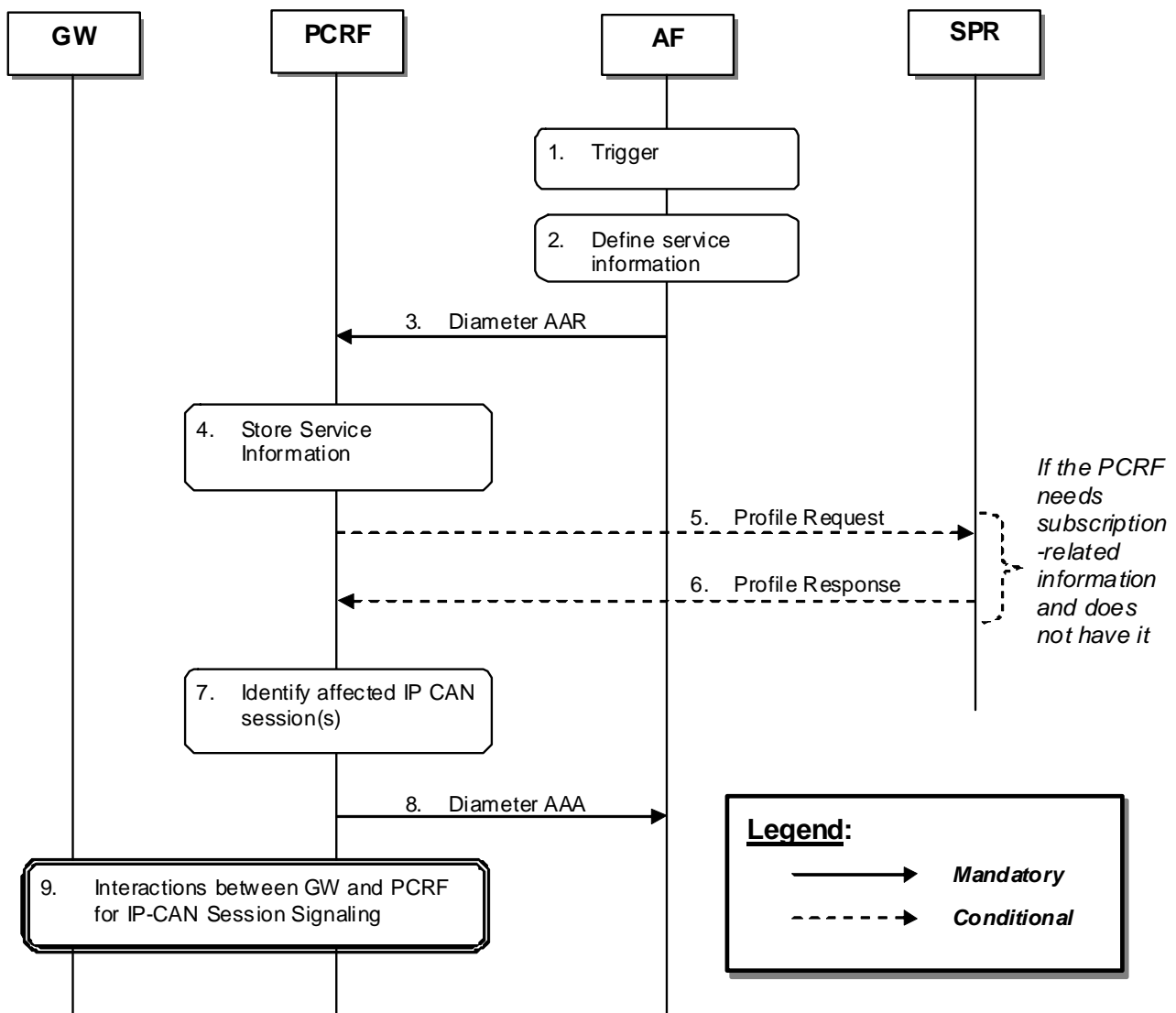
Figure 8.3-1: Resource authorization procedure

8.3.3 Attempted resource authorization procedures at session establishment

a) This measurement provides the number of attempted resource authorizations initiated by AF to PCRF when establishing new sessions.

b) CC.

   c) On receipt by the PCRF of an AAR Diameter command from AF with a new session ID (see 3GPP TS 29.213[19]).

   d) A single integer value.

   e) QOS.EstabAttAARSession.

   f) PCRFFunction.

   g) Valid for packet switched traffic.

   h) EPS

8.3.4 Attempted resource authorization procedures at session modification

   a) This measurement provides the number of attempted resource authorizations initiated by AF to PCRF when modifying the existing sessions.

   b) CC.

   c) On receipt by the PCRF of an AAR Diameter command from AF to modify an existing session (see 3GPP TS 29.213 [19]).

   d) A single integer value.

   e) QOS.ModfAttAARSession.

   f) PCRFFunction.

   g) Valid for packet switched traffic.

   h) EPS.

8.3.5 Successful resource authorization procedures at session establishment

   a) This measurement provides the number of successful resource authorizations initiated by AF to PCRF when establishing new sessions.

   b) CC.

   c) On transmission by the PCRF of an AAA Diameter command to AF with a new stored session ID and "2xxxx" result-code (see 3GPP TS 29.213[19], RFC 3588 [20]).

   d) A single integer value.

   e) QOS.EstabSuccAAASession.

   f) PCRFFunction.

   g) Valid for packet switched traffic.

   h) EPS.

8.3.6 Successful resource authorization procedures at session modification

   a) This measurement provides the number of successful resource authorizations initiated by AF to PCRF when modifying the existing sessions.

   b) CC.

   c) On transmission by the PCRF of an AAA Diameter command to AF with an existing session ID and "2xxxx" result-code (see 3GPP TS 29.213[19], RFC 3588 [20]).

d) A single integer value.

e) QOS.ModfSuccAAASession.

f) PCRFFunction.

g) Valid for packet switched traffic.

h) EPS.

