

EPG Characteristics

TECHNICAL PRODUCT DESCRIPTION

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1 Introduction

This document describes the characteristics of the EPG product for GSM, WCDMA, LTE, trusted non-3GPP network, and untrusted non-3GPP network.

The term EPG is used for figures that are applicable for all node types. If a figure is applicable for only one of the node types, it is explicitly stated. For further information that helps in understanding this document, see [CPI Library Readers' Guide](#).

1.1 Scope

This document provides information about capacity, In-Service Performance (ISP), and Performance Indicators (PIs), including Key Performance Indicators (KPIs).

1.2 Target Groups

This document is an introduction to the EPG for the following:

- Network operators
- Network and service planners
- System engineers and administrators

This document requires a basic knowledge of data communication and telecommunication.

2 Capacity

The capacity of the EPG depends on its hardware configuration, purchased licenses, and active functions. The customer purchases a specific hardware configuration that provides the required capacity, taking into account traffic scenarios, and expected traffic growth. To enable the use of a scalable amount of the available capacity, the customer must then purchase right-to-use licenses. Both the hardware configuration and the right-to-use licenses can be expanded independently of each other.

This section covers the following areas:



- Licensed capacity
- Function-related capacity
- Connections to other network peer elements

Note: For up-to-date information on bearer capacity, signalling capacity, payload capacity, and control plane and EPG user plane software applications running on the Virtual Service-Forwarder (vSFO), contact Ericsson support.

2.1 Licensed Capacity

This section describes how the capacity of the EPG is licensed. Right-to-use licenses must be purchased for both session capacity and throughput capacity.

Note: Operating at maximum session capacity and maximum throughput capacity at the same time is not possible.

For more information on licenses, refer to [Software License Management](#).

2.1.1 Session and Bearer Capacity

The capacity of the EPG is limited by the maximum number of bearers and the maximum number of sessions that can be supported. The maximum number of bearers can be configured. The maximum number of sessions can be controlled by licenses. The minimum right-to-use license for session capacity is 10,000 sessions. This minimum license can be upgraded in increments of 1,000 sessions, up to a maximum capacity of 30 million sessions (60 million bearers).

Each PGW session and bearer is located on two CPBs running PSC and two PPBs. Each SGW session and bearer is located on two CPBs running SGW Session Controller and two PPBs.

Table 1 shows the session and bearer capacity per board type.

Table 1 Session and Bearer Capacity per Board Type

Board Type	Sessions	Bearers
CPB running as PSC and SGW Session Controller	4 million PGW sessions and 4 million SGW sessions ⁽¹⁾	8 million PGW bearers and 8 million SGW bearers ⁽²⁾
PPB	8 million sessions (including PGW sessions and SGW sessions) ⁽¹⁾	8 million bearers (including PGW bearers and SGW bearers) ⁽²⁾

(1) One combined session counts as one SGW session and one PGW session towards the limit.

(2) One combined bearer counts as one SGW bearer and one PGW bearer towards the limit.



2.1.2 Throughput Capacity

The minimum right-to-use licenses for throughput capacity are 10 kilo packets per second (kpps) and 100 Mbps. These minimum licenses can be upgraded in increments of 1 kpps and 100 Mbps, up to maximum capacities of 100,000 kpps and 500,000 Mbps. When the Service-Aware Charging and Control (SACC) solution is deployed, the maximum throughput capacity is reduced to 300,000 Mbps.

2.2 Function-Related Capacity

This section describes the capacity of the EPG in relation to the functions that the EPG supports.

2.2.1 APN Capacity

The GGSN or PGW supports up to 3,000 APNs, with potentially overlapping IP addresses. The maximum number of APNs also includes the number of configured shared RADIUS and Dynamic Host Configuration Protocol (DHCP) servers. Therefore, the maximum number of actual APNs can be less than 3,000. It is possible to configure up to 100 logical APNs and up to 100 RADIUS-assisted APNs. The number of APNs that can be selected from a logical APN or from a RADIUS-assisted APN is limited only by the maximum number of APNs on the GGSN or PGW. Each APN can use a separate Virtual Private Network (VPN) and virtual routing instance for traffic separation, meaning that 3,000 VPNs and 3,000 virtual routing instances are supported by the EPG.

The EPG handles up to 1,000 simultaneous tunnels for VPN support, through GRE.

The use of VPN techniques for APN separation does not lead to any degradation of the maximum throughput (switching capacity) on the Gi or SGi interface.

2.2.2 APN IP Address Capacity

The maximum number of IP address ranges per APN is 99.

The maximum number of IP address ranges per GGSN or PGW is 20,000 (a sum of IPv4 and IPv6 address ranges). This includes the IP address ranges defined under APNs and IP address ranges used in shared pools, as described in Table 4.

2.2.3 L2TP Capacity

Each Packet Processing Board (PPB) running the Layer 2 Tunneling Protocol (L2TP) Packet Processing (TPP) application can handle a maximum of 5,000 L2TP tunnels and has a capacity of 65,000 L2TP sessions. The maximum number of PPBs running the TPP application is limited to the number of active PPBs on the GGSN or PGW. A maximum of 5,000 L2TP tunnels can be handled on node level.



2.2.4 CDR Capacity

The average EPG Charging Data Record (CDR) rate during busy hours is 80,000 CDRs per second, based on 3,000,000 bearers.

An Abstract Syntax Notation One (ASN.1) encoded fully qualified partial CDR contains 214 bytes on average.

The maximum charging data file size can be set between 1 MB and 100 MB. The maximum charging data file age can be set between 5 minutes and 1,440 minutes.

The CDR time limit has a value range of 15 to 1,440 minutes and is set in steps of 15 minutes. The value range of the CDR volume limit range is 100 KB to 1 GB and the value is set in steps of 1 KB.

The virtual EPG stores CDRs on control plane vSFOs. By default, each control plane vSFO has an 8 GB partition for storing CDRs. To increase CDR capacity, each control plane vSFO can be configured with a second larger hard disk. If the second hard disk is configured, the virtual EPG stores all the CDRs on the second hard disk. The minimum size for the second hard disk is 8 GB, the maximum size is 2 TB.

To ensure the redundancy of CDRs, the virtual EPG stores two copies of each CDR on a control plane vSFO. As a result, the capacity for unique CDRs on each control plane vSFO is half the original value.

For information on configuring a second hard disk to store CDRs, refer to [Deploying Virtual EPG](#)

2.2.5 Routing Table Capacity

The Node Management Board (NMB) of the EPG can handle a large routing table, up to 1,000,000 routes have been successfully used.

Note: If the limit is reached, traffic disturbance can occur.

2.2.6 Event-Based Monitoring Capacity

An EPG Event-Based Monitoring (EBM) profile contains the events to monitor, an optional selector defining the criteria for selecting monitored users, and an optional limit to limit the number of monitored user sessions.

The EPG supports up to 16 GGSN/PGW EBM profiles.

2.2.7 UE Trace Capacity

The EPG supports up to 256 parallel UE trace sessions.



2.2.8 SACC Capacity

The SACC functionality in the EPG is used for service-based and content-based charging for operator-provided services. The use of SACC reduces the capacity of the EPG in terms of throughput and the maximum number of bearers.

Table 2 shows the maximum number of SACC entities per EPG, per rule space, per APN, and per user session.

Table 2 Maximum Number of SACC Entities per EPG, per Rule Space, per APN, and per User Session

Entity	Per EPG	Per Rule Space	Per APN	Per User Session
Access Control Rule (ACR)		1000 per SDF		255 installed ⁽¹⁾
Access Control Group (ACG)		1000		255 installed
Base APN, SACC enabled	1,000			1
Diameter Application System (DAS)	32			
Diameter Peer	64			
Dynamic Charging Rule (DCR)				255 installed
Monitoring Key (MK)				32 active
Rating Group (RG)				64 active
Rule Space	64		64	1
Service APN	1,000	16		16
Service Data Flow (SDF)				64 active ⁽²⁾
Service Identifier (SI)				64 active
Service Set	64	64		1 active

(1) Excluding always allowed ACRs

(2) Including active ACRs and DCRs

More detailed investigations can be done by Ericsson support.



Note: An increase in the number of configured SACC entities can result in a decrease of the EPG capacity.

Packet Delay

The packet delay through the EPG depends on the amount of GPRS Tunneling Protocol (GTP) control traffic and charging events and the underlying Network Function Virtualization Infrastructure (NFVI). One-way packet delay including the time taken by vSwitch, is typically less than 2 ms.

The delay can, in certain cases, be large. If the EPG is under-dimensioned or the NFVI oversubscribed, delays can occur because of overload and buffering. Further, external SACC servers can introduce additional delays, because of external signaling related to authorization. The extra delay introduced by PISC is minor.

2.2.9

Service Chaining Capacity

Table 3 shows the maximum number of service chaining entities per EPG, per Service Chain (SC), and per service function.

Table 3 Maximum Number of Service Chaining Entities per EPG, per SC, and per Service Function

Entity	Per EPG	Per SC	Per Service Function
SCs	32	–	–
Service Functions	32	16	–
Service function Instances	–	–	255

Packet Delay

The packet delay through the EPG when service chaining is enabled, may be increased on the flows that have to traverse SCs with one or more service functions. It depends on the number of service functions, service function internal process delay, and the underlying Network Function Virtualization Infrastructure (NFVI).

Note:

- A purge flow mechanism can deallocate memory when a timeout expires without flow activity. The timeout can be configured.
- To limit memory usage when service chaining is enabled, the packet processor board can handle a limited number of flows simultaneously. The valid range of this limit is 1000–30000000. If the packet processor board has to handle new flows, the purge flow mechanism, which allows the processing of new flows, deallocate memory previously reserved for the old flows.



2.2.10 HSDPA Capacity

High-Speed Downlink Packet Access (HSDPA) for WCDMA Systems in the EPG supports a Maximum Bit Rate (MBR) between 2 and 84 Mbps in the downlink direction, which can be licensed in aggregations up to 4, 8, 16, 32, 48 and 84 Mbps.

2.2.11 Enhanced Uplink Capacity

Enhanced uplink, also referred to as High-Speed Uplink Packet Access (HSUPA), supports an MBR of up to 16 Mbps in the uplink direction, which can be licensed in aggregations up to 2, 4, 8, 11 and 16 Mbps.

2.2.12 LTE Downlink Capacity

The EPG supports an MBR of up to 1 Gbps in the downlink direction when used in an LTE system.

2.2.13 LTE Uplink Capacity

The EPG supports an MBR of up to 1 Gbps in the uplink direction when used in an LTE system.

2.2.14 3GDT Capacity

The capacity impact of 3G Direct Tunnel (3GDT) depends mainly on the following aspects:

- The number of activated bearers for 3GDT
- The signalling load in the GGSN or PGW
- The mobility rate for User Equipment (UE) using 3GDT

3GDT generates more signalling for UEs with activated bearers. Consequently, the impact of the 3GDT signalling is smaller in a network where the number of bearers is low in relation to the number of Simultaneously Attached Users (SAU).

2.2.15 Shared IP Pool Capacity

The capacities of shared IP pools and of address ranges when using shared IP pools are as follows.

Table 4 Shared IP Pool Capacities

Characteristic	Value
Total amount of address ranges per node.	$\leq 20,000$



Characteristic	Value
Total amount of address ranges per shared IP pool.	≤ 99
Total amount of shared IP pools per node.	$\leq 1,000$

2.2.15.1 Location-based Shared IP Pool Capacity

The capacities of location areas, Location Area Identities (LAIs), Tracking Area Identities (TAIs), and mappings when using location-based shared IP pools are as follows.

Table 5 Location-based Shared IP Pool Capacities

Characteristic	Value
Total amount of location areas per node.	≤ 500
Total amount of LAIs under each location area per node.	≤ 64
Total amount of TAIs under each location area per node.	≤ 64
Total amount of mappings between location areas and location-based shared IP pools per node.	$\leq 1,000$

2.2.16 P-CSCF Server Capacity

The GGSN or PGW supports up to 63 P-CSCF categories and one default P-CSCF address pool that is linked to APN directly per APN. The GGSN or PGW supports up to 1,000 P-CSCF address pools per node. Each The P-CSCF address pool can be configured with up to 100 P-CSCF server IP addresses (a sum of IPv4 and IPv6 address).

2.3 Maximum Number of Peer Network Elements

This section describes the maximum number of adjacent peer nodes supported by PGW and SGW.

2.3.1 PGW Capacity

The PGW supports the sum of 10,000 adjacent peer nodes across the Gn-C, Gp-C, S5-C and S8-C, and S2b-C (GTP-based) reference points. It is assumed that each adjacent peer node only sends to one of the PGW's control plane interfaces (for example, in the case of multiple Gn interfaces being used in the PGW).



The number of remote IP endpoints across the S5-U, S8-U, Gn-U, Gp-U, and Iu-U (3GDT), and S2b-U (GTP-based) reference points should not be a limiting factor when dimensioning a PGW.

For the maximum number of service function instances, see Section 2.2.9 on page 6.

2.3.1.1 DHCP Server Capacity

Up to three inband DHCP servers can be configured per APN. For shared DHCP servers, only one shared DHCP server pool containing up to three shared DHCP server IP addresses can be associated to an APN.

2.3.1.2 RADIUS Server Capacity

Up to 10 inband RADIUS authentication and 10 inband accounting servers can be configured per APN. Each shared RADIUS server pool can be configured with up to 10 different shared server IP addresses. The shared server can be configured as an authentication or accounting server for an APN.

2.3.2 SGW Capacity

The SGW supports the sum of 10,000 adjacent peer nodes across the S11, S4-C, S5-C and S8-C reference points.

The number of adjacent peer nodes across the S12, S1-U, S4-U, S5-U, and S8-U reference points is not a limiting factor when dimensioning an SGW.

The SGW supports path monitoring for the first 10,000 adjacent peer nodes across the S12, S1-U, S4-U, S5-U, and S8-U reference points.

2.3.2.1 Pool Capacity

A maximum of 256 pools of SGSNs or MMEs, with each pool supporting a maximum of 256 network elements, is supported when network-triggered service restoration is enabled. For information on configuring pools of SGSNs or MMEs, refer to GTP Interface Configuration.

2.4 Packet Buffering Capacity

Buffering of downlink packets is done in the following cases:

- During the PDN connection establishment procedure
- When the UE is in Idle mode
- When there is TCP throughput optimization



The packet buffer is cleared if the paging fails.

The maximum number of buffered idle packets can be applied as any of the following:

- Up to 200,000K packets can be buffered per board
- Up to 32,768 MB can be buffered per board
- Up to 512 packets can be buffered per bearer

If the maximum number of buffered idle packets is reached, additional packets are discarded. There is no time limit for packet buffering. For more information on configuring the maximum number of buffered idle packets, refer to [GTP Properties Configuration](#).

3 Virtual EPG Characteristics and Dimensioning

Ericsson has a set of tools for capacity planning, including dimensioning guidelines and a dimensioning calculation tool. The tools are available for Ericsson personnel who can assist the customer with capacity planning scenarios.

Inputs for the dimensioning are cloud system and HW characteristics, control plane and user plane traffic models, and the used EPG feature set.

The dimensioning calculation tool has reference models of the cloud system and hardware. Deviations from the reference model and the cloud system requirements can have an impact on the virtual EPG characteristics and lead to degraded performance. Each deviation compared to the stated requirements can require more HW resources than the reference model indicates, or can require system integration work to fill any performance gaps.

4 In-Service Performance

ISP can be defined and measured in different ways, for example, per end-to-end service or per node type in the network. Ericsson applies International Telecommunication Union (ITU) definitions when ISP statistics are created.



4.1 Node Availability

The availability figures presented in this section are theoretical figures.

4.1.1 EPG Mean Time to Repair

The life cycle of compute hosts is managed by the NFVI. After a compute host is recovered, the Mean Time to Repair (MTTR) of virtual EPG application follows. For the virtual EPG, the estimated MTTR for a control plane VM is 1 hour 20 minutes and for a user plane VM is 1 hour.

The MTTR includes downloading the VM images to the host, VM boot, upgrade of software revisions, and redistribution of sessions before the virtual EPG returns to the fully resilient state. If the local disk is recovered, the software upgrade is not required and the MTTR of the virtual EPG is shorter. The time for a user plane VM to boot and redistribute sessions is between 5 and 10 minutes.

4.2 Software Update

This section indicates the interval between events affecting traffic and the point when the EPG is ready to begin services towards users. Table 6 lists the interval for the software update. The time is approximate, and the actual time depends on the hardware environment.

Table 6 Software Update

Event	Time to Normal Operation
Software update	20-25 minutes

4.3 ICR In-Service Performance

Table 7 indicates ICR In-Service Performance. The times are approximate.

Table 7 ICR In-Service Performance

Event	Time
ICR switchover	500 ms ⁽¹⁾
ICR bulk synchronization	15 min ⁽²⁾

(1) This describes the maximum time it takes for an EPG to do an ICR switchover from standby state to active state and to start handling affected subscribers. The time for failure detection and network convergence is not included since it depends on the configuration and topology of the operator's network.

(2) This assumes that the bandwidth for the ICR transport channel between the EPG nodes is not a limiting factor. Also, the maximum time for the bulk synchronization depends on the current traffic model.



5 Performance Indicator Overview

This section covers the following areas:

- Key Performance Indicators, see Section 5.1 on page 12
- Traffic Usage Gauges and Counters, see Section 5.2 on page 54
- Performance Indicators and Counters, see Section 5.3 on page 74

Detailed information on and descriptions of the following counters and gauges can be found in *Counters and Gauges for the GGSN and PGW* and *Counters and Gauges for the SGW*.

5.1 Key Performance Indicators

KPIs are indicators that have a major impact on the end user's perception of quality. KPIs and PIs are used for detection of the following:

- Performance issues
- Initial troubleshooting
- Fault analyses

The KPIs and PIs in this document are valid for all EPG roles, that is, the GGSN or PGW, the SGW, and the combined SGW and PGW roles. The KPIs and PIs also provide information about indications of problems found on surrounding nodes in the network.

Figure 1 illustrates the traffic flows for the different node roles of the EPG.

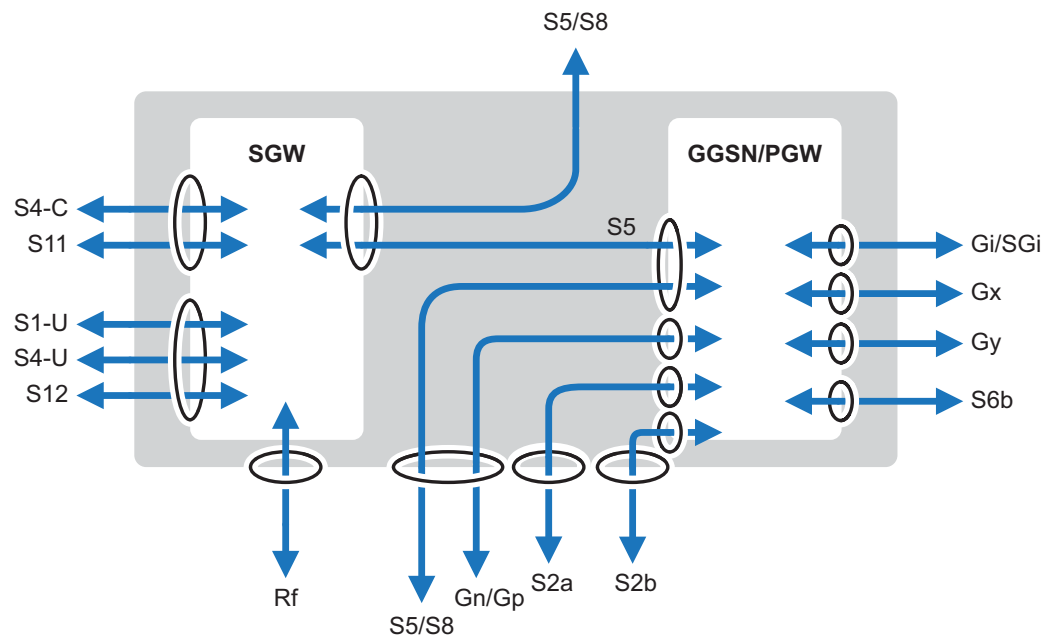


Figure 1 Traffic Flows for the EPG Roles

5.1.1 GGSN/PGW KPI Formulas

This section describes the KPI counters in the GGSN/PGW.

KPI counters in the GGSN or PGW can be calculated on node level and on APN level.

Node KPIs

The counters used for calculating node KPIs are for procedures which means that silently discarded messages by the GGSN/PGW are not considered.

APN KPIs

The counters used for calculating APN KPIs are for messages which means that silently discarded messages are considered.

For example, if there are silently discarded messages on the Gn interface, the APN KPI is worse than the node KPI because the messages are considered in the calculation. However, both KPIs appear similar if there are no silently discarded messages.

Since the counters are incremental, it is necessary to retrieve the data at two points in time and calculate the difference. The difference represents the counter for the chosen time interval and is used in the formulas presented in the following sections.

If the EPG is operating exclusively as a GGSN or PGW, the values for the SGW-specific counters are set to 0.



Multiply the equations below by 100 to have the formulas presented in percentage.

5.1.1.1 GGSN Create PDP Contexts Failure Ratios

The GGSN create PDP contexts failure ratios denotes the probability of a failed attempt to create a primary PDP context, that is the establishment of a new PDP session, on the Gn/Gp interface.

All types of rejections and failures are included, such as the following:

- Rejection because of Online Charging System (OCS) quota denial
- Terminal errors
- User errors
- RADIUS server errors
- Time-outs

To calculate the GGSN primary PDP context failure ratio on the GGSN Gn/Gp interface, use the following formula:

$$\frac{\text{GgsnAttAct} - \text{GgsnComAct}}{\text{GgsnAttAct}}$$

Equation 1 GGSN Create Primary PDP Context Failure Ratio

The parameters and the corresponding counters are listed in Table 8.

Table 8 Description of Parameters for GGSN Create Primary PDP Context Failure Ratio

Parameter	Counters (Group:Counter)
GgsnAttAct	ggsn-pdp-contexts-stats-attempted:ggsn-attempted-activation
GgsnComAct	ggsn-pdp-contexts-stats-completed:ggsn-completed-activation

The Gn/Gp create secondary PDP context failure ratio denotes the probability of a failed attempt to create a secondary PDP context, that is extension of an existing PDP session, on the Gn/Gp interface. To calculate the secondary PDP context failure ratio on the Gn/Gp interface, use the following formula:

$$\frac{\text{GgsnAttSecAct} - \text{GgsnComSecAct}}{\text{GgsnAttSecAct}}$$

Equation 2 GGSN Create Secondary PDP Context Failure Ratio

The parameters and the corresponding counters are listed in Table 9.



Table 9 Description of Parameters for GGSN Create Secondary PDP Context Failure Ratio

Parameter	Counters (Group:Counter)
GgsnAttSecAct	ggsn-pdp-contexts-stats-attempted:ggsn-attempted-secondary-activation
GgsnComSecAct	ggsn-pdp-contexts-stats-completed:ggsn-completed-secondary-activation

To calculate the GGSN create PDP context ratio per APN including both the primary and secondary PDP contexts, use the following formula:

$$\frac{\text{GgsnApnAttAct} - \text{GgsnApnComAct}}{\text{GgsnApnAttAct}}$$

Equation 3 GGSN Create PDP Context Failure Ratio per APN

The parameters and the corresponding counters are listed in Table 10.

Table 10 Description of Parameters for GGSN Create PDP Context Failure Ratio per APN

Parameter	Counters (Group:Counter)
GgsnApnAttAct	pgw-bearer-mgmt-gngp-apn:cre-pdp-att
GgsnApnComAct	pgw-bearer-mgmt-gngp-apn:cre-pdp-cmpl

Note: When the APR function is activated, if the UE uses service APN, the pgw-bearer-mgmt-gngp-apn:cre-pdp-att in both service APN and base APN is counted for each PDP context activation. Meanwhile, the ggsn-pdp-contexts-stats-attempted:ggsn-attempted-activation only counts once. That results in the number mismatch between the ggsn-pdp-contexts-stats-attempted:ggsn-attempted-activation and the total number of pgw-bearer-mgmt-gngp-apn:cre-pdp-att in each APN.

5.1.1.2 GGSN Update PDP Contexts Failure Ratio

The GGSN update PDP contexts failure ratio denotes the probability of a failed attempt to update a PDP context on the Gn/Gp interface.

To calculate the GGSN Gn/Gp update failure ratio, use the following formula:

$$\frac{\text{GgsnAttUpd} - \text{GgsnComUpd}}{\text{GgsnAttUpd}}$$

Equation 4 GGSN Update PDP Contexts Failure Ratio

The parameters and the corresponding counters are listed in Table 11.



Table 11 Description of Parameters for GGSN Update PDP Contexts Failure Ratio

Parameter	Counters (Group:Counter)
GgsnAttUpd	ggsn-pdp-contexts-stats-attempted:ggsn-attempted-update
GgsnComUpd	ggsn-pdp-contexts-stats-completed:ggsn-completed-update

To calculate the GGSN update PDP contexts failure ratio per APN, use the following formula:

$$\frac{\text{GgsnApnAttUpd} - \text{GgsnApnComUpd}}{\text{GgsnApnAttUpd}}$$

Equation 5 GGSN Update PDP Contexts Failure Ratio per APN

The parameters and the corresponding counters are listed in Table 12.

Table 12 Description of Parameters for GGSN Update PDP Contexts Failure Ratio per APN

Parameter	Counters (Group:Counter)
GgsnApnAttUpd	pgw-bearer-mgmt-gngp-apn:uesgsn-init-upd-pdp-att
GgsnApnComUpd	pgw-bearer-mgmt-gngp-apn:uesgsn-init-upd-pdp-cmpl

5.1.1.3

GGSN PDP Context Cut-off Ratio

The GGSN PDP context cut-off ratio denotes the probability of the abnormal deactivation of an active PDP context on the Gn interface, where the deactivation is initiated by the GGSN or PGW except for idle- and session-timeouts. Deactivations triggered by any received GTP message are not included.

All types of failures are included, for example, such as the following:

- Rejection because of Online Charging System (OCS) quota denial
- Terminal errors
- User errors
- RADIUS server errors
- Time-outs

To calculate the GGSN PDP context cut-off ratio, use the following formula:



$$\frac{\text{GgsnAttSelDeact} - \text{GgsnIdlTimDeact} - \text{GgsnSesTimDeact}}{\text{GgsnComAct} + \text{GgsnNbrActPdpCon}}$$

Equation 6 GGSN PDP context Cut-off Ratio

The parameters and the corresponding counters are listed in Table 13.

Table 13 Description of Parameters for GGSN PDP context Cut-off Ratio

Parameter	Counters (Group:Counter)
GgsnAttSelDeact	ggsn-pdp-contexts-stats-attempted:ggsn-attempted-selfdeactivation
GgsnIdlTimDeact	ggsn-pdp-contexts-stats-completed:ggsn-idle-timeout-deactivation
GgsnSesTimDeact	ggsn-pdp-contexts-stats-completed:ggsn-session-timeout-deactivation
GgsnComAct	ggsn-pdp-contexts-stats-completed:ggsn-completed-activation
GgsnNbrActPdpCon	ggsn-global-stats:ggsn-nbr-of-active-pdp-contexts

To calculate the GGSN PDP context cut-off ratio per APN, use the following formula:

$$\frac{\text{GgsnApnAttSelDeact} - \text{GgsnApnIdlTimDeact} - \text{GgsnApnSesTimDeact}}{\text{GgsnApnComAct} + \text{GgsnApnActPdpConCount}}$$

Equation 7 GGSN PDP Context Cut-off Ratio per APN

The parameters and the corresponding counters are listed in Table 14.

Table 14 Description of Parameters for GGSN PDP Context Cut-off Ratio per APN

Parameter	Counters (Group:Counter)
GgsnApnAttSelDeact	pgw-bearer-mgmt-gngp-apn:pgw-init-del-pdp-att
GgsnApnIdlTimDeact	pgw-bearer-mgmt-gngp-apn:del-pdp-by-idle-supervision
GgsnApnSesTimDeact	pgw-bearer-mgmt-gngp-apn:del-pdp-by-session-supervision
GgsnApnComAct	pgw-bearer-mgmt-gngp-apn:cre-pdp-cmpl
GgsnApnActPdpConCount	pgw-number-of-bearers-apn:active-pdp



Note: `ggsn-nbr-of-active-pdp-contexts` and `pgw-number-of-bearers-apn:active-pdp` are gauges and thus are non-incremental. They must be read at one specific instant in time, not during a delta time as is the case with counters.

5.1.1.4 PGW Create EPS Bearer Failure Ratios

The PGW create EPS bearer failure ratio denotes the probability of a failed attempt to create a default EPS bearer (a new PDN connection), or a dedicated EPS bearer (extension of an existing PDN connection) on the S5/S8, GTP-based S2a, and S2b interfaces. All types of rejections and failures are included, such as the following:

- Rejection because of Online Charging System (OCS) quota denial
- Terminal errors
- User errors
- RADIUS server errors
- Time-outs

$$\frac{\text{PgwAttEpsAct} - \text{PgwComEpsAct}}{\text{PgwAttEpsAct}}$$

Equation 8 PGW Create EPS Bearer Failure Ratio

The parameters and the corresponding counters are listed in Table 15.

Table 15 Description of Parameters for PGW Create EPS Bearer Failure Ratio

Parameter	Counters (Group:Counter)
PgwAttEpsAct	pgw-attempted-eps-bearer-stats:pgw-attempted-eps-bearer-activation
PgwComEpsAct	pgw-completed-eps-bearer-stats:pgw-completed-eps-bearer-activation

To calculate the PGW create EPS bearer failure ratio per APN, use the following formula:

$$\frac{\text{PgwApnAttEpsAct} - \text{PgwApnComEpsAct}}{\text{PgwApnAttEpsAct}}$$

Equation 9 PGW Create EPS Bearer Failure Ratio per APN

The parameters and the corresponding counters are listed in Table 16.



Table 16 Description of Parameters for PGW Create EPS Bearer Failure Ratio per APN

Parameter	Counters (Group:Counter)
PgwApnAttEpsAct	pgw-bearer-mgmt-apn:cre-bearer-att
PgwApnComEpsAct	pgw-bearer-mgmt-apn:cre-bearer-cmpl

Note: When the APR function is activated, if the UE uses service APN, the pgw-bearer-mgmt-apn:cre-bearer-att in both service APN and base APN is counted for each PDP context activation. Meanwhile, the pgw-attempted-eps-bearer-stats:pgw-attempted-eps-bearer-activation only counts once. That results in the number mismatch between the pgw-attempted-eps-bearer-stats:pgw-attempted-eps-bearer-activation and the total number of pgw-bearer-mgmt-apn:cre-bearer-att in each APN.

5.1.1.5

PGW GTP-Based S2a Create PDN Connection Failure Ratio

The PGW GTP-based S2a create PDN connection failure ratio denotes the probability that a failed attempt to create a default bearer (a new PDN connection) on the GTP-based S2a interface.

All types of failures are included, for example, such as the following:

- Rejection because of Online Charging System (OCS) quota denial
- Terminal errors
- User errors
- RADIUS server errors
- Time-outs

To calculate the GTP-based S2a create PDN connection failure ratio, use the following formula:

$$\frac{\text{PgwAttS2aEpsAct} - \text{PgwComS2aEpsAct}}{\text{PgwAttS2aEpsAct}}$$

Equation 10 PGW GTP-Based S2a Create PDN Connection Failure Ratio

The parameters and the corresponding counters are listed in Table 17.



Table 17 Description of Parameters for PGW GTP-Based S2a Create PDN Connection Failure Ratio

Parameter	Counters (Group:Counter)
PgwAttS2aEpsAct	pgw-attempted-eps-bearer-stats:pgw-attempted-s2a-eps-bearer-activation
PgwComS2aEpsAct	pgw-completed-eps-bearer-stats:pgw-completed-s2a-eps-bearer-activation

5.1.1.6 PGW PMIPv6-Based S2a Create PDN Connection Failure Ratio

The PGW PMIPv6-based S2a create PDN connection failure ratio denotes the probability that a failed attempt to create a PDN connection on the PMIPv6-based S2a interface.

All types of failures are included, for example, such as the following:

- Rejection because of Online Charging System (OCS) quota denial
- Terminal errors
- User errors
- RADIUS server errors
- Time-outs

$$\frac{S2aPbuPdnConCrtRcvd - S2aPbaPdnConCrtAcc}{S2aPbuPdnConCrtRcvd}$$

Equation 11 PGW PMIPv6-Based S2a Create PDN Connection Failure Ratio

The parameters and the corresponding counters are listed in Table 18.

Table 18 Description of Parameters for PGW PMIPv6-Based S2a Create PDN Connection Failure Ratio

Parameter	Counters (Group:Counter)
S2aPbuPdnConCrtRcvd	pgw-pmip:s2a-pbu-pdn-conn-create-rcvd
S2aPbaPdnConCrtAcc	pgw-pmip:s2a-pba-pdn-conn-create-acc-sent

5.1.1.7 PGW PMIPv6-Based S2a IRAT E-UTRAN to Trusted Non-3GPP PDN Connection Handover Failure Ratio

The PGW PMIPv6-Based S2a IRAT E-UTRAN to trusted non-3GPP PDN connection handover failure ratio denotes the probability that an attempt to perform an IRAT E-UTRAN to trusted non-3GPP PDN connection handover fails.



All types of failures are included, for example, such as the following:

- Rejection because of Online Charging System (OCS) quota denial
- Terminal errors
- User errors
- RADIUS server errors
- Time-outs

To calculate the PGW PMIPv6-based S2a IRAT E-UTRAN to trusted non-3GPP PDN connection handover failure ratio, use the following formula:

$$\frac{\text{AttHoIratEutranCdma} - \text{ComHoIratEutranCdma}}{\text{AttHoIratEutranCdma}}$$

Equation 12 PGW PMIPv6-Based S2a IRAT E-UTRAN to Trusted non-3GPP PDN Connection Handover Failure Ratio

The parameters and the corresponding counters are listed in Table 19.

Table 19 Description of Parameters for PGW PMIPv6-Based S2a IRAT E-UTRAN to Trusted non-3GPP PDN Connection Handover Failure Ratio

Parameter	Counters (Group:Counter)
AttHoIratEutranCdma	pgw-pmip:attempted-ho-irat-from-eutran-to-cdma
ComHoIratEutranCdma	pgw-pmip:completed-ho-irat-from-eutran-to-cdma

5.1.1.8

PGW PMIPv6-Based S2a IRAT Trusted Non-3GPP to E-UTRAN PDN Connection Handover Failure Ratio

The PGW PMIPv6-based S2a IRAT Trusted non-3GPP to E-UTRAN PDN connection handover failure ratio denotes the probability that an attempt to perform an IRAT trusted non-3GPP to E-UTRAN PDN connection handover fails.

All types of failures are included, for example, such as the following:

- Rejection because of Online Charging System (OCS) quota denial
- Terminal errors
- User errors
- RADIUS server errors
- Time-outs



To calculate the PGW PMIPv6-based S2a IRAT trusted non-3GPP to E-UTRAN PDN connection handover failure ratio, use the following formula:

$$\frac{\text{AttHoIratCdmaEutran} - \text{ComHoIratCdmaEutran}}{\text{AttHoIratCdmaEutran}}$$

Equation 13 PGW PMIPv6-Based S2a IRAT Trusted non-3GPP to E-UTRAN PDN Connection Handover Failure Ratio

The parameters and the corresponding counters are listed in Table 20.

Table 20 Description of Parameters for IRAT Trusted non-3GPP to E-UTRAN PDN Connection Handover Failure Ratio

Parameter	Counters (Group:Counter)
AttHoIratCdmaEutran	pgw-attempted-eps-bearer-stats:attempted-ho-irat-from-cdma-to-eutran
ComHoIratCdmaEutran	pgw-completed-eps-bearer-stats:completed-ho-irat-from-cdma-to-eutran

5.1.1.9

PGW PMIPv6-Based S2a Intra-Trusted Non-3GPP PDN Connection Handover Failure Ratio

The PGW PMIPv6-based S2a intra-trusted non-3GPP PDN connection handover failure ratio denotes the probability that an attempt to perform an intra-trusted non-3GPP PDN connection handover fails.