8.3.7   Failed resource authorization procedures

a) This measurement provides the number of failed resource authorizations initiated by AF to PCRF.

b) CC.

c) On transmission by the PCRF of an AAA Diameter command to AF with non-2xxx result-code (see 3GPP TS 29.213 [19], RFC 3588 [20]). Each failed resource authorization procedure will be added to the relevant measurement according to the failure cause. Possible failure causes are included in RFC 3588 [20]. The sum of all supported per cause measurements shall equal the total number of failed resource authorization procedures. In case only a subset of per cause measurements is supported, a sum subcounter will be provided first.

d) Each measurement is an integer value. The number of measurements is equal to the number of causes plus a possible sum value identified by the *.sum* suffix.

e) The measurement name has the form QoS.FailAAA.*Cause*
    where *Cause* identifies the failure cause.

f) PCRFFunction.

g) Valid for packet switched traffic.

h) EPS.

8.4 Gateway Control session establishment related measurements

8.4.1 General

The measurements defined in clauses 8.4.2, 8.4.3 and 8.4.4 are subject to the "2 out of 3 approach".

8.4.2 Attempted Gateway Control session establishment

a) This measurement provides the number of attempted session establishments initiated by BBERF to PCRF.

b) CC.

c) For the non-roaming case, On receipt by the H-PCRF of a Credit-Control-Request(CCR) Diameter command from BBERF; For the roaming case, On receipt by the V-PCRF of a Credit-Control-Request(CCR) Diameter command from BBERF (see 3GPP TS 29.213 [19]).

d) A single integer value.

e) QOS.EstabfGCAttCCR.

f) PCRFFunction.

g) Valid for packet switched traffic.

h) EPS.

8.4.3 Successful Gateway Control session establishment

a) This measurement provides the number of successful session establishments initiated by BBERF to PCRF.

b) CC.

c) For the non-roaming case, On transmission by the H-PCRF of an CCA Diameter command to BBERF; For the roaming case, On transmission by the H-PCRF of an CCA Diameter command to V-PCRF or by the V-PCRF of an CCA Diameter command to BBERF. (see 3GPP TS 29.213[19]).

d) A single integer value.

e) QOS.EstabfGCSuccCCA.

f) PCRFFunction.

g) Valid for packet switched traffic.

h) EPS.

8.4.4 Failed Gateway Control session establishment

a) This measurement provides the number of failed session establishments initiated by BBERF to PCRF.

b) CC.

c) On transmission by the PCRF of a Credit-Control-Answer (CCA) Diameter command to BBERF in the Gateway Control session establishments procedures (3GPP TS 29.213[19]). Each failed Gateway Control session establishments will be added to the relevant measurement according to the failure cause. Possible failure causes are included in RFC 3588 [20]. The sum of all supported per cause measurements shall equal the total number of failed resource authorization procedures. In case only a subset of per cause measurements is supported, a sum subcounter will be provided first.

d) Each measurement is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the .sum suffix.

e) QOS.EstabfGCFailCCA.*Cause*

where *Cause* identifies the failure cause.

   f) PCRFFunction.

   g) Valid for packet switched traffic.

   h) EPS.

8.5 Credit re-authorization procedure related measurements

8.5.1 General

The measurements defined in subclauses 8.5.2, 8.5.3 and 8.5.4 are subject to the "2 out of 3 approach".

8.5.2 Attempted credit re-authorization procedure

  a) This measurement provides the number of attempted credit re-authorization procedures.

  b) CC

  c) On transmission by the PCRF of a Re-Auth-Request (RAR) Diameter command to the PCEF in order to provision PCC rules using the PUSH procedure initiate the provision of unsolicited PCC rules. (See 3GPP TS 29.212 [18]).

  d) A single integer value.

  e) QOS.ReAuthAtt

  f) PCRFFunction

  g) Valid for packet switched traffic.

  h) EPS

8.5.3 Successful credit re-authorization procedure

  a) This measurement provides the number of successful credit re-authorization procedures.

  b) CC

  c) On receipt by the PCRF of a Re-Auth-Answer (RAA) Diameter command from PCEF in response to the RAR command (See 3GPP TS 29.212[18]).

  d) A single integer value.

  e) QOS.ReAuthSucc

  f) PCRFFunction

  g) Valid for packet switched traffic.

  h) EPS

8.5.4 Failed credit re-authorization procedure

  a) This measurement provides the number of failed credit re-authorization procedures. The measurement is split into subcounters per the failure cause.

  b) CC

  c) On receipt by the PCRF of a Re-Auth-Answer (RAA) Diameter command with Result-Code≠2001, from PCEF in response to the RAR command. Each failed credit re-authorization procedure will be added to the relevant measurement according to the failure cause. Possible failure causes are included in RFC 3588 [20]. The sum of all supported per cause measurements shall equal the total number of failed credit re-authorization procedures. In case only a subset of per cause measurements is supported, a sum subcounter will be provided first. (See 3GPP TS 29.212[18])

  d) Each measurement is an integer value. The number of measurements is equal to the number of causes supported plus a possible sum value identified by the .sum suffix.

  e) QOS.ReAuthFail.*Cause*
where *Cause* identifies the failure cause.

f) PCRFFunction

g) Valid for packet switched traffic.

h) EPS

f) PCRFFunction

g) Valid for packet switched traffic.

h) EPS

8.6 IP-CAN session termination related measurements

8.6.1 Attempted IP-CAN session termination

a) This measurement provides the number of attempted IP-CAN session termination procedures on Gx interface.

b) CC

c) On receipt by the PCRF of a Credit-Control-Request(CCR) Diameter command with a CC-Request-Type AVP set to the value "TERMINATION_REQUEST" from PCEF to terminate a IP-CAN session on Gx interface (see 3GPP TS 29.212 [18], 3GPP TS 29.213[19]).

d) A single integer value.

e) QOS.TerminatCCRAtt

f) EP_RP_EPS

g) Valid for packet switched traffic.

h) EPS

8.6.2 Successful IP-CAN session termination

a) This measurement provides the number of successful IP-CAN session termination procedures on Gx interface.

b) CC

c) On transmission by the PCRF of a Credit-Control-Answer(CCA) Diameter command to PCEF with result-code="2001" in response to Credit-Control-Request with CC-Request-Type AVP set to the value "TERMINATION_REQUEST" in the IP-CAN session termination procedures on Gx interface (see 3GPP TS 29.212[18], 3GPP TS 29.213[19], RFC 3588 [20]).

d) A single integer value.

e) QOS.TerminatCCASucc

f) EP_RP_EPS

g) Valid for packet switched traffic.

h) EPS

9 Equipment resource

9.0 Introduction

The measurements defined in this subclause are related to the equipment resource (including physical resources and VR) aspect performance. The measurements defined in the following subclauses are common for all of the NEs/NFs in EPC and shall be applied to all of the NEs/NFs in EPC.