All types of failures are included, for example, such as the following:

- Rejection because of Online Charging System (OCS) quota denial
- Terminal errors
- User errors
- RADIUS server errors
- Time-outs

To calculate the PGW PMIPv6-based S2a intra-trusted non-3GPP PDN connection handover failure ratio, use the following formula:

$$\frac{\text{PbuHoIntraRcvd} - \text{PbaHoIntraSent}}{\text{PbuHoIntraRcvd}}$$

Equation 14 PGW PMIPv6-Based S2a Intra-Trusted non-3GPP PDN Connection Handover Failure Ratio

The parameters and the corresponding counters are listed in Table 21.



Table 21 Description of Parameters for PGW PMIPv6-Based S2a Intra-Trusted non-3GPP PDN Connection Handover Failure Ratio

Parameter	Counters (Group:Counter)
PbuHoIntraRcvd	pgw-pmip:s2a-pbu-pdn-conn-ho-intra-rcvd
PbaHoIntraSent	pgw-pmip:s2a-pba-pdn-conn-ho-intra-acc-sent

5.1.1.10

PGW S2b Create EPS Bearer Failure Ratios

The PGW S2b create EPS bearer failure ratio denotes the probability that a failed attempt to create a default EPS bearer (a new PDN connection), or a dedicated EPS bearer (extension of an existing PDN connection) on the S2b interface.

All types of failures are included, for example, such as the following:

- Rejection because of Online Charging System (OCS) quota denial
- Terminal errors
- User errors
- RADIUS server errors
- Time-outs

To calculate the PGW S2b create EPS bearer failure ratio, use the following formula:

$$\frac{\text{PgwAttS2bEpsAct} - \text{PgwComS2bEpsAct}}{\text{PgwAttS2bEpsAct}}$$

Equation 15 PGW S2b Create EPS Bearer Failure Ratio

The parameters and the corresponding counters are listed in Table 22.

Table 22 Description of Parameters for PGW S2b Create EPS Bearer Failure Ratio

Parameter	Counters (Group:Counter)
PgwAttS2bEpsAct	pgw-attempted-eps-bearer-stats:pgw-attempted-s2b-eps-bearer-activation
PgwComS2bEpsAct	pgw-completed-eps-bearer-stats:pgw-completed-s2b-eps-bearer-activation

To calculate the PGW S2b create EPS bearer failure ratio per APN, use the following formula:



$$\frac{\text{PgwApnAttS2bEpsAct} - \text{PgwApnComS2bEpsAct}}{\text{PgwApnAttS2bEpsAct}}$$

Equation 16 PGW S2b Create EPS Bearer Failure Ratio per APN

The parameters and the corresponding counters are listed in Table 23.

Table 23 Description of Parameters for PGW S2b Create EPS Bearer Failure Ratio per APN

Parameter	Counters (Group:Counter)
PgwApnAttS2bEpsAct	pgw-bearer-mgmt-s2b-apn:cre-bearer-att
PgwApnComS2bEpsAct	pgw-bearer-mgmt-s2b-apn:cre-bearer-cmpl

5.1.1.11

PGW Create Dedicated Bearer Failure Ratio

The PGW creates dedicated bearer failure ratio denotes the probability of a failed attempt to create a dedicated EPS bearer on the S5/S8 interface. It is also possible to create relevant PIs from the SGW counters.

To calculate the PGW create dedicated bearer failure ratio, use the following formula:

$$\frac{\text{PgwAttDedEpsAct} - \text{PgwComDedEpsAct}}{\text{PgwAttDedEpsAct}}$$

Equation 17 PGW Create Dedicated Bearer Failure Ratio

The parameters and the corresponding counters are listed in Table 24.

Table 24 Description of Parameters for PGW Create Dedicated Bearer Failure Ratio

Parameter	Counters (Group:Counter)
PgwAttDedEpsAct	pgw-attempted-eps-bearer-stats:pgw-attempted-dedicated-eps-bearer-activation
PgwComDedEpsAct	pgw-completed-eps-bearer-stats:pgw-completed-dedicated-eps-bearer-activation

To calculate the PGW create dedicated bearer failure ratio per APN, use the following formula:

$$\frac{\text{PgwApnAttDedEpsAct} - \text{PgwApnComDedEpsAct}}{\text{PgwApnAttDedEpsAct}}$$

Equation 18 PGW Create Dedicated Bearer Failure Ratio per APN

The parameters and the corresponding counters are listed in Table 25.



Table 25 Description of Parameters for PGW Create Dedicated Bearer Failure Ratio per APN

Parameter	Counters (Group:Counter)
PgwApnAttDedEpsAct	pgw-dedi-bearer-mgmt-apn:cre-bearer-att
PgwApnComDedEpsAct	pgw-dedi-bearer-mgmt-apn:cre-bearer-cmpl

5.1.1.12

PGW GTP-Based S2b Create Dedicated Bearer Failure Ratio

The PGW GTP-based S2b creates dedicated bearer failure ratio denotes the probability of a failed attempt to create a dedicated EPS bearer on the GTP-based S2b interface.

To calculate the PGW GTP-based S2b create dedicated bearer failure ratio, use the following formula:

$$\frac{\text{PgwAttS2bDedEpsAct} - \text{PgwComS2bDedEpsAct}}{\text{PgwAttS2bDedEpsAct}}$$

Equation 19 PGW GTP-based S2b Create Dedicated Bearer Failure Ratio

The parameters and the corresponding counters are listed in Table 26.

Table 26 Description of Parameters for PGW GTP-Based S2b Create Dedicated Bearer Failure Ratio

Parameter	Counters (Group:Counter)
PgwAttS2bDedEpsAct	pgw-attempted-eps-bearer-stats:pgw-attempted-s2b-dedicated-eps-bearer-activation
PgwComS2bDedEpsAct	pgw-completed-eps-bearer-stats:pgw-completed-s2b-dedicated-eps-bearer-activation

To calculate the PGW GTP-based S2b create dedicated bearer failure ratio per APN, use the following formula:

$$\frac{\text{PgwApnAttS2bDedEpsAct} - \text{PgwApnComS2bDedEpsAct}}{\text{PgwApnAttS2bDedEpsAct}}$$

Equation 20 PGW GTP-based S2b Create Dedicated Bearer Failure Ratio per APN

The parameters and the corresponding counters are listed in Table 27.



Table 27 Description of Parameters for PGW GTP-Based S2b Create Dedicated Bearer Failure Ratio per APN

Parameter	Counters (Group:Counter)
PgwApnAttS2bDedEpsAct	pgw-dedi-bearer-mgmt-s2b-apn:cre-bearer-att
PgwApnComS2bDedEpsAct	pgw-dedi-bearer-mgmt-s2b-apn:cre-bearer-cmpl

5.1.1.13

PGW Update Dedicated Bearer Failure Ratio

The PGW update dedicated bearer failure ratio denotes the probability of a failed attempt to update a dedicated EPS bearer on the S5/S8 interface.

To calculate the PGW update dedicated bearer failure ratio per APN, use the following formula:

$$\frac{PgwApnAttDedMod - PgwApnComDedMod}{PgwApnAttDedMod}$$

Equation 21 PGW Update Dedicated Bearer Failure Ratio per APN

The parameters and the corresponding counters are listed in Table 28.

Table 28 Description of Parameters for PGW Update Dedicated Bearer Failure Ratio per APN

Parameter	Counters (Group:Counter)
PgwApnAttDedMod	pgw-bearer-mgmt-s5s8-apn:netw-init-upd-dedi-bearer-att
PgwApnComDedMod	pgw-bearer-mgmt-s5s8-apn:netw-init-upd-dedi-bearer-cmpl

5.1.1.14

PGW Modify Bearer Failure Ratio

The PGW modifies bearer failure ratio denotes the probability of a failed attempt to update an EPS bearer on the S5/S8 interface.

To calculate the PGW modify bearer failure ratio, use the following formula:

$$\frac{PgwAttEpsMod - PgwComEpsMod}{PgwAttEpsMod}$$

Equation 22 PGW Modify Bearer Failure Ratio

The parameters and the corresponding counters are listed in Table 29.



Table 29 Description of Parameters for PGW Modify Bearer Failure Ratio

Parameter	Counters (Group:Counter)
PgwAttEpsMod	pgw-attempted-eps-bearer-stats:pgw-attempted-eps-bearer-modification
PgwComEpsMod	pgw-completed-eps-bearer-stats:pgw-completed-eps-bearer-modification

To calculate the PGW modify bearer failure ratio for UE-initiated or SGW-initiated modification per APN, use the following formula:

$$\frac{\text{PgwApnAttS5SgwMod} - \text{PgwApnComS5SgwMod}}{\text{PgwApnAttS5SgwMod}}$$

Equation 23 PGW Modify Bearer UE-Initiated or SGW-Initiated Modification Failure Ratio per APN

The parameters and the corresponding counters are listed in Table 30.

Table 30 Description of Parameters for PGW Modify Bearer UE-Initiated or SGW-Initiated Modification Failure Ratio per APN

Parameter	Counters (Group:Counter)
PgwApnAttS5SgwMod	pgw-mobility-mgmt-apn:ho-non3gpp-to-eutran-att
PgwApnComS5SgwMod	pgw-mobility-mgmt-apn:ho-non3gpp-to-eutran-cmp1

5.1.1.15

PGW IRAT E-UTRAN to Untrusted Non-3GPP PDN Connection Handover Failure Ratio

The PGW IRAT E-UTRAN to untrusted non-3GPP PDN connection handover failure ratio denotes the probability that an attempt to perform an IRAT E-UTRAN to untrusted non-3GPP PDN connection handover fails.

All types of failures are included, for example, such as the following:

- Rejection because of Online Charging System (OCS) quota denial
- Terminal errors
- User errors
- RADIUS server errors
- Time-outs

To calculate the PGW IRAT E-UTRAN to untrusted non-3GPP PDN connection handover failure ratio, use the following formula:



$$\frac{\text{IratHoAttEutUwlan} - \text{IratHoComEutUwlan}}{\text{IratHoAttEutUwlan}}$$

Equation 24 PGW IRAT E-UTRAN to Untrusted Non-3GPP PDN Connection Handover Failure Ratio

The parameters and the corresponding counters are listed in Table 31.

Table 31 Description of Parameters for PGW IRAT E-UTRAN to Untrusted Non-3GPP PDN Connection Handover Failure Ratio

Parameter	Counters (Group:Counter)
IratHoAttEutUwlan	pgw-attempted-eps-bearer-stats:irat-ho-att-from-eutran-to-uwlan
IratHoComEutUwlan	pgw-completed-eps-bearer-stats:irat-ho-comp-from-eutran-to-uwlan

5.1.1.16

PGW IRAT Untrusted Non-3GPP to E-UTRAN PDN Connection Handover Failure Ratio

The IRAT untrusted non-3GPP to E-UTRAN PDN connection handover failure ratio denotes the probability that an attempt to perform an IRAT untrusted non-3GPP to E-UTRAN PDN connection handover fails.

All types of failures are included, for example, such as the following:

- Rejection because of Online Charging System (OCS) quota denial
- Terminal errors
- User errors
- RADIUS server errors
- Time-outs

To calculate the PGW IRAT untrusted non-3GPP to E-UTRAN PDN connection handover failure ratio, use the following formula:

$$\frac{\text{IratHoAttUwlEutran} - \text{IratHoComUwlEutran}}{\text{IratHoAttUwlEutran}}$$

Equation 25 PGW IRAT Untrusted Non-3GPP to E-UTRAN PDN Connection Handover Failure Ratio

The parameters and the corresponding counters are listed in Table 32.



Table 32 Description of Parameters for PGW IRAT Untrusted Non-3GPP to E-UTRAN PDN Connection Handover Failure Ratio

Parameter	Counters (Group:Counter)
IratHoAttUwIEutran	pgw-attempted-eps-bearer-stats:irat-ho-att-from-uwlan-to-eutran
IratHoComUwIEutran	pgw-completed-eps-bearer-stats:irat-ho-comp-from-uwlan-to-eutran

5.1.1.17 GGSN or PGW Downlink Data Drop Ratio

The GGSN or PGW downlink data drop ratio denotes the probability of a dropped downlink IPv4 or IPv6 packet. All drop reasons are counted, including policing, traffic shaping, tunnel removed, and access control. This formula is valid for the Gn, S5, S8, S2a, and S2b interfaces.

$$\frac{\text{GgsnDnlkDrop}}{\text{GgsnDnlkDrop} + \text{GgsnDnlkPkt}}$$

Equation 26 GGSN or PGW Downlink Data Drop Ratio

The parameters and the corresponding counters are listed in Table 33.

Table 33 Description of Parameters for GGSN or PGW Downlink Data Drop Ratio

Parameter	Counters (Group:Counter)
GgsnDnlkDrop	ggsn-downlink-traffic-info:ggsn-downlink-drops
GgsnDnlkPkt	ggsn-downlink-traffic-info:ggsn-downlink-packets

To calculate the GGSN or PGW downlink data drop ratio per APN, use the following formula:

$$\frac{\text{GgsnApnDnlkDrop}}{\text{GgsnApnDnlkDrop} + \text{GgsnApnDnlkPkt}}$$

Equation 27 GGSN or PGW Downlink Data Drop Ratio per APN

The parameters and the corresponding counters are listed in Table 34.

Table 34 Description of Parameters for GGSN or PGW Downlink Data Drop Ratio per APN

Parameter	Counters (Group:Counter)
GgsnApnDnlkDrop	pgw-traffic-apn:dl-packets-dropped
GgsnApnDnlkPkt	pgw-traffic-apn:dl-packets

**5.1.1.18 GGSN or PGW Uplink Data Drop Ratio**

The GGSN or PGW uplink data drop ratio denotes the probability of a dropped uplink IPv4 or IPv6 packet. This formula is valid for the Gn, S5, S8, S2a, and S2b interfaces.

$$\frac{\text{GgsnUplkDrop}}{\text{GgsnUplkDrop} + \text{GgsnUplkPkt}}$$

Equation 28 GGSN or PGW Uplink Data Drop Ratio

The parameters and the corresponding counters are listed in Table 35.

Table 35 Description of Parameters for GGSN or PGW Uplink Data Drop Ratio

Parameter	Counters (Group:Counter)
GgsnUplkDrop	ggsn-uplink-traffic-info:ggsn-uplink-drops
GgsnUplkPkt	ggsn-uplink-traffic-info:ggsn-uplink-packets

To calculate the GGSN or PGW uplink data drop ratio per APN, use the following formula:

$$\frac{\text{GgsnApnUplkDrop}}{\text{GgsnApnUplkDrop} + \text{GgsnApnUplkPkt}}$$

Equation 29 GGSN or PGW Uplink Data Drop Ratio per APN

The parameters and the corresponding counters are listed in Table 36.

Table 36 Description of Parameters for GGSN or PGW Uplink Data Drop Ratio per APN

Parameter	Counters (Group:Counter)
GgsnApnUplkDrop	pgw-traffic-apn:ul-packets-dropped
GgsnApnUplkPkt	pgw-traffic-apn:ul-packets

5.1.1.19 GGSN or PGW Service Chaining Downlink Data Drop Service Function Ratio

The GGSN or PGW downlink data drop ratio denotes the probability of a dropped downlink IPv4 or IPv6 packet that can traverse a specific service function from users belonging to a specific APN. The following reasons can be counted:

- All service function instances in the service function are down:

$$\frac{\text{DIPktDropAllServFuncFail}}{\text{DIPktDropAllServFuncFail} + \text{DIPktSent}}$$

Equation 30 GGSN or PGW Downlink Data Drop Service Function Ratio when All Service Function Instances are Down

The parameters and the corresponding counters are listed in Table 37.



Table 37 Description of Parameters for GGSN or PGW Downlink Data Drop Service Function Ratio

Parameter	Counters (Group:Counter)
DIPktDropAllServFuncFail	pgw-sc-apn-serv-func:d1-pkt-drop-all-serv-func-fail
DIPktSent	pgw-sc-apn-serv-func:d1-pkt-sent

— A specific service function instance in the service function is down:

$$\frac{\text{DIPktDropOneServFuncFail}}{\text{DIPktDropOneServFuncFail} + \text{DIPktSent}}$$

Equation 31 GGSN or PGW Downlink Data Drop Service Function Ratio when a Specific Service Function Instance is Down

The parameters and the corresponding counters are listed in Table 38.

Table 38 Description of Parameters for GGSN or PGW Downlink Data Drop Service Function Ratio

Parameter	Counters (Group:Counter)
DIPktDropOneServFuncFail	pgw-sc-apn-serv-func:d1-pkt-drop-one-serv-func-fail
DIPktSent	pgw-sc-apn-serv-func:d1-pkt-sent

To aggregate all reasons for dropping packets, use the following formula:

$$\frac{\text{DIPktDropOneServFuncFail} + \text{DIPktDropAllServFuncFail}}{(\text{DIPktDropOneServFuncFail} + \text{DIPktDropAllServFuncFail}) + \text{DIPktSent}}$$

Equation 32 GGSN or PGW Downlink Data Drop Service Function Ratio, Aggregate All Reasons

Note: To detect traffic dropping by the service function, compare the number of packets ingress and egress from the service function. For more information, see Section 5.3 on page 74.

To achieve more accurate calculations, use byte counters instead of packet counters.

Refer to *Service Chaining* for more information about failure policies.

5.1.1.20 GGSN or PGW Service Chaining Downlink Data Drop Service Chain Ratio

The GGSN or PGW downlink data drop ratio denotes the probability of a dropped downlink IPv4 or IPv6 packet that can traverse a specific Service Chain (SC) from users belonging to a specific APN. The following reasons can be counted:

— All service function instances in a service function belonging to the SC are down:



$$\frac{\text{DIPktDropAllServFuncFail}}{\text{DIPktIn}}$$

Equation 33 GGSN or PGW Downlink Data Drop SC Ratio when All Service Function Instances are Down

The parameters and the corresponding counters are listed in Table 39.