9.1 Processor usage

9.1.1 Mean processor usage

a) This measurement provides the mean usage of processors during the granularity period. For the non-virtualized NE, each equipment may have more than one key processors, the measurement is split into subcounters per key processor. For the virtualized EPC NF, the measurement provides the mean composite virtual CPU usage of the underlying virtualized compute resources of a virtualized EPC NF.

b) For non-virtualized NE: SI;
   For virtualized EPC NF: OM.

c) For non-virtualized NE: this measurement is obtained by sampling at a pre-defined interval the usage of the processor and then taking the arithmetic mean for each key processor;
   For virtualized EPC NF: EM receives one or more VcpuUsageMeanVnf.*vComputeId* measurement(s) (see clause 6.2.1 of ETSI GS IFA 027 [22]) for the VNFC instance(s) from VNFM (see 3GPP TS 28.500 [21]) for one or more collection period(s) used between EM and VNFM, and maps the measured object from VNFC instance(s) that are identified by `objectType` and `objectInstanceId` received in the corresponding source PerformanceReportEntry (see clause 9.7.6.2 of ETSI GS NFV-IFA 008 [23]) to the EPC NF MOI(s). The EM generates the measurement with .sum suffix for each EPC NF MOI by taking the weighted average of the performanceValues of all of the VcpuUsageMeanVnf.*vComputeId* measurement(s) mapped from the VNFC instances to the measured EPC NF MOI. The algorithm of the weighted average is vendor specific.

d) Each measurement is an integer value (Unit: %).

e) The measurement name has the form EQPT.MeanProcessorUsage.*ProcessorID*
   For non-virtualized NE: where *ProcessorID* identifies the key processor of this equipment, the format of *ProcessorID* is vendor specific;
   For virtualized EPC NF: the.sum suffix is used as subcounter name instead of the value of *ProcessorID*.

f) For non-virtualized NE: ManagedElement;
   For virtualized EPC NF, the following measured objects are applicable:
   - MMEFunction
   - PGWFunction
   - ServingGWFunction
   - MBMSGWFunction
   - PCRFFunction

g) Valid for circuit switched and packet switched traffic.

h) EPS.

9.1.2 Peak processor usage

a) This measurement provides the peak usage of each key processor during the granularity period. This measurements is only applicable to non-virtualized NE. Each equipment may have more than one key processors, the measurement is split into subcounters per key processor.

b) SI.

c) This measurement is obtained by sampling at a pre-defined interval the usage of the processor and then taking the maximum for each key processor.

d) Each measurement is an integer value (Unit: %).

e) The measurement name has the form EQPT.PeakProcessorUsage.*ProcessorID*
   where *ProcessorID* identifies the key processor of this equipment, the format of *ProcessorID* is vendor specific.

f) ManagedElement.

g) Valid for circuit switched and packet switched traffic.

h) EPS.

9.2 Memory usage

9.2.1 Mean memory usage

a) This measurement provides the mean memory usage during the granularity period. For the non-virtualized NE, the measurement is split into subcounters per key memory. For the virtualized EPC NF, the measurement provides the mean composite virtual memory usage of the underlying virtualized compute resources of a virtualized EPC NF.

b) For non-virtualized NE: SI;
   For virtualized EPC NF: OM

c) For non-virtualized NE: This measurement is obtained by sampling at a predefined interval the usage of the memory and then taking the arithmetic mean;
   For virtualized EPC NF: EM receives one or more VcpuUsageMeanVnf.*vComputeId* measurement(s) (see clause 6.2.1 of ETSI GS IFA 027 [22]) for the VNFC instance(s) from VNFM (see 3GPP TS 28.500 [21]) for one or more collection period(s) used between EM and VNFM, and maps the measured object from VNFC instance(s) that are identified by `objectType` and `objectInstanceId` received in the corresponding source PerformanceReportEntry (see clause 9.7.6.2 of ETSI GS NFV-IFA 008 [23]) to the EPC NF MOI(s). The EM generates the measurement with .sum suffix for each EPC NF MOI by taking the weighted average of the performanceValues of all of the VcpuUsageMeanVnf.*vComputeId* measurement(s) mapped from the VNFC instances to the measured EPC NF MOI. The algorithm of the weighted average is vendor specific.

d) Each measurement is a real value (Unit: %).

e) The measurement name has the form EQPT.MemMeanUsage.*MemID*
   For non-virtualized NE: where the definition of the *MemID* and the number of subcounter are vendor specific;
   For virtualized EPC NF: the.sum suffix is used as subcounter name instead of the value of *MemID*.

f) For non-virtualized NE: ManagedElement;
   For virtualized EPC NF, the following measured objects are applicable:
   - MMEFunction
   - PGWFunction
   - ServingGWFunction
   - MBMSGWFunction
   - PCRFFunction

g) Valid for packet switched traffic.

h) EPS.