Table 39 Description of Parameters for GGSN or PGW Downlink Data Drop SC Ratio

Parameter	Counters (Group:Counter)
DIPktDropAllServFuncFail	pgw-sc-apn-serv-chain:dl-pkt-drop-all-serv-func-fail
DIPktIn	pgw-sc-apn-serv-chain:dl-pkt-in

— A specific service function instance in a service function belonging to the SC is down:

$$\frac{\text{DIPktDropOneServFuncFail}}{\text{DIPktIn}}$$

Equation 34 GGSN or PGW Downlink Data Drop SC Ratio when a Specific Service Function Instance is Down

The parameters and the corresponding counters are listed in Table 40.

Table 40 Description of Parameters for GGSN or PGW Downlink Data Drop Service Chain Ratio

Parameter	Counters (Group:Counter)
DIPktDropOneServFuncFail	pgw-sc-apn-serv-chain:dl-pkt-drop-one-serv-func-fail
DIPktIn	pgw-sc-apn-serv-chain:dl-pkt-in

To aggregate all reasons for dropping packets, use the following formula:

$$\frac{\text{DIPktDropOneServFuncFail} + \text{DIPktDropAllServFuncFail}}{\text{DIPktIn}}$$

Equation 35 GGSN or PGW Downlink Data Drop Service Function Ratio, Aggregate All Reasons

Note: To detect traffic dropping by any service function in the SC, compare the number of packets ingress and egress from the SC. For more information, see Section 5.3 on page 74.

To achieve more accurate calculations, use byte counters instead of packet counters.

Refer to *Service Chaining* for more information about failure policies.



5.1.1.21 GGSN or PGW Service Chaining Downlink Data Bypass Service Function Ratio

The GGSN or PGW downlink data bypass ratio denotes the probability of a bypassed downlink IPv4 or IPv6 packet that can traverse a specific service function from users belonging to a specific APN. The following reasons can be counted:

- All service function instances in the service function are down:

$$\frac{\text{DIPktBypassAllServFuncFail}}{\text{DIPktBypassAllServFuncFail} + \text{DIPktSent}}$$

Equation 36 GGSN or PGW Downlink Data Bypass Service Function Ratio when All Service Function Instances are Down

The parameters and the corresponding counters are listed in Table 41.

Table 41 Description of Parameters for GGSN or PGW Downlink Data Bypass Service Function Ratio

Parameter	Counters (Group:Counter)
DIPktBypassAllServFuncFail	pgw-sc-apn-serv-func:d1-pkt-bypass-all-serv-func-fail
DIPktSent	pgw-sc-apn-serv-func:d1-pkt-sent

- A specific service function instance in the service function is down:

$$\frac{\text{DIPktBypassOneServFuncFail}}{\text{DIPktBypassOneServFuncFail} + \text{DIPktSent}}$$

Equation 37 GGSN or PGW Downlink Data Bypass Service Function Ratio when a Specific Service Function Instance is Down

The parameters and the corresponding counters are listed in Table 42.

Table 42 Description of Parameters for GGSN or PGW Downlink Data Bypass Service Function Ratio

Parameter	Counters (Group:Counter)
DIPktBypassOneServFuncFail	pgw-sc-apn-serv-func:d1-pkt-bypass-one-serv-func-fail
DIPktSent	pgw-sc-apn-serv-func:d1-pkt-sent

To aggregate all reasons for bypassing packets, use the following formula:

$$\frac{\text{DIPktBypassOneServFuncFail} + \text{DIPktBypassAllServFuncFail}}{((\text{DIPktBypassOneServFuncFail} + \text{DIPktBypassAllServFuncFail}) + \text{DIPktSent})}$$

Equation 38 GGSN or PGW Downlink Data Bypass Service Function Ratio, Aggregate All Reasons



Note: To achieve more accurate calculations, use byte counters instead of packet counters.

Refer to *Service Chaining* for more information about failure policies.

5.1.1.22 GGSN or PGW Service Chaining Uplink Data Drop Service Function Ratio

The GGSN or PGW uplink data drop ratio denotes the probability of a dropped uplink IPv4 or IPv6 packet that can traverse a specific service function from users belonging to a specific APN. The following reasons can be counted:

- All service function instances in the service function are down:

$$\frac{\text{UIPktDropAllServFuncFail}}{\text{UIPktDropAllServFuncFail} + \text{UIPktSent}}$$

Equation 39 GGSN or PGW Uplink Data Drop Service Function Ratio when All Service Function Instances are Down

The parameters and the corresponding counters are listed in Table 43.

Table 43 Description of Parameters for GGSN or PGW Uplink Data Drop Service Function Ratio

Parameter	Counters (Group:Counter)
UIPktDropAllServFuncFail	pgw-sc-apn-serv-func:ul-pkt-drop-all-serv-func-fail
UIPktSent	pgw-sc-apn-serv-func:ul-pkt-sent

- A specific service function instance in the service function is down:

$$\frac{\text{UIPktDropOneServFuncFail}}{\text{UIPktDropOneServFuncFail} + \text{UIPktSent}}$$

Equation 40 GGSN or PGW Uplink Data Drop Service Function Ratio when a Specific Service Function Instance is Down

The parameters and the corresponding counters are listed in Table 44.

Table 44 Description of Parameters for GGSN or PGW Uplink Data Drop Service Function Ratio

Parameter	Counters (Group:Counter)
UIPktDropOneServFuncFail	pgw-sc-apn-serv-func:ul-pkt-drop-one-serv-func-fail
UIPktSent	pgw-sc-apn-serv-func:ul-pkt-sent

To aggregate all reasons for dropping packets, use the following formula:



$$\frac{\text{UIPktDropOneServFuncFail} + \text{UIPktDropAllServFuncFail}}{((\text{UIPktDropOneServFuncFail} + \text{UIPktDropAllServFuncFail}) + \text{UIPktSent})}$$

Equation 41 GGSN or PGW Uplink Data Drop Service Function Ratio, Aggregate All Reasons

Note: To detect traffic dropping by the service function, compare the number of packets ingress and egress from the service function. For more information, see Section 5.3 on page 74.

To achieve more accurate calculations, use byte counters instead of packet counters.

Refer to *Service Chaining* for more information about failure policies.

5.1.1.23 GGSN or PGW Service Chaining Uplink Data Drop Service Chain Ratio

The GGSN or PGW uplink data drop ratio denotes the probability of a dropped uplink IPv4 or IPv6 packet that can traverse a specific Service Chain (SC) from users belonging to a specific APN. The following reasons can be counted:

- All service function instances in a service function belonging to the SC are down:

$$\frac{\text{UIPktDropAllServFuncFail}}{\text{UIPktIn}}$$

Equation 42 GGSN or PGW Uplink Data Drop SC Ratio when All Service Function Instances are Down

The parameters and the corresponding counters are listed in Table 45.

Table 45 Description of Parameters for GGSN or PGW Uplink Data Drop SC Ratio

Parameter	Counters (Group:Counter)
UIPktDropAllServFuncFail	pgw-sc-apn-serv-chain:ul-pkt-drop-all-serv-func-fail
UIPktIn	pgw-sc-apn-serv-chain:ul-pkt-in

- A specific service function instance in a service function belonging to the SC is down:

$$\frac{\text{UIPktDropOneServFuncFail}}{\text{UIPktIn}}$$

Equation 43 GGSN or PGW Uplink Data Drop SC Ratio when a Specific Service Function Instance is Down

The parameters and the corresponding counters are listed in Table 46.



Table 46 Description of Parameters for GGSN or PGW Uplink Data Drop SC Ratio

Parameter	Counters (Group:Counter)
UIPktDropOneServFuncFail	pgw-sc-apn-serv-chain:ul-pkt-drop-one-serv-func-fail
UIPktIn	pgw-sc-apn-serv-chain:ul-pkt-in

To aggregate all reasons for dropping packets, use the following formula:

$$\frac{\text{UIPktDropOneServFuncFail} + \text{UIPktDropAllServFuncFail}}{\text{UIPktIn}}$$

Equation 44 GGSN or PGW Uplink Data Drop Service Function Ratio, Aggregate All Reasons

Note: To detect traffic dropping by any service function in the SC, compare the number of packets ingress and egress from the SC. For more information, see Section 5.3 on page 74.

To achieve more accurate calculations, use byte counters instead of packet counters.

Refer to *Service Chaining* for more information about failure policies.

5.1.1.24 GGSN or PGW Service Chaining Uplink Data Bypass Service Function Ratio

The GGSN or PGW uplink data bypass ratio denotes the probability of a bypassed uplink IPv4 or IPv6 packet that can traverse a specific service function from users belonging to a specific APN. The following reasons can be counted:

— All service function instances in the service function are down:

$$\frac{\text{UIPktBypassAllServFuncFail}}{\text{UIPktBypassAllServFuncFail} + \text{UIPktSent}}$$

Equation 45 GGSN or PGW Uplink Data Bypass Service Function Ratio when All Service Function Instances are Down

The parameters and the corresponding counters are listed in Table 47.

Table 47 Description of Parameters for GGSN or PGW Uplink Data Bypass Service Function Ratio

Parameter	Counters (Group:Counter)
UIPktBypassAllServFuncFail	pgw-sc-apn-serv-func:ul-pkt-bypass-all-serv-func-fail
UIPktSent	pgw-sc-apn-serv-func:ul-pkt-sent

— A specific service function instance in the service function is down:



$$\frac{\text{UIPktBypassOneServFuncFail}}{\text{UIPktBypassOneServFuncFail} + \text{UIPktSent}}$$

Equation 46 GGSN or PGW Uplink Data Bypass Service Function Ratio when a Specific Service Function Instance is Down

The parameters and the corresponding counters are listed in Table 48.

Table 48 Description of Parameters for GGSN or PGW Uplink Data Bypass Service Function Ratio

Parameter	Counters (Group:Counter)
UIPktBypassOneServFuncFail	pgw-sc-apn-serv-func:ul-pkt-bypass-one-serv-func-fail
UIPktSent	pgw-sc-apn-serv-func:ul-pkt-sent

To aggregate all reasons for bypassing packets, use the following formula:

$$\frac{\text{UIPktBypassOneServFuncFail} + \text{UIPktBypassAllServFuncFail}}{((\text{UIPktBypassOneServFuncFail} + \text{UIPktBypassAllServFuncFail}) + \text{UIPktSent})}$$

Equation 47 GGSN or PGW Uplink Data Bypass Service Function Ratio, Aggregate All Reasons

Note: To achieve more accurate calculations, use byte counters instead of packet counters.

Refer to *Service Chaining* for more information about failure policies.

5.1.1.25 GGSN or PGW Gx View of IMS Registration Failure Ratio

The GGSN or PGW Gx view of IMS registration failure ratio denotes the probability of failed PDN connection over the Gx interface per APN.

All types of failures are included, for example, such as the following:

- Rejection because of Online Charging System (OCS) quota denial
- Terminal errors
- User errors
- RADIUS server errors
- Time-outs

To calculate the GGSN or PGW Gx view of IMS registration failure ratio, use the following formula:

$$\frac{\text{CcrInitialFailed}}{\text{CcrInitialSent}}$$

Equation 48 GGSN or PGW Gx View of IMS Registration Failure Ratio per APN



The parameters and the corresponding counters are listed in Table 49.

Table 49 Description of Parameters for GGSN or PGW Gx View of IMS Registration Failure Ratio per APN

Parameter	Counters (Group:Counter)
CcrInitialFailed	pgw-apn-gx:ccr-initial-failed
CcrInitialSent	pgw-apn-gx:ccr-initial-sent

5.1.2 SGW KPI Formulas

This section describes the KPI counters in the SGW.

5.1.2.1 SGW S5/S8 Create Dedicated Bearer Failure Ratio

The SGW create dedicated bearer failure ratio denotes the probability of a failed attempt to create a dedicated EPS bearer on the S5, S8, or combined S5/S8 interfaces.

$$\frac{\text{CrBrReqRcvd} - \text{CrBrResAccSent}}{\text{CrBrReqRcvd}}$$

Equation 49 SGW Create Dedicated Bearer Failure Ratio

If a separate S5 interface is configured on the SGW, Table 50 lists the counters corresponding to the parameters in Equation 49.

Table 50 Description of SGW S5 Create Dedicated Bearer Failure Ratio Parameters

Parameter	Counters (Group:Counter)
CrBrReqRcvd	sgw-gtp-tunnel-mgmt-s5:sm-create-bearer-req-rcvd
CrBrResAccSent	sgw-gtp-tunnel-mgmt-s5:sm-create-bearer-resp-acc-sent

If a separate S8 interface is configured on the SGW, Table 51 lists the counters corresponding to the parameters in Equation 49.

Table 51 Description of SGW S8 Create Dedicated Bearer Failure Ratio Parameters

Parameter	Counters (Group:Counter)
CrBrReqRcvd	sgw-gtp-tunnel-mgmt-s8:sm-create-bearer-req-rcvd
CrBrResAccSent	sgw-gtp-tunnel-mgmt-s8:sm-create-bearer-resp-acc-sent



If a combined S5/S8 interface is configured on the SGW, Table 52 lists the counters corresponding to the parameters in Equation 49.

Table 52 Description of SGW S5/S8 Create Dedicated Bearer Failure Ratio Parameters

Parameter	Counters (Group:Counter)
CrBrReqRcvd	sgw-gtp-tunnel-mgmt-s5-s8:sm-create-bearer-req-rcvd
CrBrResAccSent	sgw-gtp-tunnel-mgmt-s5-s8:sm-create-bearer-resp-acc-sent

5.1.2.2

SGW S5/S8 Update Dedicated Bearer Failure Ratio

The SGW update dedicated bearer failure ratio denotes the probability of a failed attempt to update a dedicated EPS bearer on the S5, S8, or combined S5/S8 interfaces.

$$\frac{\text{UpBrReqRcvd} - \text{UpBrResAccSent}}{\text{UpBrReqRcvd}}$$

Equation 50 SGW Update Dedicated Bearer Failure Ratio

If a separate S5 interface is configured on the SGW, Table 53 lists the counters corresponding to the parameters in Equation 50.

Table 53 Description of SGW S5 Update Dedicated Bearer Failure Ratio Parameters

Parameter	Counters (Group:Counter)
UpBrReqRcvd	sgw-gtp-tunnel-mgmt-s5:sm-update-bearer-req-rcvd
UpBrResAccSent	sgw-gtp-tunnel-mgmt-s5:sm-update-bearer-resp-acc-sent

If a separate S8 interface is configured on the SGW, Table 54 lists the counters corresponding to the parameters in Equation 50.

Table 54 Description of SGW S8 Update Dedicated Bearer Failure Ratio Parameters

Parameter	Counters (Group:Counter)
UpBrReqRcvd	sgw-gtp-tunnel-mgmt-s8:sm-update-bearer-req-rcvd
UpBrResAccSent	sgw-gtp-tunnel-mgmt-s8:sm-update-bearer-resp-acc-sent



If a combined S5/S8 interface is configured on the SGW, Table 55 lists the counters corresponding to the parameters in Equation 50.

Table 55 Description of SGW S5/S8 Update Dedicated Bearer Failure Ratio Parameters

Parameter	Counters (Group:Counter)
UpBrReqRcvd	sgw-gtp-tunnel-mgmt-s5-s8:sm-update-bearer-req-rcvd
UpBrResAccSent	sgw-gtp-tunnel-mgmt-s5-s8:sm-update-bearer-resp-acc-sent

5.1.2.3

SGW S4/S11 Create Session Failure Ratio

The SGW S4/S11 create session failure ratio denotes the probability of a failed attempt to create a session on the S4 or S11 interface.

Note: The procedures triggering the incoming Create Session Request are not only limited to the initial UE attach requests and additional PDN connectivity requests, but also to an SGW change for any reason.

$$\frac{S4S11CrSesReqRcvd - S4S11CrSesResAccSent}{S4S11CrSesReqRcvd}$$

Equation 51 SGW S4/S11 Create Session Failure Ratio

The parameters and the corresponding counters are listed in Table 56.

Table 56 Description of SGW S4/S11 Create Session Failure Ratio Parameters

Parameter	Counters (Group:Counter)
S4S11CrSesReqRcvd	sgw-gtp-tunnel-mgmt-s4-s11:sm-create-session-req-rcvd
S4S11CrSesResAccSent	sgw-gtp-tunnel-mgmt-s4-s11:sm-create-session-resp-acc-sent

5.1.2.4

SGW S4/S11 Modify Bearer Failure Ratio

The SGW S4/S11 Modify Bearer failure ratio denotes the probability of a failed attempt to modify an EPS bearer from the MME or SGSN on the S4 or S11 interface.

$$\frac{S4S11ModBrReqRcvd - S4S11ModBrResAccSent}{S4S11ModBrReqRcvd}$$

Equation 52 SGW S4/S11 Modify Bearer Failure Ratio

The parameters and the corresponding counters are listed in Table 57.



Table 57 Description of SGW S4/S11 Modify Bearer Failure Ratio Parameters

Parameter	Counters (Group:Counter)
S4S11ModBrReqRcvd	sgw-gtp-tunnel-mgmt-s4-s11:sm-modify-bearer-req-rcvd
S4S11ModBrResAccSent	sgw-gtp-tunnel-mgmt-s4-s11:sm-modify-bearer-resp-acc-sent

5.1.2.5 SGW Rf Transaction Failure Ratio

The SGW Rf Transaction Failure Ratio denotes the probability of failed accounting requests from the SGW towards the Charging Data Function (CDF).

$$\frac{\text{RfAcctAnswerRejRec}}{\text{RfAcctReqSent}}$$

Equation 53 SGW Rf Transaction Failure Ratio

The parameters and the corresponding counters are listed in Table 58.

Table 58 Description of SGW Rf Transaction Failure Ratio Parameters

Parameter	Counters (Group:Counter)
RfAcctAnswerRejRec	offline-charging:rf-acct-answer-rej-rec
RfAcctReqSent	offline-charging:rf-acct-req-sent

5.1.2.6 SGW Uplink Packet Drop Ratio

The SGW uplink packet drop ratio denotes the probability of a dropped uplink IPv4 or IPv6 packet.

All types of failures are included, for example, such as the following:

- Rejection because of Online Charging System (OCS) quota denial
- Terminal errors
- User errors
- RADIUS server errors
- Time-outs

The formula for the S5 interface is as follows:

$$\frac{\text{SgwUpDropPkts}}{\text{SgwUpDropPkts} + \text{S5OutDataPkts}}$$

Equation 54 SGW Uplink Packet Drop Ratio over the S5 Interface



The parameters and the corresponding counters are listed in Table 59.