9.3 Disk usage

9.3.1 Mean disk usage

a) This measurement provides the mean disk usage during the granularity period. For the non-virtualized NE, the measurement is split into subcounters per key disk. For the virtualized EPC NF, the measurement provides the mean composite virtual disk usage of the underlying virtualized compute resources of a virtualized EPC NF.

b) For non-virtualized NE: SI;
   For virtualized EPC NF: OM

c) For non-virtualized NE: This measurement is obtained by sampling at a predefined interval the usage of the disk and then taking the arithmetic mean;
   For virtualized EPC NF: EM receives one or more VdiskUsageMeanVnf.*vComputeId* measurement(s) (see clause 6.2.1 of ETSI GS IFA 027 [22]) for the VNFC instance(s) from VNFM (see 3GPP TS 28.500 [21]) for one or more collection period(s) used between EM and VNFM, and maps the measured object from VNFC instance(s) that are identified by `objectType` and `objectInstanceId` received in the corresponding source PerformanceReportEntry (see clause 9.7.6.2 of ETSI GS NFV-IFA 008 [23]) to the EPC NF MOI(s). The EM generates the measurement with .sum suffix for each EPC NF MOI by taking the weighted average of the performanceValues of all of the VdiskUsageMeanVnf.*vComputeId* measurement(s) mapped from the VNFC instances to the measured EPC NF MOI. The algorithm of the weighted average is vendor specific.

d) Each measurement is a real value (Unit: %).

e) The measurement name has the form EQPT.DiskMeanUsage.*DiskId*
   For non-virtualized NE: where the definition of the *DiskId* and the number of subcounter are vendor specific;
   For virtualized EPC NF: the.sum suffix is used as subcounter name instead of the value of *DiskID*.

f) For non-virtualized NE: ManagedElement;
   For virtualized EPC NF, the following measured objects are applicable:
   - MMEFunction
   - PGWFunction

- ServingGWFunction
- MBMSGWFunction
- PCRFFunction

g) Valid for packet switched traffic.

h) EPS.

Annex A (informative): Use case for measurements

A.1 Use case for mobility management related measurements

A UE/user needs to register with the network to receive services that require registration. This registration is described as Network Attachment. The always-on IP connectivity for UE/users of the EPS is enabled by establishing a default EPS bearer during Network Attachment. The PCC rules applied to the default EPS bearer may be predefined in the PDN GW and activated in the attachment by the PDN GW itself. The Attach procedure may trigger one or multiple Dedicated Bearer Establishment procedures to establish dedicated EPS bearer(s) for that UE. During the attach procedure, the UE may request for an IP address allocation. Terminals utilising only IETF based mechanisms for IP address allocation are also supported.

If user or subscriber cannot attach to the PS network of EPC, they cannot access network, so they may complain about quality of service provided by EPC network. So it is necessary to define attach related measurements to evaluate network attchment performance of EPC network by attchment success rate.

If inter RAT handover fails, it will lead to call drop. So the measurements related to inter RAT handover are useful to identify the problems in core network, sometimes signalling transmitted in core network will be lost or error because of some unknown reasons. Also for incoming inter RAT handover cases, if MME decides not to allow incoming handover, MME will not send related message to eNodeB, so incoming handover failure will not be counted from EUTRAN measurement. Inter RAT handover related measurements based on MME will cover cases handover from eNodeB to RNC or BSC or CDMA2000 and vice versa. So it is necessary to define inter RAT handover related measurements.

A.2 Use case for detach related measurements

The detach procedure is used by the UE to detach only for EPS services or to detach for both EPS services and non-EPS services or only for non-EPS services via a combined detach procedure. Also the detach procedure can be used by the network to inform the UE that it does not have access to the EPS any longer. Three detach procedures are provided when the UE accesses the EPS through E-UTRAN. The first detach procedure is UE-initiated detach procedure and other detach procedures are network-initiated detach procedures, which are MME-initiated detach procedure and HSS-initiated detach procedure respectively.

The detach procedure shall be invoked by the UE if the UE is switched off, the USIM card is removed from the UE or the EPS capability or CS fallback capability of the UE is disabled. The detach procedure shall be invoked by the network if the UE is illegal or GPRS services are not allowed in this PLMN and etc. The UE is detached either explicitly or implicitly. Explicit detach means that the network or the UE explicitly requests detach and signal with each other; implicit detach means that the network detaches the UE without notifying the UE, which is typically the case when the network presumes that it is not able to communicate with the UE, e.g. due to radio conditions.

If the detach procedure is performed, the EPS bearer context(s) for this particular UE are deactivated locally without peer-to-peer signalling between the UE and the MME.

Due to different EMM causes, the detach procedures are invoked by the UE or the network. In order to estimate the relative performance of detach of EPC network, it is necessary to define detach related measurements by detach success rate.

A.3 Use case for tracking and routeing area update related measurements

If a user fails upating the Tracking Area or Routeing Area, it may not be able to attach to the new Tracking Area or Routeing Area, and then the user experience would be very intolerable. Since MME determines to relocate S-GW based on S-GW service area, which is composed of TAs or RAs, it is assumed that S-GW service area is already known in MMEs. If the MME identifies that the new TA or RA is out of the scope of S-GW service area, it shall perform inter S-

GW Tracking or Routeing Area Update procedure, otherwise, it shall perform intra S-GW Tracking or Routeing Area Update procedure.

Thus it is necessary to define Tracking or Routeing Area Update related measurements includes both Inter and Intra S-GW Tracking or Routeing Area Update procedures to evaluate network tracking or Routeing area update performance of EPC network by calculate success rate.

A.4 Use case for session related measurements

The purpose of the dedicated bearer context activation procedure is to establish an EPS bearer context with specific QoS and TFT (Traffic Flow Template) between the UE and the EPC. The dedicated EPS bearer context activation procedure is initiated by the network, but may be requested by the UE by means of the UE requested bearer resource allocation procedure. The dedicated bearer context activation procedure can be part of the attach procedure, and if the attach procedure fails, the UE shall consider that the dedicated bearer activation has implicitly failed.

The purpose of the EPS bearer context modification procedure is to modify an EPS bearer context with a specific QoS and TFT. The EPS bearer context modification procedure is initiated by the network in order to either modify the QoS, the TFT, or both. The EPS bearer context modification procedure is initiated by the network, but it may be initiated as part of the UE requested bearer resource allocation procedure.

The purpose of the EPS bearer context deactivation procedure is to deactivate an EPS bearer context or disconnect from a PDN by deactivating all EPS bearer contexts to the PDN. The EPS bearer context deactivation procedure is initiated by the network, and it may be triggered by the UE by means of the UE requested bearer resource release procedure or UE requested PDN disconnect procedure.

If users or subscribers cannot use the services provided by EPS successfully, the users' subjective feel to the network is influenced. So it is necessary to define session related measurements to evaluate session performance of EPC network.

A.5 Use case for EPS paging procedures

Paging success rate is one of the important performance indicators for network performance analysis. It measures the paging response acceptance rate when the CN believes that the mobile is in the coverage area and pages the mobile to find the terminating mobile party to complete the incoming call. If the paging success rate is too low, network access success rate will be impacted. Paging success rate is calculated by paging related measurements. So it is necessary to define paging related measurements.

A.6 Use case of PDN-GW initiated Dedicated Bearer Creation related measurements for EPC

As PDN-GW is the element that initiate the dedicated bearer, if PDN-GW can not activate the dedicated bearer, then users or subscribers cannot use the services provided by EPS successfully, which will influence the users' subjective feel to the network. So it is necessary to define PDN-GW initiated Dedicated Bearer Creation related measurements to evaluate session performance of EPC network.

A.7 Use case of PDN-GW initiated Dedicated Bearer Deletion related measurements for EPC

The PDN-GW shall be able to delete the dedicated bearer to release more network resources. If the PDN-GW can not delete the dedicated bearer, then the valid network resource for user will become less and less which may leads to system crash. So it is necessary to define PDN-GW initiated Dedicated Bearer Deletion related measurements to evaluate session performance of EPC network.

A.8 Use case of PDN-GW initiated Dedicated Bearer Modification with QoS Update related measurements for EPC

The PDN-GW shall be able to update the dedicated bearer to modify an EPS bearer with a specific QoS and TFT, if PDN-GW can not update QoS and TFT, then users or subscribers cannot achieve better network resource and the PDN-GW cannot map the service flow to the appropriate bearer, which will influence the users' subjective feel to the network. So it is necessary to define PDN-GW initiated Dedicated Bearer Modification with QoS Update related measurements to evaluate session performance of EPC network.

A.9 Use case of PDN-GW initiated Dedicated Bearer Modification without QoS Update related measurements for EPC

The PDN-GW shall be able to update the dedicated bearer to modify an EPS bearer with a specific TFT, if PDN-GW can not update TFT, then the PDN-GW cannot map the service flow to the appropriate bearer, which will influence the users' subjective feel to the network. So it is necessary to define PDN-GW initiated Dedicated Bearer Modification without QoS Update related measurements to evaluate session performance of EPC network.

A.10 Use case of GTP S5/S8 data volume related measurements

GTP S5/S8 related measurements are used to measure data volume on S5/S8 interface including incoming and outgoing of data and signalling packets without counting the mandatory part of the GTP header.

It is useful to analyze transport bandwidth usage of S5/S8 interface. If the transport bandwidth usage is too high, more bandwidth should be deployed. Also from the ratio of signaling to data bandwidth usage, it is useful to analyze network performance, such as if the ratio of them is too high, some abnormal events are possible happened, GTP S5/S8 related measurements should be together with other performance measurements to analysis network performance to find out the abnormal events.

So it is necessary to define GTP S5/S8 related measurements.

A.11 Use case of S1-U data volume related measurements

S1-U related measurements are used to measure data volume on S1-U interface including incoming and outgoing of GTP data packets and octets without counting the mandatory part of he GTP-U header

It is useful to analyze transport bandwidth usage of S1-U interface. If the transport bandwidth usage is too high, more bandwidth should be deployed, or load balance should be considered according to core network dimension if there are multiple S-GWs connected to multiple eNodeBs.

So it is necessary to define S1-U related measurements.

A.12 Use case of SGi related measurements for EPC

SGi related measurements are used to measure data volume on SGi interface including incoming and outgoing of IP data packets and octets.

It is useful to analyze transport bandwidth usage of SGi interface. If the transport bandwidth usage is too high, more bandwidth should be deployed.

So it is necessary to define SGi related measurements.

A.13   Use case of subscriber management for MME related measurements

Subscriber management includes Insert Subscriber Data and Delete Subscriber Data related measurements that are useful to monitor network performance. For example, a surge of insert or delete subscriber data messages can occur if there is a failure/recovery of a MME, or an operator controlled modification of a large number of subscriber profiles (e.g. to include a new service). Such an increase could lead to overload of signaling network elements, which would otherwise operate efficiently with the available resources.

Since number of subscriber is one of MME capacity indicators, number of subscribers in ECM-IDLE and ECM-CONNECTED state is very useful to learn the load of MME. Measurement object based on TA is needed, especially in the case of MME pool.

So it is necessary to define subscriber management for MME related measurements.

A.14   Use case of S1-MME data volume related measurements

S1-MME related measurements are used to measure data volume on S1-MME interface including incoming and outgoing of IP data packets and octets.

It is useful to analyze transport bandwidth usage of S1-MME interface. If the transport bandwidth usage is too high, more bandwidth should be deployed, or load balance should be considered according to core network dimension if there are multiple MMEs connected to multiple eNodeBs.

So it is necessary to define S1-MME data volume related measurements.

A.15   Use case of Active EPS Bearers related measurements for EPC

Active EPS Bearers related measurements in PDN GW include the mean and maximum number of active EPS Bearers created by PDN GW in QCI level.

The former could reflect the general load condition of PDN GW, which could help the operator for network optimization and load balance. The latter could reflect that whether the capacity of PDN GW should be extended or not, if the maximum number approaches or exceeds the equipment capacity, the operator should consider deploying more capacity or adding new equipment, otherwise it will impact the success rate for user EPS bearer activation.

A.16   Use case of MME control of overload related measurements for EPC

Under unusual circumstances or overload situations, the MME shall restrict the load that its eNodeBs are generating on it using OVERLOAD START message. When the MME has recovered and wishes to increase its load, the MME sends OVERLOAD STOP messages to the eNodeB(s).

The counters should be incremented for each OVERLOAD START message and for each OVERLOAD STOP message sent to an eNodeB respectively, and the severity of the unusual or overload conditions could be reflected by the values of the counters. For Operators, they need to know the probabilities of overload in MME to ensure that the capacity of MME can meet the requirements of subscribers in most cases. So MME control of overload related measurements are very useful for operator and could help operator to monitor unusual or overload conditions, and also estimate the severity of the conditions. Using the measurements, the operator could analyze whether some problems exist in the network or not, and may find out abnormal events leaded to the bad conditions, finally resolve the problems.