Table 59 Description of Parameters for SGW Uplink Packet Drop Ratio over the S5 Interface

Parameter	Counters (Group:Counter)
SgwUpDropPkts	sgw-uplink-traffic:sgw-uplink-dropped-packets
S5OutDataPkts	sgw-gtp-traffic-s5:out-data-pkt

The formula for the S8 interface is as follows:

$$\frac{\text{SgwUpDropPkts}}{\text{SgwUpDropPkts} + \text{S8OutDataPkts}}$$

Equation 55 SGW Uplink Packet Drop Ratio over the S8 Interface

The parameters and the corresponding counters are listed in Table 60.

Table 60 Description of Parameters for SGW Uplink Packet Drop Ratio over the S8 Interface

Parameter	Counters (Group:Counter)
SgwUpDropPkts	sgw-uplink-traffic:sgw-uplink-dropped-packets
S8OutDataPkts	sgw-gtp-traffic-s8:out-data-pkt

The formula for the S5/S8 interface is as follows:

$$\frac{\text{SgwUpDropPkts}}{\text{SgwUpDropPkts} + \text{S5S8OutDataPkts}}$$

Equation 56 SGW Uplink Packet Drop Ratio over the S5/S8 Interface

The parameters and the corresponding counters are listed in Table 61.

Table 61 Description of Parameters for SGW Uplink Packet Drop Ratio over the S5/S8 Interface

Parameter	Counters (Group:Counter)
SgwUpDropPkts	sgw-uplink-traffic:sgw-uplink-dropped-packets
S5S8OutDataPkts	sgw-gtp-traffic-s5-s8:out-data-pkt

5.1.2.7

SGW Downlink Packet Drop Ratio

The SGW downlink packet drop ratio denotes the probability of a dropped downlink IPv4 or IPv6 packet. This formula is valid for the S1-U, S4-U, and S12 interfaces.

All types of failures are included, for example, such as the following:



- Rejection because of Online Charging System (OCS) quota denial
- Terminal errors
- User errors
- RADIUS server errors
- Time-outs

$$\frac{\text{SgwDnlkDropPkts}}{\text{SgwDnlkDropPkts} + \text{S1S4S12OutDataPkts}}$$

Equation 57 SGW Downlink Packet Drop Ratio

The parameters and the corresponding counters are listed in Table 62.

Table 62 Description of Parameters for SGW Downlink Packet Drop Ratio

Parameter	Counters (Group:Counter)
SgwDnlkDropPkts	sgw-downlink-traffic:sgw-downlink-dropped-packets
S1S4S12OutDataPkts	sgw-gtp-traffic-s1u-s4-s12:out-data-pkt

5.1.2.8

SGW S4/S11 Create Default Bearer Attempt Success Ratio per QCI

The SGW S4/S11 create default bearer attempt success ratio per QCI denotes the probability of a successful attempt to create a default bearer with a specific QCI when a Create Session Request message is received on the S4/S11 interface.

Note: The KPI is based on message counters per success rate, where >1 (above 100%) or $<< 1$ (far below 100%) indicates that the active PGW in some cases attempts to perform a QoS reclassification of the created default bearer to a lower QCI value than the initially requested QCI value. The reclassification is forwarded in the response sent on the S4 or S11 interface.

$$\frac{\text{S4S11CrDefBrReqFfd}}{\text{S4S11CrDefBrReq}}$$

Equation 58 SGW S4/S11 Create Default Bearer Attempt Success Ratio per QCI

The parameters and the corresponding counters are listed in Page 44.



Table 63 Description of SGW S4/S11 Create Default Bearer Attempt Success Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
S4S11CrDefBrReq	sgw-bearer-mgmt-qci-s4-s11:sm-create-default-bearer-request
S4S11CrDefBrReqFfd	sgw-bearer-mgmt-qci-s4-s11:sm-create-default-bearer-request-fulfilled

5.1.2.9

SGW S4/S11 Create Dedicated Bearer Attempt Failure Ratio per QCI

The SGW S4/S11 create dedicated bearer attempt failure ratio per QCI denotes the probability of a failed attempt to create a dedicated bearer with a specific QCI value when a Create Bearer Request message is sent on the S4 or S11 interface.

$$\frac{S4S11CrDedBrAttInit - S4S11CrDedBrAttSucc}{S4S11CrDedBrAttInit}$$

Equation 59 SGW S4/S11 Create Dedicated Bearer Attempt Failure Ratio per QCI

The parameters and the corresponding counters are listed in Table 64.

Table 64 Description of SGW S4/S11 Create Dedicated Bearer Attempt Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
S4S11CrDedBrAttInit	sgw-bearer-mgmt-qci-s4-s11:sm-create-dedicated-bearer-attempt-init
S4S11CrDedBrAttSucc	sgw-bearer-mgmt-qci-s4-s11:sm-create-dedicated-bearer-attempt-success

5.1.2.10

SGW S4/S11 Update Bearer Attempt Failure Ratio per QCI

The SGW S4/S11 update bearer attempt failure ratio per QCI denotes the probability of a failed attempt to update a bearer with a specific QCI value when an Update Bearer Request message is sent on the S4 or S11 interface.

$$\frac{S4S11UpBrAttInit - S4S11UpBrAttSucc}{S4S11UpBrAttInit}$$

Equation 60 SGW S4/S11 Update Bearer Attempt Failure Ratio per QCI

The parameters and the corresponding counters are listed in Table 65.



Table 65 Description of SGW S4/S11 Update Bearer Attempt Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
S4S11UpBrAttInit	sgw-bearer-mgmt-qci-s4-s11:sm-update-bearer-attempt-init
S4S11UpBrAttSuc c	sgw-bearer-mgmt-qci-s4-s11:sm-update-bearer-attempt-success

5.1.2.11

SGW S4/S11 Delete Session Request Failure Ratio per QCI

The SGW S4/S11 delete session request failure ratio per QCI denotes the probability of a failed attempt to delete a bearer with a specific QCI value when a Delete Session Request message is received on the S4 or S11 interface.

$$\frac{S4S11DelBrSessReq - S4S11DelBrSessReqFfd}{S4S11DelBrSessReq}$$

Equation 61 SGW S4/S11 Delete Session Request Failure Ratio per QCI

The parameters and the corresponding counters are listed in Table 66.

Table 66 Description of SGW S4/S11 Delete Session Request Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
S4S11DelBrSessReq	sgw-bearer-mgmt-qci-s4-s11:sm-delete-bearer-delsession-request
S4S11DelBrSessReqFfd	sgw-bearer-mgmt-qci-s4-s11:sm-delete-bearer-delsession-request-fulfilled

5.1.2.12

SGW S4/S11 Delete Bearer Command Request Failure Ratio per QCI

The SGW S4/S11 delete bearer command request failure ratio per QCI denotes the probability of a failed attempt to delete a bearer with a specific QCI value when a Delete Bearer Command message is received on the S4 or S11 interface.

$$\frac{S4S11DelBrCmdReq - S4S11DelBrCmdReqFfd}{S4S11DelBrCmdReq}$$

Equation 62 SGW S4/S11 Delete Bearer Command Request Failure Ratio per QCI

The parameters and the corresponding counters are listed in Table 67.



Table 67 Description of SGW S4/S11 Delete Bearer Request Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
S4S11DelBrCmdReq	sgw-bearer-mgmt-qci-s4-s11:sm-delete-bearer-cmd-request
S4S11DelBrCmdReqFfd	sgw-bearer-mgmt-qci-s4-s11:sm-delete-bearer-cmd-request-fulfilled

5.1.2.13

SGW S4/S11 Delete Bearer Attempt Failure Ratio per QCI

The SGW S4/S11 delete bearer attempt failure ratio per QCI denotes the probability of a failed attempt to delete a bearer with a specific QCI value when a Delete Bearer Request message is sent on the S4 or S11 interface.

$$\frac{S4S11DelBrAttInit - S4S11DelBrAttSucc}{S4S11DelBrAttInit}$$

Equation 63 SGW S4/S11 Delete Bearer Attempt Failure Ratio per QCI

The parameters and the corresponding counters are listed in Table 68.

Table 68 Description of SGW S4/S11 Delete Bearer Attempt Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
S4S11DelBrAttInit	sgw-bearer-mgmt-qci-s4-s11:sm-delete-bearer-attempt-init
S4S11DelBrAttSucc	sgw-bearer-mgmt-qci-s4-s11:sm-delete-bearer-attempt-success

5.1.2.14

SGW S4/S11 Create Dedicated Bearer Request Failure Ratio per QCI during SGW Relocation

The SGW S4/S11 create dedicated bearer request failure ratio per QCI during SGW relocation denotes the probability of a failed attempt to create a dedicated bearer with a specific QCI value when a Create Session Request message is received on the S4 or S11 interface in an SGW relocation scenario.

$$\frac{S4S11RelocCrDedBrReq - S4S11RelocCrDedBrReqFfd}{S4S11RelocCrDedBrReq}$$

Equation 64 SGW S4/S11 Create Dedicated Bearer Request Failure Ratio per QCI during SGW Relocation

The parameters and the corresponding counters are listed in Table 69.



Table 69 Description of SGW S4/S11 Create Dedicated Bearer Request Failure Ratio per QCI During SGW Relocation Parameters

Parameter	Counters (Group:Counter)
S4S11RelocCrDedBrReq	sgw-bearer-mgmt-qci-s4-s11:sm-sgw-reloc-create-dedicated-bearer-request
S4S11RelocCrDedBrReqFfd	sgw-bearer-mgmt-qci-s4-s11:sm-sgw-reloc-create-dedicated-bearer-request-fulfilled

5.1.2.15

SGW Create Dedicated Bearer Request Failure Ratio per QCI

The SGW creates dedicated bearer request failure ratio per QCI denotes the probability of a failed attempt to create a dedicated bearer with a specific QCI value when a Create Bearer Request message is received on the S5, S8, or combined S5/S8 interface.

$$\frac{\text{CrDedBrReq} - \text{CrDedBrReqFfd}}{\text{CrDedBrReq}}$$

Equation 65 SGW Create Dedicated Bearer Request Failure Ratio per QCI

If a separate S5 interface is configured on the SGW, Table 70 lists the counters corresponding to the parameters in Equation 65.

Table 70 Description of SGW S5 Create Dedicated Bearer Request Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
CrDedBrReq	sgw-bearer-mgmt-qci-s5:sm-create-dedicated-bearer-request
CrDedBrReqFfd	sgw-bearer-mgmt-qci-s5:sm-create-dedicated-bearer-request-fulfilled

If a separate S8 interface is configured on the SGW, Table 71 lists the counters corresponding to the parameters in Equation 65.

Table 71 Description of SGW S8 Create Dedicated Bearer Request Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
CrDedBrReq	sgw-bearer-mgmt-qci-s8:sm-create-dedicated-bearer-request
CrDedBrReqFfd	sgw-bearer-mgmt-qci-s8:sm-create-dedicated-bearer-request-fulfilled

If a combined S5/S8 interface is configured on the SGW, Table 72 lists the counters corresponding to the parameters in Equation 65.



Table 72 Description of SGW S5/S8 Create Dedicated Bearer Request Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
CrDedBrReq	sgw-bearer-mgmt-qci-s5-s8:sm-create-dedicated-bearer-request
CrDedBrReqFfd	sgw-bearer-mgmt-qci-s5-s8:sm-create-dedicated-bearer-request-fulfilled

5.1.2.16

SGW Create Default Bearer Attempt Success Ratio per QCI

The SGW Create Default Bearer Attempt Success Ratio per QCI denotes the probability of a successful attempt to create a default bearer with a specific QCI value when a Create Session Request message is sent on the S5, S8, or the combined S5/S8 interface.

Note: The KPI is based on message counters per success rate, where >1 (above 100%) or << 1 (far below 100%) indicates that the responding PGW in some responses to a Create Default Bearer Attempt, performs a QoS reclassification of the created default bearer to a lower QCI value than the initially requested QCI value.

$$\frac{\text{CrDefBrAttSucc}}{\text{CrDefBrAttInit}}$$

Equation 66 SGW Create Default Bearer Attempt Success Ratio per QCI

If a separate S5 interface is configured on the SGW, Table 73 lists the counters corresponding to the parameters in Equation 66.

Table 73 Description of SGW S5 Create Default Bearer Attempt Success Ratio per QCI Parameters

Parameter	Counters Group:Counter
CrDefBrAttInit	sgw-bearer-mgmt-qci-s5:sm-create-default-bearer-attempt-init
CrDefBrAttSucc	sgw-bearer-mgmt-qci-s5:sm-create-default-bearer-attempt-success

If a separate S8 interface is configured on the SGW, Table 74 lists the counters corresponding to the parameters in Equation 66.



Table 74 Description of SGW S8 Create Bearer Attempt Success Ratio per QCI Parameters

Parameter	Counters Group:Counter
CrDefBrAttInit	sgw-bearer-mgmt-qci-s8:sm-creat e-default-bearer-attempt-init
CrDefBrAttSucc	sgw-bearer-mgmt-qci-s8:sm-crea te-default-bearer-attempt-succ ess

If a combined S5/S8 interface is configured on the SGW, Table 75 lists the counters corresponding to the parameters in Equation 66

Table 75 Description of SGW S5/S8 Create Default Bearer Attempt Success Ratio per QCI Parameters

Parameter	Counters Group:Counter
CrDefBrAttInit	sgw-bearer-mgmt-qci-s5-s8:sm-c reate-default-bearer-attempt-i nit
CrDefBrAttSucc	sgw-bearer-mgmt-qci-s5-s8:sm-cr eate-default-bearer-attempt-su ccess

5.1.2.17

SGW Update Bearer Request Failure Ratio per QCI

The SGW update bearer request failure ratio per QCI denotes the probability of a failed attempt to update a bearer with a specific QCI value when an Update Bearer Request message is received on the S5, S8, or combined S5/S8 interface.

$$\frac{\text{UpBrReq} - \text{UpBrReqFfd}}{\text{UpBrReq}}$$

Equation 67 SGW Update Bearer Request Failure Ratio per QCI

If a separate S5 interface is configured on the SGW, Table 76 lists the counters corresponding to the parameters in Equation 67.

Table 76 Description of SGW S5 Update Bearer Request Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
UpBrReq	sgw-bearer-mgmt-qci-s5:sm-update-bearer-req uest
UpBrReqFfd	sgw-bearer-mgmt-qci-s5:sm-update-bearer-req uest-fulfilled



If a separate S8 interface is configured on the SGW, Table 77 lists the counters corresponding to the parameters in Equation 67.

Table 77 Description of SGW S8 Update Bearer Request Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
UpBrReq	sgw-bearer-mgmt-qci-s8:sm-update-bearer-request
UpBrReqFfd	sgw-bearer-mgmt-qci-s8:sm-update-bearer-request-fulfilled

If a combined S5/S8 interface is configured on the SGW, Table 78 lists the counters corresponding to the parameters in Equation 67.

Table 78 Description of SGW S5/S8 Update Bearer Request Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
UpBrReq	sgw-bearer-mgmt-qci-s5-s8:sm-update-bearer-request
UpBrReqFfd	sgw-bearer-mgmt-qci-s5-s8:sm-update-bearer-request-fulfilled

5.1.2.18

SGW Delete Bearer Command Attempt Failure Ratio per QCI

The SGW delete bearer command attempt failure ratio per QCI denotes the probability of a failed attempt to delete a bearer with a specific QCI value when a Delete Bearer Command message is sent on the S5, S8, or combined S5/S8 interface.

$$\frac{\text{DelBrCmdAttInit} - \text{DelBrCmdAttSucc}}{\text{DelBrCmdAttInit}}$$

Equation 68 SGW Delete Bearer Command Attempt Failure Ratio per QCI

If a separate S5 interface is configured on the SGW, Table 82 lists the counters corresponding to the parameters in Equation 69.

Table 79 Description of SGW S5 Delete Bearer Command Attempt Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
DelBrCmdAttInit	sgw-bearer-mgmt-qci-s5:sm-delete-bearer-cmd-attempt-init
DelBrCmdAttSucc	sgw-bearer-mgmt-qci-s5:sm-delete-bearer-cmd-attempt-success



If a separate S8 interface is configured on the SGW, Table 83 lists the counters corresponding to the parameters in Equation 69.

Table 80 Description of SGW S8 Delete Bearer Command Attempt Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
DelBrCmdAttInit	sgw-bearer-mgmt-qci-s8:sm-delete-bearer-cmd-attempt-init
DelBrCmdAttSucc	sgw-bearer-mgmt-qci-s8:sm-delete-bearer-cmd-attempt-success

If a combined S5/S8 interface is configured on the SGW, Table 84 lists the counters corresponding to the parameters in Equation 69.

Table 81 Description of SGW S5/S8 Delete Bearer Command Attempt Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
DelBrCmdAttInit	sgw-bearer-mgmt-qci-s5-s8:sm-delete-bearer-cmd-attempt-init
DelBrCmdAttSucc	sgw-bearer-mgmt-qci-s5-s8:sm-delete-bearer-cmd-attempt-success

5.1.2.19

SGW Delete Session Attempt Failure Ratio per QCI

The SGW delete session attempt failure ratio per QCI denotes the probability of a failed attempt to delete a bearer with a specific QCI value when a Delete Session Request message is sent on the S5, S8, or combined S5/S8 interface.

$$\frac{\text{DelSessAttInit} - \text{DelSessAttSucc}}{\text{DelSessAttInit}}$$

Equation 69 SGW Delete Session Attempt Failure Ratio per QCI

If a separate S5 interface is configured on the SGW, Table 82 lists the counters corresponding to the parameters in Equation 69.

Table 82 Description of SGW S5 Delete Session Attempt Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
DelSessAttInit	sgw-bearer-mgmt-qci-s5:sm-delete-bearer-delsession-attempt-init
DelSessAttSucc	sgw-bearer-mgmt-qci-s5:sm-delete-bearer-delsession-attempt-success



If a separate S8 interface is configured on the SGW, Table 83 lists the counters corresponding to the parameters in Equation 69.