A.17 Use case of UE requested bearer resource modification related measurements for EPC

The purpose of UE requested bearer resource modification related measurements for EPC procedure is to request for a modification of bearer resources for one traffic flow aggregate with a specific QoS demand, or for the modification of the packet filters used for an active traffic flow aggregate, without changing QoS.

For example, if the subscribers cannot obtain the QoS resource that they have requested, and the subjective feel of the subscribers to the network may be influenced, but on the other hand, the resource of the network is limited and the subscribers' demand could not be always satisfied. Based on the UE requested bearer resource modification related measurements, operators can get the success rate of UE requested bearer resource modification, which can help opertors find a balance point between the network resource and user experience, and then the operators could optimize the user experience and also network quality. The failure UE requested bearer resource modification can be used also in trouble shooting when necessary.

A.18 Use case for registered subscribers related measurements for EPC

The UE state in the MME enters the EMM-REGISTERED state by a successful TAU procedure for a UE selecting an E-UTRAN cell from GERAN/UTRAN or by an Attach procedure via E-UTRAN. In the EMM-REGISTERED state, the UE can receive services that require registration in the EPS. And the UE location is known in the MME to at least an accuracy of the tracking area list allocated to that UE (excluding some abnormal cases). Operators shall have the knowledge of the number of registered subscribers in MME to evaluate the capacity status of MME.

A.19 Use case of PDN Connections related measurements for EPC

A PDN connection defines the association between a UE represented by one IP address and a PDN represented by a APN.Different kinds of services may be located in different PDN, and the users may access specific service via the specific APN. For example, APN1 is for Internet service accessed by laptop, and then APN2 is for WAP service accessed by mobile phone.

PDN Connections related measurements per APN, including mean and max number of PDN Connections, could provide an approach for the operator to monitor the amount of PDN Connections for specific APN and make the operators know whether the services located in specific PDN are accepted and enjoyed by the subscribers or not.

A.20 Use case of MME processor usage

When network is very busy, for example on important holiday or emergency events happened, the traffic of one MME is very heavy. So MME processor (physical or virtual) usage measurements are very important to indicate MME processor load capability. If MME processors usage is too high, operator must take action to avoid network paralysis.

A.21 Use case for EPS Service Request related Measurements

Service Request procedure is one of the important NAS procedure which is triggered by the UE when it is idle state and has some data to send or receive(after the paging procedure).

There should be a good success rate of the procedure; failing so, would affect the user experience of not sending / receiving the data.

When the UE is in idle state and has some user data pending to be sent, Service Request procedure is triggered by sending the NAS Service Request message to the MME. When the MME Accepts, it would request radio / S1 bearers to be established.

Similarly When the UE is in idle state and the Network has some user data to be sent, Paging procedure is triggered, which when accepted by UE, would trigger the Service Request procedure. In other words, Paging Success can be considered as Service Request procedure initiated by the Network.

A.22 Use case for session management based on SGW related Measurements

If EPS bearer can not be created, then users or subscribers cannot use the services provided by EPS successfully. If EPS bearer can not be updated with a specific QoS and TFT, users or subscribers cannot achieve better network resource. It will influence the users' subjective feel to the network. Also from EPS bearer creation / modification based on SGW related measurements it is useful to evaluate EPS bearer creation or modification success rate on the S4/S11/S5/S8 interface respectively. So it is necessary to define session management based on SGW related measurements.

A.23 Use case for MBMS session related measurements

The purpose of the MBMS session start procedure is to establish the bearer resource for MBMS data transfer. If this session can not be created, then users or subscribers cannot use the MBMS services provided by EPS successfully. It will influence the users' subjective feel to the network. Also from MBMS bearer creation based on MBMS GW related measurements, it is useful to evaluate MBMS bearer creation success rate. So it is necessary to define MBMS session related measurements.

A.24 Use case of SGW bearer deletion related measurements

The SGW shall be able to delete the bearers to release the network resources. If the SGW can not delete the bearers, then the valid network resource for user will become less and less, and it will cuase the bearers can't be activated, and then the users cannot use the services provided by EPS successfully. So it is necessary to define SGW Bearer Deletion related measurements to evaluate the invalid usage of the bearer resource.

A.25 Use case of bearer resource usage related measurements

The number of bearers is an important capacity parameter for SGW. If bearer resource is insufficient, the SGW can not activate the bearer,then the users cannot use the services provided by EPS successfully, which will influence the users' subjective feel to the network. So it is necessary to define usage of bearer resource related measurements to evaluate whether the capacity of SGW should be extended or not.

A.26 Use case for M1 data volume related measurements

The measuerments of data volume on M1 is useful to evaluate the throughput capacity of MBMS GW. If the capacity is not enough, the MBMS GW may need to be extended or load balance should be considered according to core network dimension if there are multiple MBMS GW connected to multiple eNodeBs. So it is necessary to define M1 data volume related measurements.

A.27 Use case for combined TA/LA update procedure related measurements

The CS fallback (CSFB) in EPS enables the provision of voice and other CS-domain services by reuse of the CS infrastructure. When a CS fallback capable UE is EPS/IMSI attached, it initiates the combined TA/LA procedure based on the triggers specified in TS 23.401 and when a CS fallback and/or SMS over SGs capable UE is not EPS/IMSI attached, it may initiate a combined TA/LA procedure in order to use CS Fallback or SMS over SGs services.If a CSFB capable user fails to perform the combined TA/LA update procedure, the user may not be able to use the CS-domain

services, and if the success rate is low the user experience would be bad. So it is necessary to define combined TA/LA update procedure related measurements to evaluate the combined TA/LA update performance of EPC network by calculating the success rate.

A.28 Use case of S4 data volume related measurements

GTP S4 related measurements are used to measure data volume on S4 interface including incoming and outgoing packets.It is useful to analyze transport bandwidth usage of S4 interface. If the transport bandwidth usage is too high, more bandwidth of S4 interface should be deployed or the operator can decide to deploy the optional S12 interface between UTRAN and SGW if S12 interface doesn't exist. So it is necessary to define GTP S4 data volume related measurements.

A.29 Use case of S12 data volume related measurements

S12 related measurements are used to measure data volume on S12 interface including incoming and outgoing of GTP data packets and octets. It is useful to analyze transport bandwidth usage of S12 interface. If the transport bandwidth usage is too high, more bandwidth should be deployed. So it is necessary to define S12 related measurements.

A.30 Use case of implicit detach related measurements

This measurement provides the number of implicit detach procedures initiated by MME. After the mobile reachable timer expires, the MME may initiate an implicit detach procedure in order to return the EMM contexts in the MME to EMM-DEREGISTERED state. Normally, an appropriate configuration of the timer will make the ratio of the number of implicit detach procedures to the total number of detach procedures at the MME side increase and decrease around a specific value resulting in an acceptable quality of service for the users. If an incorrect configuration of the timer results in this ratio being too high, the users will be implicitly detached a large number of times while using a certain application service. This is one of the issues of mobility management and the user's experience will be impaired. Furthermore, this measurement could help operators to analyse users' behaviour when the ratio has changed considerably during a specific time interval.

A.31 Use case for IP-CAN session establishment related measurements

IP-CAN session is association between a UE and an IP network. An IP-CAN session incorporates one or more IP-CAN bearers. So IP-CAN session success rate is an important performance indicator of IP network, it can be calculated from attempted and successful IP-CAN session establishment measurement. And failed IP-CAN session establishment measurement is useful to locate trouble. So it is necessary to define attempted, successful and failed IP-CAN session establishment measurements.

A.32 Use case for credit re-authorization procedure related measurements

Re-Auth-Request (RAR) Command is sent by the PCRF to the PCEF in order to provision PCC rules using the PUSH procedure initiate the provision of unsolicited PCC rules. It is used to provision PCC rules, event triggers and event report indications for the session. So credit re-authorization success rate is an important performance indicator of initiation the provision of unsolicited PCC rules, it can be calculated from attempted and successful credit re-authorization measurement. And failed credit re-authorization measurement is useful to locate trouble. So it is necessary to define attempted, successful and failed credit re-authorization measurements.

A.33 Use case for IP-CAN session related measurements

IP-CAN session is association between a UE and an IP network. An IP-CAN session incorporates one or more IP-CAN bearers. So IP-CAN session establishment and termination success rate is an important performance indicator of IP network. IP-CAN session establishment success rate can be calculated from attempted and successful IP-CAN session

establishment measurement. IP-CAN session termination success rate can be calculated from attempted and successful IP-CAN session termination measurement. Failed IP-CAN session establishment measurement is useful to locate trouble. So it is necessary to define attempted, successful and failed IP-CAN session establishment and attempted, successful termination measurements.

A.34 Use case for update location related measurements

The Update Location Procedure is used between the MME and the HSS and between the SGSN and the HSS to update location information in the HSS. The procedure shall be invoked by the MME or SGSN and is used:

- to inform the HSS about the identity of the MME or SGSN currently serving the user, and optionally in addition;

- to update MME or SGSN with user subscription data;

- to provide the HSS with other user data, such as Terminal Information.

At timer expired, update location message will be sent several times if no answer received, and all procedures will be used to calculate update location success rate. If the update location success rate between MME and HSS is very low, the user data in HSS will be not aligned with the fact. Therefore it is necessary to define attempted and successful update location performance measurements to calculate update location success rate. The failed update location performance measurement is useful to do trouble shooting.

A.35 Use case for authentication information retrieval related measurements

The Authentication Information Retrieval Procedure is used by the MME to request Authentication Information from the HSS. At timer expired, authentication information request will be sent several times if no answer received, and all procedures will be used to calculate Authentication Information Retrieval success rate. If the Authentication Information Retrieval success rate is very low, user experience will be affected, such as user will wait for a long time or even be rejected to access the network. Therefore it is important to define attempted and successful authentication information retrieval performance measurements to calculate authentication information retrieval success rate. The failed authentication information retrieval performance is useful to do trouble shooting.

A.36 Use case for Number of EPS bearer in PGW related measurements

An EPS bearer uniquely identifies traffic flows that receive a common QoS treatment between a UE and a PDN GW for GTP-based S5/S8, and between UE and Serving GW for PMIP-based S5/S8. One EPS bearer is established when the UE connects to a PDN, and that remains established throughout the lifetime of the PDN connection to provide the UE with always-on IP connectivity to that PDN. That bearer is referred to as the default bearer. Any additional EPS bearer that is established for the same PDN connection is referred to as a dedicated bearer.

The number of EPS bearer in PGW is one of the capacity indicators of PGW equipment, so it can help operator to decide to increase capacity or not.

A.37 Use case of VR related measurements for EPC NFs

In case the EPC NF is virtualized, the performance of an EPC NF may be impacted by the underlying VRs (i.e., virtual CPUs, virtual memories and virtual storages). To enable the operator to anaylize the impact of the VRs to the performance of the EPC NF, in addition to the process usage as described in use case A.20, the performance of the virtual memory and virtual disk also needs to be monitored. The usage is the key measurement for the performance of the VR, it can tell whether the VR is overloaded and whether the VR is efficiently utilized. By correlating the VR related measurements with the performance measurement of the EPC NF, the operator can know whether the EPC NF performance is impacted by the VRs. When necessary, the operator may take appropriate action to solve the performance issue of the EPC NF, for example, to scale in/out the VNF instance that realizes the EPC NF, or switch on/off the auto-scaling for the VNF instance.