Table 83 Description of SGW S8 Delete Session Attempt Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
DelSessAttInit	sgw-bearer-mgmt-qci-s8:sm-delete-bearer-delsession-attempt-init
DelSessAttSucc	sgw-bearer-mgmt-qci-s8:sm-delete-bearer-delsession-attempt-success

If a combined S5/S8 interface is configured on the SGW, Table 84 lists the counters corresponding to the parameters in Equation 69.

Table 84 Description of SGW S5/S8 Delete Session Attempt Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
DelSessAttInit	sgw-bearer-mgmt-qci-s5-s8:sm-delete-bearer-delsession-attempt-init
DelSessAttSucc	sgw-bearer-mgmt-qci-s5-s8:sm-delete-bearer-delsession-attempt-success

5.1.2.20

SGW Delete Bearer Request Failure Ratio per QCI

The SGW delete bearer request failure ratio per QCI denotes the probability of a failed attempt to delete a bearer with a specific QCI value when a Delete Bearer Request message is received on the S5, S8, or combined S5/S8 interface.

$$\frac{\text{DelBrReq} - \text{DelBrReqFfd}}{\text{DelBrReq}}$$

Equation 70 SGW Delete Bearer Request Failure Ratio per QCI

If a separate S5 interface is configured on the SGW, Table 85 lists the counters corresponding to the parameters in Equation 70.

Table 85 Description of SGW S5 Delete Bearer Request Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
DelBrReq	sgw-bearer-mgmt-qci-s5:sm-delete-bearer-request
DelBrReqFfd	sgw-bearer-mgmt-qci-s5:sm-delete-bearer-request-fulfilled



If a separate S8 interface is configured on the SGW, Table 86 lists the counters corresponding to the parameters in Equation 70.

Table 86 Description of SGW S8 Delete Bearer Request Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
DelBrReq	sgw-bearer-mgmt-qci-s8:sm-delete-bearer-request
DelBrReqFfd	sgw-bearer-mgmt-qci-s8:sm-delete-bearer-request-fulfilled

If a combined S5/S8 interface is configured on the SGW, Table 87 lists the counters corresponding to the parameters in Equation 70.

Table 87 Description of SGW S5/S8 Delete Bearer Request Failure Ratio per QCI Parameters

Parameter	Counters (Group:Counter)
DelBrReq	sgw-bearer-mgmt-qci-s5-s8:sm-delete-bearer-request
DelBrReqFfd	sgw-bearer-mgmt-qci-s5-s8:sm-delete-bearer-request-fulfilled

5.1.2.21

SGW Modify Bearer Attempt Failure Ratio per QCI during SGW Relocation

The SGW modify bearer attempt failure ratio per QCI during SGW relocation denotes the probability of a failed attempt to modify a bearer with a specific QCI value when a Modify Bearer Request message is sent on the S5, S8, or combined S5/S8 interface in an SGW relocation scenario.

$$\frac{\text{RelocModBrAttInit} - \text{RelocModBrAttSucc}}{\text{RelocModBrAttInit}}$$

Equation 71 SGW Modify Bearer Attempt Failure Ratio per QCI during SGW Relocation

If a separate S5 interface is configured on the SGW, Table 88 lists the counters corresponding to the parameters in Equation 71.

Table 88 Description of SGW S5 Modify Bearer Attempt Failure Ratio per QCI during SGW Relocation Parameters

Parameter	Counters (Group:Counter)
RelocModBrAttInit	sgw-bearer-mgmt-qci-s5:sm-sgw-reloc-modify-bearer-attempt-init
RelocModBrAttSucc	sgw-bearer-mgmt-qci-s5:sm-sgw-reloc-modify-bearer-attempt-success



If a separate S8 interface is configured on the SGW, Table 89 lists the counters corresponding to the parameters in Equation 71.

Table 89 Description of SGW S8 Modify Bearer Attempt Failure Ratio per QCI during SGW Relocation Parameters

Parameter	Counters (Group:Counter)
RelocModBrAttInit	sgw-bearer-mgmt-qci-s8:sm-sgw-reloc-modify-bearer-attempt-init
RelocModBrAttSuc	sgw-bearer-mgmt-qci-s8:sm-sgw-reloc-modify-bearer-attempt-success

If a combined S5/S8 interface is configured on the SGW, Table 90 lists the counters corresponding to the parameters in Equation 71.

Table 90 Description of SGW S5/S8 Modify Bearer Attempt Failure Ratio per QCI during SGW Relocation Parameters

Parameter	Counters (Group:Counter)
RelocModBrAttInit	sgw-bearer-mgmt-qci-s5-s8:sm-sgw-reloc-modify-bearer-attempt-init
RelocModBrAttSuc	sgw-bearer-mgmt-qci-s5-s8:sm-sgw-reloc-modify-bearer-attempt-success

5.2 Traffic Usage Indicators

Gauges and counters indicating the traffic capacity are described below for the following deployment types.

- GGSN or PGW, see Section 5.2.1 on page 54
- SGW, see Section 5.2.2 on page 69
- Combined SGW and PGW, see Section 5.2.3 on page 74

Note: The naming convention used for the counters is **GroupName:CounterName** in the following subsections.

5.2.1 GGSN/PGW Traffic Usage Indicators

Gauges and counters indicating the traffic capacity for a GGSN or PGW are described below.

5.2.1.1 Number of Currently Active PDP Contexts in the GGSN

The number of currently active PDP contexts is indicated by **ggsn-global-stats:ggsn-nbr-of-active-pdp-contexts**.



5.2.1.2 Number of Currently Active PDP Contexts per APN in the GGSN

The number of active PDP contexts per APN is indicated by `pgw-number-of-bearers-apn:active-pdp`.

5.2.1.3 Number of Currently Active EPS Bearers in the PGW

The number of currently active EPS bearers is indicated by `pgw-global-stats:pgw-nbr-of-active-eps-bearer`.

5.2.1.4 Number of Currently Active EPS Bearers per APN in the PGW

The number of currently active EPS bearers per APN is indicated by `pgw-number-of-bearers-apn:eps-active-bearer`.

5.2.1.5 Number of Currently Active Dedicated EPS Bearers per APN in the PGW

The number of currently active dedicated EPS bearers per APN is indicated by `pgw-number-of-bearers-apn:eps-active-dedi-bearer`.

5.2.1.6 Maximum Number of Active PDP Contexts per APN in the GGSN

The maximum number of PDP contexts that has been active at the same time for the APN.

The maximum number of active PDP contexts and EPS bearers per APN at the same time is indicated by `pgw-number-of-bearers-apn:active-pdp-max`.

5.2.1.7 Number of Subscribers in the GGSN or PGW

The gauge `ggsn-global-stats:ggsn-nbr-of-subscribers` indicates the current number of subscribers over the Gn/Gp interface, identified either by IMSI or IMEI, where IMEI is used for emergency calls for unauthenticated users.

5.2.1.8 Mean Number of Active PDP Contexts per APN in the GGSN/PGW

The mean number of active PDP contexts and EPS bearers per APN is indicated by: `pgw-number-of-bearers-apn:active-pdp-mean`.

It is calculated with five samples taken over a 15 minute period.

5.2.1.9 GGSN or PGW Uplink Packet Throughput

Total number of uplink Gn, S5, S8, S2a, and S2b user plane IPv4 and IPv6 packets processed by the GGSN or PGW.



The total number of user payload packets received from the Gn, S5, S8, S2a, and S2b interfaces is indicated by **ggsn-uplink-traffic-info:ggsn-uplink-packets**.

The throughput is specified in packets per second (pps), when divided by the length of the measurement interval in seconds.

GGSN or PGW uplink packet throughput (measured in kpps) is equal to:

$$\frac{\text{GgsnUITrafGgsnUIPkts}}{(\text{measurementInterval}) * 1000}$$

Equation 72 GGSN or PGW Uplink Packet Throughput [kpps]

Table 91 Description of Parameters for GGSN or PGW Uplink Packet Throughput [kpps]

Parameter	Counters (Group:Counter)
GgsnUITrafGgsnUIPkts	ggsn-uplink-traffic-info:ggsn-uplink-packets
measurementInterval	measurement interval

5.2.1.10

GGSN or PGW Downlink Packet Throughput

Total number of downlink Gn, S5, S8, S2a, and S2b user plane IPv4 and IPv6 packets processed by the GGSN or PGW.

The total number of user payload packets sent to the Gn, S5, S8, S2a, and S2b interfaces is indicated by **ggsn-downlink-traffic-info:ggsn-downlink-packets**.

The throughput is specified in pps, when divided by the length of the measurement interval in seconds.

GGSN or PGW downlink packet throughput (measured in kpps) is equal to:

$$\frac{\text{DeltaGgsnDITrafGgsnDIPkts}}{(\text{measurementInterval}) * 1000}$$

Equation 73 GGSN or PGW Downlink Packet Throughput [kpps]

Table 92 Description of Parameters for GGSN or PGW Downlink Packet Throughput [kpps]

Parameter	Counters (Group:Counter)
DeltaGgsnDITrafGgsnDIPkts	ggsn-downlink-traffic-info:ggsn-downlink-packets(stop time) - ggsn-downlink-traffic-info:ggsn-downlink-packets(start time)
measurementInterval	measurement interval (in seconds)



5.2.1.11 GGSN or PGW Uplink Byte Throughput

Total number of uplink Gn, S5, S8, S2a, and S2b user plane IPv4 and IPv6 bytes processed by the GGSN or PGW.

The total number of bytes for user payload packets in the uplink direction is indicated by `ggsn-uplink-traffic-info:ggsn-uplink-bytes`.

The throughput is specified in bits per second (bps), when multiplied by eight and divided by the length of the measurement interval in seconds.

PGW uplink throughput (measured in Mbps) is equal to:

$$\frac{\text{DeltaGgsnUITrafGgsnUIBytes} * 8}{(\text{measurementInterval}) * 1000 * 1000}$$

Equation 74 GGSN or PGW Uplink Byte Throughput [Mbps]

Table 93 Description of Parameters for GGSN or PGW Uplink Byte Throughput [Mbps]

Parameter	Counters (Group:Counter)
DeltaGgsnUITrafGgsnUIBytes	ggsn-uplink-traffic-info:ggsn-uplink-bytes(stop time) - ggsn-uplink-traffic-info:ggsn-uplink-bytes(start time)
measurementInterval	measurement interval (in seconds)

5.2.1.12 GGSN or PGW Downlink Byte Throughput

Total number of downlink Gn, S5, S8, S2a, and S2b user plane IPv4 and IPv6 bytes processed by the GGSN or PGW.

The total number of bytes for user payload packets in the downlink direction is indicated by `ggsn-downlink-traffic-info:ggsn-downlink-bytes`.

The throughput is specified in bps, when multiplied by eight and divided by the length of the measurement interval in seconds.

PGW downlink throughput (measured in Mbps) is equal to:

$$\frac{\text{DeltaGgsnDITrafGgsnDIBytes} * 8}{(\text{measurementInterval}) * 1000 * 1000}$$

Equation 75 GGSN or PGW Downlink Byte Throughput [Mbps]



Table 94 Description of Parameters for GGSN or PGW Downlink Byte Throughput [Mbps]

Parameter	Counters (Group:Counter)
DeltaGgsnDITrafGgsnDIBytes	ggsn-downlink-traffic-info:ggsn-downlink-bytes(stop time) - ggsn-downlink-traffic-info:ggsn-downlink-bytes(start time)
measurementInterval	measurement interval (in seconds)

5.2.1.13 Total Packet Throughput for GGSN/PGW

The total number of packet throughput for the GGSN/PGW in uplink and downlink directions.

Total packet throughput (measured in kpps) is equal to **GGSN or PGW Uplink Packet Throughput + GGSN or PGW Downlink Packet Throughput**.

5.2.1.14 Total Byte Throughput for GGSN/PGW

The total data throughput for the GGSN/PGW in uplink and downlink directions.

Total throughput (measured in Mbps) is equal to **GGSN or PGW Uplink Throughput + GGSN or PGW Downlink Throughput**.

5.2.1.15 GGSN 3GDT Uplink Packet Throughput per APN

Total number of uplink Gn user plane IPv4 and IPv6 packets that are associated with 3GDT contexts.

The total number of uplink user payload packets that are associated with 3GDT contexts per APN and that are received from RNCs is indicated by **pgw-traffic-iu-3gdt-apn:ul-packets**.

The throughput is specified in pps, when divided by the length of the measurement interval in seconds.

GGSN 3GDT uplink packet throughput (measured in kpps) is equal to:

$$\frac{\text{DeltaGgsnApnGnApn3gdtUIPkts}}{(\text{measurementInterval}) * 1000}$$

Equation 76 GGSN 3GDT Uplink Packet Throughput per APN [kpps]



Table 95 Description of Parameters for GGSN 3GDT Uplink Packet Throughput per APN [kpps]

Parameter	Counters (Group:Counter)
DeltaGgsnApnGnApn3gdtUIPkts	pgw-traffic-iu-3gdt-apn:ul-packets(stop time) - pgw-traffic-iu-3gdt-apn:ul-packets(start time)
measurementInterval	measurement interval (in seconds)

5.2.1.16 GGSN 3GDT Downlink Packet Throughput per APN

Total number of downlink Gn user plane IPv4 and IPv6 packets that are associated with 3GDT contexts.

The total number of downlink user payload packets that are associated with 3GDT contexts per APN and that are sent to RNCs is indicated by **pgw-traffic-iu-3gdt-apn:d1-packets**.

The throughput is specified in pps, when divided by the length of the measurement interval in seconds.

GGSN 3GDT downlink packet throughput (measured in kpps) is equal to:

$$\frac{\text{DeltaGgsnApnGnApn3gdtDIPkts}}{(\text{measurementInterval}) * 1000}$$

Equation 77 GGSN 3GDT Downlink Packet Throughput per APN [kpps]

Table 96 Description of Parameters for GGSN 3GDT Downlink Packet Throughput per APN [kpps]

Parameter	Counters (Group:Counter)
DeltaGgsnApnGnApn3gdtDIPkts	pgw-traffic-iu-3gdt-apn:d1-packets (stop time) - pgw-traffic-iu-3gdt-apn:d1-packets (start time)
measurementInterval	Measurement interval (in seconds)

5.2.1.17 Service Chaining Service Function Uplink Byte Throughput

The throughput of data that the GGSN or PGW sent to the service function and the throughput of data that the service function sent back to the GGSN or PGW can be distinguished as follows:

- GGSN or PGW egress uplink byte throughput to the service function, that is, the total number of uplink user plane IPv4 and IPv6 bytes sent to process from GGSN or PGW to the service function.

The total number of bytes for user payload packets in the uplink direction is indicated by **pgw-sc-apn-serv-func:ul-byte-send**.



$$\frac{\text{deltaUIByteSent} * 8}{(\text{measurementInterval}) * 1000 * 1000}$$

Equation 78 Service Function Uplink Byte Throughput [Mbps]

Table 97 Description of Parameters for Service Function Uplink Byte Throughput [Mbps]

Parameter	Counters (Group:Counter)
deltaUIByteSent	pgw-sc-apn-serv-func:ul-byte-sent(stop time) – pgw-sc-apn-serv-func:ul-byte-sent(start time)
measurementInterval	measurement interval (in seconds)

- GGSN or PGW ingress uplink byte throughput from the service function, that is, the total number of uplink user plane IPv4 and IPv6 bytes received from the service function after processing to the GGSN or PGW.

The total number of bytes for user payload packets in the uplink direction is indicated by **pgw-sc-apn-serv-func:ul-byte-rcvd**.

$$\frac{\text{deltaUIByteRcvd} * 8}{(\text{measurementInterval}) * 1000 * 1000}$$

Equation 79 Service Function Uplink Byte Throughput [Mbps]

Table 98 Description of Parameters for Service Function Uplink Byte Throughput [Mbps]

Parameter	Counters (Group:Counter)
deltaUIByteRcvd	pgw-sc-apn-serv-func:ul-byte-rcvd(stop time) – pgw-sc-apn-serv-func:ul-byte-rcvd(start time)
measurementInterval	measurement interval (in seconds)

The throughput is specified in bits per second (bps), when multiplied by eight and divided by the length of the measurement interval in seconds.

Note: This indicator can be calculated on APN level using the counter directly or aggregating so that is possible calculate at node level.

5.2.1.18

Service Chaining Service Function Uplink Packet Throughput

The throughput of data that the GGSN or PGW sent to the service function and the throughput of data that the service function sent back to the GGSN or PGW can be distinguished as follows:

- GGSN or PGW egress uplink packet throughput to the service function, that is, the total number of uplink user plane IPv4 and IPv6 packets sent to process from GGSN or PGW to the service function.



The total number of packets for user payload packets in the uplink direction is indicated by **pgw-sc-apn-serv-func:ul-pkt-send**.

$$\frac{\text{deltaUIPktSent}}{(\text{measurementInterval}) * 1000}$$

Equation 80 Service Function Uplink Packet Throughput [kpps]

Table 99 Description of Parameters for Service Function Uplink Packet Throughput [kpps]

Parameter	Counters (Group:Counter)
deltaUIPktSent	pgw-sc-apn-serv-func:ul-pkt-send(stop time) – pgw-sc-apn-serv-func:ul-pkt-send(start time)
measurementInterval	measurement interval (in seconds)

- GGSN or PGW ingress uplink packet throughput from the service function, that is, the total number of uplink user plane IPv4 and IPv6 packets received from the service function after processing to the GGSN or PGW.

The total number of packets for user payload packets in the uplink direction is indicated by **pgw-sc-apn-serv-func:ul-pkt-rcvd**.

$$\frac{\text{deltaUIPktRcvd}}{(\text{measurementInterval}) * 1000}$$

Equation 81 Service Function Uplink Packet Throughput [kpps]

Table 100 Description of Parameters for Service Function Uplink Packet Throughput [kpps]

Parameter	Counters (Group:Counter)
deltaUIPktRcvd	pgw-sc-apn-serv-func:ul-pkt-rcvd(stop time) – pgw-sc-apn-serv-func:ul-pkt-rcvd(start time)
measurementInterval	measurement interval (in seconds)

The throughput is specified in packets per second (pps), when divided by the length of the measurement interval in seconds.

Note: This indicator can be calculated on APN level using the counter directly or aggregating so that is possible calculate at node level.

5.2.1.19

Service Chaining Service Function Downlink Byte Throughput

The throughput of data that the GGSN or PGW sent to the service function and the throughput of data that the service function sent back to the GGSN or PGW can be distinguished as follows:



- GGSN or PGW egress downlink byte throughput to the service function, that is, the total number of downlink user plane IPv4 and IPv6 bytes sent to process from GGSN or PGW to the service function.

The total number of bytes for user payload packets in the downlink direction is indicated by **pgw-sc-apn-serv-func:d1-byte-send**.

$$\frac{\text{deltaDlByteSent} * 8}{(\text{measurementInterval}) * 1000 * 1000}$$

Equation 82 Service Function Downlink Byte Throughput [Mbps]

Table 101 Description of Parameters for Service Function Downlink Byte Throughput [Mbps]

Parameter	Counters (Group:Counter)
deltaDlByteSent	pgw-sc-apn-serv-func:d1-byte-sent(stop time) – pgw-sc-apn-serv-func:d1-byte-sent(start time)
measurementInterval	measurement interval (in seconds)

- GGSN or PGW ingress downlink byte throughput from the service function, that is, the total number of downlink user plane IPv4 and IPv6 bytes received from the service function after processing to the GGSN or PGW.

The total number of bytes for user payload packets in the downlink direction is indicated by **pgw-sc-apn-serv-func:d1-byte-rcvd**.

$$\frac{\text{deltaDlByteRcvd} * 8}{(\text{measurementInterval}) * 1000 * 1000}$$

Equation 83 Service Function Downlink Byte Throughput [Mbps]

Table 102 Description of Parameters for Service Function Downlink Byte Throughput [Mbps]

Parameter	Counters (Group:Counter)
deltaDlByteRcvd	pgw-sc-apn-serv-func:d1-byte-rcvd(stop time) – pgw-sc-apn-serv-func:d1-byte-rcvd(start time)
measurementInterval	measurement interval (in seconds)

The throughput is specified in bits per second (bps), when multiplied by eight and divided by the length of the measurement interval in seconds.

Note: This indicator can be calculated on APN level using the counter directly or aggregating so that is possible calculate at node level.



5.2.1.20

Service Chaining Service Function Downlink Packet Throughput

The throughput of data that the GGSN or PGW sent to the service function and the throughput of data that the service function sent back to the GGSN or PGW can be distinguished as follows:

- GGSN or PGW egress downlink packet throughput to the service function, that is, the total number of downlink user plane IPv4 and IPv6 packets sent to process from GGSN or PGW to the service function.

The total number of packets for user payload packets in the downlink direction is indicated by **pgw-sc-apn-serv-func:d1-pkt-send**.

$$\frac{\text{deltaDIPktSent}}{(\text{measurementInterval}) * 1000}$$

Equation 84 Service Function Downlink Packet Throughput [kpps]

Table 103 Description of Parameters for Service Function Downlink Packet Throughput [kpps]

Parameter	Counters (Group:Counter)
deltaDIPktSent	pgw-sc-apn-serv-func:d1-pkt-sent(stop time) – pgw-sc-apn-serv-func:d1-pkt-sent(start time)
measurementInterval	measurement interval (in seconds)

- GGSN or PGW ingress downlink packet throughput from the service function, that is, the total number of downlink user plane IPv4 and IPv6 packets received from the service function after processing to the GGSN or PGW.

The total number of packets for user payload packets in the downlink direction is indicated by **pgw-sc-apn-serv-func:d1-pkt-rcvd**.

$$\frac{\text{deltaDIPktRcvd}}{(\text{measurementInterval}) * 1000}$$

Equation 85 Service Function Downlink Packet Throughput [kpps]

Table 104 Description of Parameters for Service Function Downlink Packet Throughput [kpps]

Parameter	Counters (Group:Counter)
deltaDIPktRcvd	pgw-sc-apn-serv-func:d1-pkt-rcvd(stop time) – pgw-sc-apn-serv-func:d1-pkt-rcvd(start time)
measurementInterval	measurement interval (in seconds)

The throughput is specified in packets per second (pps), when divided by the length of the measurement interval in seconds.



Note: This indicator can be calculated on APN level using the counter directly or aggregating so that is possible calculate at node level.

5.2.1.21 Service Chaining Total Byte Throughput for Service Function

The total data throughput for the service function in uplink and downlink directions.

Total data throughput (measured in kpps) is equal to **Service Function Uplink Byte Throughput + Service Function Downlink Byte Throughput**.

5.2.1.22 Service Chaining Total Packet Throughput for Service Function

The total number of packet throughput for the service function in uplink and downlink directions.

Total packet throughput (measured in kpps) is equal to **Service Function Uplink Packet Throughput + Service Function Downlink Packet Throughput**.

5.2.1.23 Service Chaining SC Uplink Byte Throughput

The throughput of data sent to the Service Chain (SC) and the throughput that the SC sent back to the internet can be distinguished as follows:

- GGSN or PGW egress uplink byte throughput to the SC, that is, the total number of uplink user plane IPv4 and IPv6 bytes sent to process from GGSN or PGW to the service functions belonging to the SC.

The total number of bytes for user payload packets in the uplink direction is indicated by **pgw-sc-apn-serv-chain:ul-byte-in**.

$$\frac{\text{deltaUlByteIn} * 8}{(\text{measurementInterval}) * 1000 * 1000}$$

Equation 86 SC Uplink Byte Throughput [Mbps]

Table 105 Description of Parameters for SC Uplink Byte Throughput [Mbps]

Parameter	Counters (Group:Counter)
deltaUlByteIn	pgw-sc-apn-serv-chain:ul-byte-in(stop time) – pgw-sc-apn-serv-chain:ul-byte-in(start time)
measurementInterval	measurement interval (in seconds)

- GGSN or PGW ingress uplink byte throughput from the SC, that is, the total number of uplink user plane IPv4 and IPv6 bytes received from the SC after processing to the GGSN or PGW.



The total number of bytes for user payload packets in the uplink direction is indicated by **pgw-sc-apn-serv-chain:ul-byte-out**.

$$\frac{\text{deltaUIByteOut} * 8}{(\text{measurementInterval}) * 1000 * 1000}$$

Equation 87 SC Uplink Byte Throughput [Mbps]

Table 106 Description of Parameters for SC Uplink Byte Throughput [Mbps]

Parameter	Counters (Group:Counter)
deltaUIByteOut	pgw-sc-apn-serv-chain:ul-byte-out(stop time) – pgw-sc-apn-serv-chain:ul-byte-out(start time)
measurementInterval	measurement interval (in seconds)

The throughput is specified in bits per second (bps), when multiplied by eight and divided by the length of the measurement interval in seconds.

Note: This indicator can be calculated on APN level using the counter directly or aggregating so that is possible calculate at node level.

5.2.1.24

Service Chaining SC Uplink Packet Throughput

The throughput of data sent to the Service Chain (SC) and the throughput that the SC sent back to the internet can be distinguished as follows:

- GGSN or PGW egress uplink packet throughput to the SC, that is, the total number of uplink user plane IPv4 and IPv6 packets sent to process from GGSN or PGW to the service functions belonging to the SC.

The total number of packets for user payload packets in the uplink direction is indicated by **pgw-sc-apn-serv-chain:ul-pkt-in**.

$$\frac{\text{deltaUIPktIn}}{(\text{measurementInterval}) * 1000}$$

Equation 88 SC Uplink Packet Throughput [kpps]

Table 107 Description of Parameters for SC Uplink Packet Throughput [kpps]

Parameter	Counters (Group:Counter)
deltaUIPktIn	pgw-sc-apn-serv-chain:ul-pkt-in(stop time) – pgw-sc-apn-serv-chain:ul-pkt-in(start time)
measurementInterval	measurement interval (in seconds)

- GGSN or PGW ingress uplink packet throughput from the SC, that is, the total number of uplink user plane IPv4 and IPv6 packets received from the SC after processing to the GGSN or PGW.



The total number of packets for user payload packets in the uplink direction is indicated by `pgw-sc-apn-serv-chain:ul-pkt-out`.

$$\frac{\text{deltaUIPktOut}}{(\text{measurementInterval}) * 1000}$$

Equation 89 SC Uplink Packet Throughput [kpps]

Table 108 Description of Parameters for SC Uplink Packet Throughput [kpps]

Parameter	Counters (Group:Counter)
deltaUIPktOut	pgw-sc-apn-serv-chain:ul-pkt-out(stop time) – pgw-sc-apn-serv-chain:ul-pkt-out(start time)
measurementInterval	measurement interval (in seconds)

The throughput is specified in packets per second (pps), when divided by the length of the measurement interval in seconds.

Note: This indicator can be calculated on APN level using the counter directly or aggregating so that is possible calculate at node level.

5.2.1.25

Service Chaining SC Downlink Byte Throughput

The throughput of data sent to the Service Chain (SC) and the throughput that the SC back to the internet can be distinguished as follows:

- GGSN or PGW egress downlink byte throughput to the SC, that is, the total number of downlink user plane IPv4 and IPv6 bytes sent to process from GGSN or PGW to the service functions belonging to the SC.

The total number of bytes for user payload packets in the downlink direction is indicated by `pgw-sc-apn-serv-chain:dl-byte-in`.

$$\frac{\text{deltaDIByteIn} * 8}{(\text{measurementInterval}) * 1000 * 1000}$$

Equation 90 SC Downlink Byte Throughput [Mbps]

Table 109 Description of Parameters for SC Downlink Byte Throughput [Mbps]

Parameter	Counters (Group:Counter)
deltaDIByteIn	pgw-sc-apn-serv-chain:dl-byte-in(stop time) – pgw-sc-apn-serv-chain:dl-byte-in(start time)
measurementInterval	measurement interval (in seconds)

- GGSN or PGW ingress downlink byte throughput from the SC, that is, the total number of downlink user plane IPv4 and IPv6 bytes received from the SC after processing to the GGSN or PGW.



The total number of bytes for user payload packets in the downlink direction is indicated by **pgw-sc-apn-serv-chain:dl-byte-out**.

$$\frac{\text{deltaDlByteOut} * 8}{(\text{measurementInterval}) * 1000 * 1000}$$

Equation 91 SC Downlink Byte Throughput [Mbps]

Table 110 Description of Parameters for SC Downlink Byte Throughput [Mbps]

Parameter	Counters (Group:Counter)
deltaDlByteOut	pgw-sc-apn-serv-chain:dl-byte-out(stop time) – pgw-sc-apn-serv-chain:dl-byte-out(start time)
measurementInterval	measurement interval (in seconds)

The throughput is specified in bits per second (bps), when multiplied by eight and divided by the length of the measurement interval in seconds.

Note: This indicator can be calculated on APN level using the counter directly or aggregating so that is possible calculate at node level.

5.2.1.26

Service Chaining SC Downlink Packet Throughput

The throughput of data sent to the Service Chain (SC) and the throughput that the SC sent back to the internet can be distinguished as follows:

- GGSN or PGW egress downlink packet throughput to the SC, that is, the total number of downlink user plane IPv4 and IPv6 packets sent to process from GGSN or PGW to the service functions belonging to the SC.

The total number of packets for user payload packets in the downlink direction is indicated by **pgw-sc-apn-serv-chain:dl-pkt-in**.

$$\frac{\text{deltaDlPktIn}}{(\text{measurementInterval}) * 1000}$$

Equation 92 SC Downlink Packet Throughput [kpps]

Table 111 Description of Parameters for SC Downlink Packet Throughput [kpps]

Parameter	Counters (Group:Counter)
deltaDlPktIn	pgw-sc-apn-serv-chain:dl-pkt-in(stop time) – pgw-sc-apn-serv-chain:dl-pkt-in(start time)
measurementInterval	measurement interval (in seconds)

- GGSN or PGW ingress downlink packet throughput from the SC, that is, the total number of downlink user plane IPv4 and IPv6 packets received from the SC after processing to the GGSN or PGW.



The total number of packets for user payload packets in the downlink direction is indicated by `pgw-sc-apn-serv-chain:dl-pkt-out`.

$$\frac{\text{deltaDIPktOut}}{(\text{measurementInterval}) * 1000}$$

Equation 93 SC Downlink Packet Throughput [kpps]

Table 112 Description of Parameters for SC Downlink Packet Throughput [kpps]

Parameter	Counters (Group:Counter)
deltaDIPktOut	pgw-sc-apn-serv-chain:dl-pkt-out(stop time) – pgw-sc-apn-serv-chain:dl-pkt-out(start time)
measurementInterval	measurement interval (in seconds)

The throughput is specified in packets per second (pps), when divided by the length of the measurement interval in seconds.

Note: This indicator can be calculated on APN level using the counter directly or aggregating so that is possible calculate at node level.

5.2.1.27 Service Chaining Total Packet Throughput for SC

The total number of packet throughput for the Service Chain (SC) in uplink and downlink directions.

Total packet throughput (measured in kpps) is equal to **Service Chain Uplink Packet Throughput + Service Chain Downlink Packet Throughput**.

5.2.1.28 Service Chaining Total Byte Throughput for SC

The total data throughput for the Service Chain (SC) in uplink and downlink directions.

Total packet throughput (measured in Mbps) is equal to **Service Chain Uplink Byte Throughput + Service Chain Downlink Byte Throughput**.

5.2.1.29 Service Chaining Number of Currently Active PDN Connections Using a Service Function per APN in GGSN or PGW

The number of currently active PDN connections using a service function per APN is indicated by `pgw-sc-apn-serv-func:active-pdn-connections`.

Note: This indicator can be calculated on APN level using the counter directly or aggregating so that is possible calculate at node level.



- 5.2.1.30 Service Chaining Number of Currently Active PDN Connections Using a Service Chain per APN in GGSN or PGW**
- The number of currently active PDN connections using Service Chain (SC) per APN is indicated by `pgw-sc-apn-serv-chain:active-pdn-connections`.
- Note:** This indicator can be calculated on APN level using the counter directly or aggregating so that is possible calculate at node level.
- 5.2.1.31 Service Chaining Number of Currently Active PDN Connections Using Service Chaining per APN in GGSN or PGW**
- The number of currently active PDN connections using service chaining per APN is indicated by `pgw-sc-apn:active-pdn-connections`.
- Note:** This indicator can be calculated on APN level using the counter directly or aggregating so that is possible calculate at node level.
- 5.2.2 SGW Traffic Usage Indicators**
- Gauges and counters indicating the traffic capacity for an SGW are described below.
- 5.2.2.1 Number of Attached UE devices in the SGW**
- The number of attached UE devices in the SGW based on IMSI or IMEI with one or more currently active EPS bearers is indicated by `sgw-number-of-ues:sgw-nbr-of-ues`.
- 5.2.2.2 Number of Bearers Handled by the SGW**
- The number of bearers handled by the SGW is indicated by `sgw-number-of-sessions:sgw-nbr-of-bearers`.
- 5.2.2.3 Number of SGW PDN Connections**
- The number of SGW PDN connections is indicated by `sgw-number-of-sessions:sgw-nbr-of-pdn-connections`.
- 5.2.2.4 Number of Connected UE Devices in the SGW**
- The number of connected UE devices in the SGW is indicated by `sgw-number-of-ues:sgw-nbr-of-connected-ues`.
- 5.2.2.5 SGW Uplink Packet Throughput**
- The total number of uplink user plane packets processed by the SGW.



The total number of user payload packets received on the S1-U, S4, or S12 interfaces going towards external S5, S8, or S5/S8 interfaces is indicated by **sgw-gtp-traffic-s1u-s4-s12:in-data-pkt**.

The throughput is specified in pps, when divided by the length of the measurement interval in seconds.

SGW uplink packet throughput (measured in Kpps) is equal to:

$$\frac{\text{DeltaSgwGtpTrafS1uS4S12InPkts}}{(\text{measurementInterval}) * 1000}$$

Equation 94 SGW Uplink Packet Throughput [Kpps]

Table 113 Description of Parameters for SGW Uplink Packet Throughput [Kpps]

Parameter	Counters (Group:Counter)
DeltaSgwGtpTrafS1uS4S12InPkts	sgw-gtp-traffic-s1u-s4-s12:in-data-pkt(stop time) - sgw-gtp-traffic-s1u-s4-s12:in-data-pkt(start time)
measurementInterval	measurement interval (in seconds)

5.2.2.6

SGW Uplink Byte Throughput

The total number of uplink user plane bytes processed by the SGW.

The total number of bytes for user payload packets received on the S1-U, S4, or S12 interfaces going towards external S5, S8, or S5/S8 interfaces is indicated by **sgw-gtp-traffic-s1u-s4-s12:in-data-byte**.

The throughput is specified in bps, when multiplied by eight and divided by the length of the measurement interval in seconds.

SGW uplink throughput (measured in Mbps) is equal to:

$$\frac{\text{DeltaSgwGtpTrafS1uS4S12InBytes} * 8}{(\text{measurementInterval}) * 1000 * 1000}$$

Equation 95 SGW Uplink Byte Throughput [Mbps]

Table 114 Description of Parameters for SGW Uplink Byte Throughput (S5 Interface) [Mbps]

Parameter	Counters (Group:Counter)
DeltaSgwGtpTrafS1uS4S12InByte	sgw-gtp-traffic-s1u-s4-s12:in-data-byte(stop time) - sgw-gtp-traffic-s1u-s4-s12:in-data-byte(start time)
measurementInterval	measurement interval (in seconds)



5.2.2.7 SGW Downlink Packet Throughput (S5 Interface)

The total number of downlink user plane packets processed by the SGW.

The total number of user payload packets coming from the external S5 interface is indicated by **sgw-gtp-traffic-s5:in-data-pkt**.

The throughput is specified in pps, when divided by the length of the measurement interval in seconds.

SGW downlink packet throughput (measured in Kpps) is equal to:

$$\frac{\text{DeltaSgwGtpTrafS5InPkts}}{(\text{measurementInterval}) * 1000}$$

Equation 96 SGW Downlink Packet Throughput (S5 Interface) [Kpps]

Table 115 Description of Parameters for SGW Downlink Packet Throughput (S5 Interface) [Kpps]

Parameter	Counters (Group:Counter)
DeltaSgwGtpTrafS5InPkts	sgw-gtp-traffic-s5:in-data-pkt(stop time) - sgw-gtp-traffic-s5:in-data-pkt(start time)
measurementInterval	measurement interval (in seconds)

5.2.2.8 SGW Downlink Packet Throughput (S8 Interface)

The total number of downlink user plane packets processed by the SGW.