Annex B (informative):
Change history

					Change history		
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
Dec 2008	SP-42	SP-080840			Presentation to SA for information		1.0.0
Mar 2009	SP-43	SP-090064	--	--	Presentation to SA for approval	2.0.0	8.0.0
Jun 2009	SP-44	SP-090290	001	-	Addition of use case of GTP S5/S8 data volume related measurements	8.0.0	9.0.0
Jun 2009	SP-44	SP-090290	002	-	Addition of GTP S5/S8 data volume related measurements	8.0.0	9.0.0
Jun 2009	SP-44	SP-090290	003	-	Addition of use case of S1-U data volume related measurements	8.0.0	9.0.0
Jun 2009	SP-44	SP-090290	004	-	Addition of S1U data volume related measurements	8.0.0	9.0.0
Jun 2009	SP-44	SP-090290	005	-	Addition of use case of SGi related measurements	8.0.0	9.0.0
Jun 2009	SP-44	SP-090290	006	-	Addition of use case of subscriber management for MME related measurements	8.0.0	9.0.0
Jun 2009	SP-44	SP-090290	007	-	Addition of subscriber management for MME related measurements	8.0.0	9.0.0
Jun 2009	SP-44	SP-090290	008	-	Addition of use case of S1-MME data volume related measurements	8.0.0	9.0.0
Jun 2009	SP-44	SP-090290	009	-	Addition of Active EPS Bearers related measurements for EPC	8.0.0	9.0.0
Jun 2009	SP-44	SP-090290	010	-	Addition of MME control of overload for EPC	8.0.0	9.0.0
Jun 2009	SP-44	SP-090290	011	-	Addition of UE requested bearer resource modification related measurements for EPC	8.0.0	9.0.0
Jun 2009	SP-44	SP-090290	012	-	Use case for registered subscribers related measurements for EPC	8.0.0	9.0.0
Jun 2009	SP-44	SP-090290	013	-	proposal of registered subscriber related measurements for EPC	8.0.0	9.0.0
Jun 2009	SP-44	SP-090290	014	-	Addition of PDN Connections related measurements for EPC	8.0.0	9.0.0
Jun 2009	SP-44	SP-090290	015	-	Addition of S1-MME data volume related measurements	8.0.0	9.0.0
Jun 2009	SP-44	SP-090290	016	-	Addition of inter RAT handover related measurements	8.0.0	9.0.0
Jun 2009	SP-44	SP-090290	017	-	Addition of SGi related measurements	8.0.0	9.0.0
Jun 2009	SP-44	SP-090290	018	-	Addition of MME processor usage related measurements	8.0.0	9.0.0
Sep 2009	SP-45	SP-090627	019	-	Addition of routeing area update with MME interaction related measurements	9.0.0	9.1.0
Sep 2009	SP-45	SP-090627	020	-	Add service request related measurements	9.0.0	9.1.0
Mar 2010	SP-47	SP-100036	021	-	CR R10 Correct 32.426 editorial errors	9.1.0	10.0.0
Mar 2010	SP-47	SP-100036	022	-	Addition of EPS bearer based on SGW related measurements	9.1.0	10.0.0
Sep 2010	SP-49	SP-100487	023	--	Correct NE in measurement condition	10.0.0	10.1.0
Sep 2010	SP-49	SP-100489	024	--	Add bearer resource usage related measurements	10.0.0	10.1.0
Sep 2010	SP-49	SP-100489	025	--	Add SGW bearer deletion related measurements	10.0.0	10.1.0
Sep 2010	SP-49	SP-100650	026	1	Add MBMS session related measurements	10.0.0	10.1.0
Sep 2010	SP-49	SP-100489	027	--	Add the measurements of data volume on M1	10.0.0	10.1.0
Dec 2010	SP-49	SP-100833	031	1	Changing measurement object class SGWFunction to ServingGWFunction - Align with 32.752 EPC NRM definition	10.1.0	10.2.0
Dec 2010	SP-49	SP-100858	033	1	Changing the number of GTP data packets on the S5/S8 interface (without the GTP header)	10.1.0	10.2.0
Dec 2010	SP-49	SP-100833	035	1	Modify trigger message of total successful EPS service request measurement	10.1.0	10.2.0
Dec 2010	SP-49	SP-100833	036	2	Modify subcounters of EPS attach related measurements	10.1.0	10.2.0

Mar 2011	SP-51	SP-110095	037	1		Add combined TA/LA update related measurements	10.2.0	10.3.0
Sep 2011	SP-53	SP-110535	038	1		Add S4 data volume related measurements	10.3.0	11.0.0
Sep 2011	SP-53	SP-110535	039	1		Add S12 data volume related measurements	10.3.0	11.0.0
Sep 2011	SP-53	SP-110535	041	-		Add the measurement of number of implicit detach procedure	10.3.0	11.0.0
Sep 2011	SP-53	SP-110535	042	1		Addition of IP-CAN session establishment related measurements	10.3.0	11.0.0
Dec 2011	SP-54	SP-110713	047	1		Addition of location update by S6a related measurements	11.0.0	11.1.0
Dec 2011	SP-54	SP-110713	048	1		Addition of authentication by S6a related measurements	11.0.0	11.1.0
Dec 2011	SP-54	SP-110707	043	1		Removal of hanging paragraphs	11.0.0	11.1.0
Dec 2011	SP-54	SP-110713	044	1		Addition of PCRF related measurements	11.0.0	11.1.0
Dec 2011	SP-54	SP-110713	045	1		Addition of credit re-authorization procedure related measurements	11.0.0	11.1.0
Dec 2011	SP-54	SP-110713	046	1		Addition of IP-CAN session termination related measurements	11.0.0	11.1.0
Mar 2012	SP-55	SP-120051	050	1		Addition of the EPS bearers number of PGW related performance measurement	11.1.0	11.2.0
Mar 2012	SP-55	SP-120051	0051	1		Addition of the number of subscribers in ECM-IDLE state and in ECM-CONNECTED state related measurements	11.1.0	11.2.0
Jun 2012	SP-56	SP-120363	0055	1		Correction of use case titles	11.2.0	11.3.0
Jun 2012	SP-56	SP-120363	0058	1		Re-alignment with measurement template	11.2.0	11.3.0
Jun 2013	SP-60	SP-130265	0060	1		Clarification of trigger conditions for S-GW data volume measurements	11.3.0	11.4.0
2014-10	-	-	-	-		Update to Rel-12 version (MCC)	11.4.0	**12.0.0**
2016-01	-	-	-	-		Update to Rel-13 version (MCC)	12.0.0	**13.0.0**
2017-04	SA#75	-	-	-		Promotion to Release 14 without technical change	13.0.0	**14.0.0**

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2017-09	SA#77	SP-170652	0066	2	B	Add VR related measurements for EPC NFs	14.1.0
2018-06	SA#80	SP-180424	0068	1	B	Add performance measurements to PGW-C and PGW-U	15.0.0
2018-06	SA#81	SP-180829	0070	1	B	Addition of PFCP session management measurements	15.1.0

History

Document history		
V15.0.0	June 2018	Publication
V15.1.0	October 2018	Publication