The total number of user payload packets coming from the external S8 interface is indicated by **sgw-gtp-traffic-s8:in-data-pkt**.

The throughput is specified in pps, when divided by the length of the measurement interval in seconds.

SGW downlink packet throughput (measured in Kpps) is equal to:

$$\frac{\text{DeltaSgwGtpTrafS8InPkts}}{(\text{measurementInterval}) * 1000}$$

Equation 97 SGW Downlink Packet Throughput (S8 Interface) [Kpps]



Table 116 Description of Parameters for SGW Downlink Packet Throughput (S8 Interface) [Kpps]

Parameter	Counters (Group:Counter)
DeltaSgwGtpTrafS8InPkts	sgw-gtp-traffic-s8:in-data-pkt(stop time) - sgw-gtp-traffic-s8:in-data-pkt(start time)
measurementInterval	measurement interval (in seconds)

5.2.2.9 SGW Downlink Byte Throughput (S5 Interface)

The total number of downlink user plane bytes processed by the SGW.

The total number of bytes for user payload packets in the downlink direction coming from external S5 interface is indicated by **sgw-gtp-traffic-s5:in-data-byte**.

The throughput is specified in bps, when multiplied by eight and divided by the length of the measurement interval in seconds.

SGW downlink throughput (measured in Mbps) is equal to:

$$\frac{\text{DeltaSgwGtpTrafS5InBytes} * 8}{(\text{measurementInterval}) * 1000 * 1000}$$

Equation 98 SGW Downlink Byte Throughput (S5 Interface) [Mbps]

Table 117 Description of Parameters for SGW Downlink Byte Throughput (S5 Interface) [Mbps]

Parameter	Counters (Group:Counter)
DeltaSgwGtpTrafS5InByte	sgw-gtp-traffic-s5:in-data-byte(stop time) - sgw-gtp-traffic-s5:in-data-byte(start time)
measurementInterval	measurement interval (in seconds)

5.2.2.10 SGW Downlink Byte Throughput (S8 Interface)

The total number of downlink user plane bytes processed by the SGW.

The total number of bytes for user payload packets in the downlink direction coming from external S8 interface is indicated by **sgw-gtp-traffic-s8:in-data-byte**.

The throughput is specified in bps, when multiplied by eight and divided by the length of the measurement interval in seconds.

SGW downlink throughput (measured in Mbps) is equal to:



$$\frac{\text{DeltaSgwGtpTrafS8InBytes} * 8}{(\text{measurementInterval}) * 1000 * 1000}$$

Equation 99 SGW Downlink Byte Throughput (S8 Interface) [Mbps]

Table 118 Description of Parameters for SGW Downlink Byte Throughput (S8 Interface) [Mbps]

Parameter	Counters (Group:Counter)
DeltaSgwGtpTrafS8InByte	sgw-gtp-traffic-s8:in-data-byte(stop time) - sgw-gtp-traffic-s8:in-data-byte(start time)
measurementInterval	measurement interval (in seconds)

5.2.2.11 SGW Downlink Byte Throughput (S5/S8 Interface)

The total number of downlink user plane bytes processed by the SGW.

The total number of bytes for user payload packets in the downlink direction coming from combined external S5/S8 interface is indicated by **sgw-gtp-traffic-s5-s8:in-data-byte**.

The throughput is specified in bps, when multiplied by eight and divided by the length of the measurement interval in seconds.

SGW downlink throughput (measured in Mbps) is equal to:

$$\frac{\text{DeltaSgwGtpTrafS5S8InBytes} * 8}{(\text{measurementInterval}) * 1000 * 1000}$$

Equation 100 SGW Downlink Byte Throughput (S5/S8 Interface) [Mbps]

Table 119 Description of Parameters for SGW Downlink Byte Throughput (S5/S8 Interface) [Mbps]

Parameter	Counters (Group:Counter)
DeltaSgwGtpTrafS5S8InByte	sgw-gtp-traffic-s5-s8:in-data-byte(stop time) - sgw-gtp-traffic-s5-s8:in-data-byte(start time)
measurementInterval	measurement interval (in seconds)

5.2.2.12 Total Packet Throughput for SGW

The total number of packet throughput for the SGW in uplink and downlink directions.

Total packet throughput (measured in kpps) is equal to **SGW Uplink Packet Throughput + SGW Downlink Packet Throughput**.



The **SGW Downlink Packet Throughput** is calculated either for S5, S8, or S5/S8 interface depending on whether S5 and S8 interfaces are configured as separate interfaces or as a combined interface in the EPG.

5.2.2.13 Total Byte Throughput for SGW

The total data throughput for the SGW in uplink and downlink directions.

Total throughput (measured in Mbps) is equal to **SGW Uplink Throughput + SGW Downlink Throughput**.

The **SGW Downlink Throughput** is calculated either for S5, S8, or S5/S8 interface depending on whether S5 and S8 interfaces are configured as separate interfaces or as a combined interface in the EPG.

5.2.3 Combined SGW and PGW Traffic Usage Indicators

Gauges and counters indicating the throughput for a combined SGW and PGW are described below:

5.2.3.1 SGW and PGW Total Packet Throughput

The total number of packet throughput for the combined SGW and PGW in uplink and downlink directions.

Total packet throughput (measured in kpps) is equal to **PGW Uplink Packet Throughput + PGW Downlink Packet Throughput + SGW Uplink Packet Throughput + SGW Downlink Packet Throughput**.

The **SGW Downlink Packet Throughput** is calculated either for S5, S8, or S5/S8 interface depending on whether S5 and S8 interfaces are configured as separate interfaces or as a combined interface in the EPG.

5.2.3.2 SGW and PGW Total Byte Throughput

The total byte throughput for the combined SGW and PGW in uplink and downlink directions.

Total byte throughput (measured in Mbps) is equal to **PGW Uplink Throughput + PGW Downlink Throughput + SGW Uplink Throughput + SGW Downlink Throughput**.

The **SGW Downlink Throughput** is calculated either for S5, S8, or S5/S8 interface depending on whether S5 and S8 interfaces are configured as separate interfaces or as a combined interface in the EPG.



5.3 Performance Indicators

PIs and counters are used for troubleshooting and to display serviceability. Some of the equations in the following sections include a summation sign which denotes a summation over all servers serving the APN.

5.3.1 GGSN Deactivation Failure Ratio

The GGSN deactivation failure ratio denotes the probability of a failed attempt to deactivate a PDP context:

$$1 - \frac{\text{GgsnComSelDeact} + \text{GgsnComDeact}}{\text{GgsnAttSelDeact} + \text{GgsnAttDeact}}$$

Equation 101 GGSN Deactivation Failure Ratio

The parameters and the corresponding counters are listed in Table 62.

Table 120 Description of Parameters for GGSN Deactivation Failure Ratio

Parameter	Counters (Group:Counter)
GgsnComSelDeact	ggsn-pdp-contexts-stats-completed:ggsn-completed-self-deactivation
GgsnComDeact	ggsn-pdp-contexts-stats-completed:ggsn-completed-deactivation
GgsnAttSelDeact	ggsn-pdp-contexts-stats-attempted:ggsn-attempted-self-deactivation
GgsnAttDeact	ggsn-pdp-contexts-stats-attempted:ggsn-attempted-deactivation

Many KPIs and PIs on GGSN level can also be calculated on APN level, see examples below.

Deactivation per APN:

$$1 - \frac{\text{GgsnApnComDeact}}{\text{GgsnApnAttDeact}}$$

Equation 102 GGSN Deactivation Failure Ratio per APN

The parameters and the corresponding counters are listed in Table 62.

Table 121 Description of Parameters for GGSN Deactivation Failure Ratio per APN

Parameter	Counters (Group:Counter)
GgsnApnComDeact	pgw-bearer-mgmt-gngp-apn:del-pdp-cmpl
GgsnApnAttDeact	pgw-bearer-mgmt-gngp-apn:del-pdp-att



UE-initiated deactivation per APN:

$$1 - \frac{\text{GgsnApnComMsDeact}}{\text{GgsnApnAttMsDeact}}$$

Equation 103 UE-Initiated Deactivation per APN

The parameters and the corresponding counters are listed in Table 122.

Table 122 Description of Parameters for UE-Initiated Deactivation per APN

Parameter	Counters (Group:Counter)
GgsnApnComMsDeact	pgw-bearer-mgmt-gngp-apn:uesgsn-init-del-pdp-cmpl
GgsnApnAttMsDeact	pgw-bearer-mgmt-gngp-apn:uesgsn-init-del-pdp-att

GGSN-initiated deactivation per APN:

$$1 - \frac{\text{GgsnApnComSelDeact}}{\text{GgsnApnAttSelDeact}}$$

Equation 104 GGSN-Initiated Deactivation per APN

The parameters and the corresponding counters are listed in Table 123.

Table 123 Description of Parameters for GGSN-Initiated Deactivation per APN

Parameter	Counters (Group:Counter)
GgsnApnComSelDeact	pgw-bearer-mgmt-gngp-apn:pgw-init-del-pdp-cmpl
GgsnApnAttSelDeact	pgw-bearer-mgmt-gngp-apn:pgw-init-del-pdp-att

5.3.2

PGW Deactivation Failure Ratio

The PGW deactivation failure ratio denotes the probability of a failed attempt to deactivate an EPS bearer:

$$1 - \frac{\text{PgwComEpsBearDeact}}{\text{PgwAttEpsBearDeact}}$$

Equation 105 PGW Deactivation Failure Ratio

The parameters and the corresponding counters are listed in Table 124.



Table 124 Description of Parameters for PGW Deactivation Failure Ratio

Parameter	Counters (Group:Counter)
PgwComEpsBearDeact	pgw-completed-eps-bearer-stats:pgw-completed-eps-bearer-deactivation
PgwAttEpsBearDeact	pgw-attempted-eps-bearer-stats:pgw-attempted-eps-bearer-deactivation

Many KPIs and PIs on PGW level can also be calculated on APN level, see examples below.

Deactivation per APN:

$$1 - \frac{\text{PgwApnComEpsBearDeact}}{\text{PgwApnAttEpsBearDeact}}$$

Equation 106 PGW Deactivation Failure Ratio Per APN

The parameters and the corresponding counters are listed in Table 125.

Table 125 Description of Parameters for PGW Deactivation Failure Ratio Per APN

Parameter	Counters (Group:Counter)
PgwApnComEpsBearDeact	pgw-bearer-mgmt-apn:del-bearer-cmpl
PgwApnAttEpsBearDeact	pgw-bearer-mgmt-apn:del-bearer-att

UE- or SGW-initiated deactivation per APN:

$$1 - \frac{\text{PgwApnComS5}}{\text{PgwApnAttS5}}$$

Equation 107 UE- or SGW-Initiated Deactivation per APN

The parameters and the corresponding counters are listed in Table 126.

Table 126 Description of Parameters for UE- or SGW-Initiated Deactivation per APN

Parameter	Counters (Group:Counter)
PgwApnComS5	pgw-bearer-mgmt-s5s8-apn:uesgw-init-del-bearer-cmpl
PgwApnAttS5	pgw-bearer-mgmt-s5s8-apn:uesgw-init-del-bearer-att

Network-initiated deactivation per APN:



$$1 - \frac{\text{PgwApnComS5Nw}}{\text{PgwApnAttS5Nw}}$$

Equation 108 Network-Initiated Deactivation per APN

The parameters and the corresponding counters are listed in Table 127.

Table 127 Description of Parameters for Network-Initiated Deactivation per APN

Parameter	Counters (Group:Counter)
PgwApnComS5Nw	pgw-bearer-mgmt-s5s8-apn:netw-init-del-bearer-cmpl
PgwApnAttS5Nw	pgw-bearer-mgmt-s5s8-apn:netw-init-del-beare r-att

5.3.3

PGW PMIPv6-Based S2a Deletion Failure Ratio

The PGW PMIPv6-based S2a deletion failure ratio denotes the probability that an attempt to delete a PMIPv6-based S2a PDN connection in the PGW fails.

$$1 - \frac{\text{S2aPbaPdnConSent}}{\text{S2aPbuPdnConRcvd}}$$

Equation 109 PGW PMIPv6-Based S2a Deletion Failure Ratio

The parameters and the corresponding counters are listed in Table 128.

Table 128 Description of Parameters for PGW PMIPv6-Based S2a Deletion Failure Ratio

Parameter	Counters (Group:Counter)
S2aPbaPdnConSent	pgw-pmip:s2a-pba-pdn-conn-deletion-acc-sent
S2aPbuPdnConRcvd	pgw-pmip:s2a-pbu-pdn-conn-deletion-rcvd

5.3.4

PGW Rf Transaction Failure Ratio

The PGW Rf Transaction Failure Ratio denotes the probability of failed accounting requests from the PGW towards the CDF.

$$\frac{\text{RfAcctAnsRejRec}}{\text{RfAcctReqSent}}$$

Equation 110 PGW Rf Transaction Failure Ratio

The parameters and the corresponding counters are listed in Table 129.



Table 129 Description of Parameters for PGW Rf Transaction Failure Ratio

Parameter	Counters (Group:Counter)
RfAcctAnsRejRec	pgw-offline-charging:rf-acct-answer-rej-rec
RfAcctReqSent	pgw-offline-charging:rf-acct-req-sent

5.3.5 PGW S6b Transaction Failure Ratio

To calculate the failure ratio of failed authorization requests from the PGW towards the 3GPP AAA server, use the following formula:

$$1 - \frac{S6bAaaSuccRcvd}{S6bAarSent}$$

Equation 111 PGW S6b Transaction Failure Ratio

The parameters and the corresponding counters are listed in Table 130.

Table 130 Description of Parameters for PGW S6b Transaction Failure Ratio

Parameter	Counters (Group:Counter)
S6bAaaSuccRcvd	pgw-aaa-interface:aaa-succ-rcvd
S6bAarSent	pgw-aaa-interface:aar-sent

5.3.6 SGW Downlink S4/S11 Data Notification Ratio

The downlink S4/S11 data notification failure ratio denotes the probability of the reception of a downlink data notification failure indication message.

$$\frac{smDIDataNotifFailureIndRcvd}{smDIDataNotifSent + smDIDataNotifAckRejRcvd}$$

Equation 112 SGW Downlink Data Notification Ratio

The parameters and the corresponding counters are listed in Table 131.

Table 131 Description of Parameters for SGW Downlink Data Notification Ratio

Parameter	Counters (Group:Counter)
DIDataNotifFailIndRcvd	sgw-gtp-tunnel-mgmt-s4-s11:sm-dl-data-notif-failure-ind-rcvd
DIDataNotifSent	sgw-gtp-tunnel-mgmt-s4-s11:sm-dl-data-notif-sent



5.3.7 Service Chaining Ingress or Egress Service Function Uplink Ratio Traffic

To determine if the service function drops or generates packets, use the following formula:

$$\frac{\text{UIPktRcvd} - \text{UIPktSent}}{\text{UIPktSent}}$$

Equation 113 Service Chaining Ingress or Egress Service Function Uplink Ratio

The parameters and the corresponding counters are listed in Table 132.

Table 132 Description of Parameters for Service Chaining Ingress or Egress Service Function Uplink Ratio

Parameter	Counters (Group:Counter)
UIPktRcvd	pgw-sc-apn-serv-func:ul-pkt-rcvd
UIPktSent	pgw-sc-apn-serv-func:ul-pkt-sent

Note:

- For non-intrusive service function, the ratio is 0.
 - For a service function that generates packets, the ratio is greater than 0.
 - For a service function that drops packets, the ratio is lower than 0.
 - The resulting value depends on the specific policy of the service function itself. Values, for example, near to -1 mean almost all traffic is dropped by the service function. Values near to 1 mean that the service function basically only injects packets into the network.
- Check what is the expected behavior and apply network and specific service function troubleshooting, if necessary.
- To achieve more accurate calculations, use byte counters instead of packet counters.

5.3.8 Service Chaining Ingress or Egress Service Function Downlink Ratio Traffic

To determine if the service function drops or generates packets, use the following formula:

$$\frac{\text{DIPktRcvd} - \text{DIPktSent}}{\text{DIPktSent}}$$

Equation 114 Service Chaining Ingress or Egress Service Function Downlink Ratio

The parameters and the corresponding counters are listed in Table 133.



Table 133 Description of Parameters for Service Chaining Ingress or Egress Service Function Downlink Ratio

Parameter	Counters (Group:Counter)
DIPktRcvd	pgw-sc-apn-serv-func:d1-pkt-rcvd
DIPktSent	pgw-sc-apn-serv-func:d1-pkt-sent

Note:

- For non-intrusive service function, the ratio is 0.
 - For a service function that generates packets, the ratio is greater than 0.
 - For a service function that drops packets, the ratio is lower than 0.
 - The resulting value depends on the specific policy of the service function itself. Values, for example, near to -1, mean almost all traffic is dropped by the service function. Values near to 1 mean that the service function basically only injects packets into the network.
- Check what is the expected behavior and apply network and specific service function troubleshooting, if necessary.
- To achieve more accurate calculations, use byte counters instead of packet counters.

5.3.9 Service Chaining Ingress or Egress SC Uplink Ratio Traffic

To determine if the Service Chain (SC) drops or generates packets, use the following formula:

$$\frac{UIPktIn - UIPktOut}{UIPktIn}$$

Equation 115 Service Chaining Ingress or Egress SC Uplink Ratio

The parameters and the corresponding counters are listed in Table 134.

Table 134 Description of Parameters for Service Chaining Ingress or Egress SC Uplink Ratio

Parameter	Counters (Group:Counter)
UIPktIn	pgw-sc-apn-serv-chain:ul-pkt-in
UIPktOut	pgw-sc-apn-serv-chain:ul-pkt-out

**Note:**

- For SCs with one or more service functions that generates packets, the ratio is greater than 0.
- For SCs with one or more service functions that drops packets, the ratio is lower than 0.
- The resulting value depends on the specific policy of the service functions in the SC and the number of bypass and drop actions performed by the GGSN or PGW. To check the bypass or drop ratios, see Section 5.1 on page 12.

- If bypass and drop ratio is low and the values are near to -1 , it means that almost all traffic is dropped by one or more of the service functions in the SC.

Check what is the expected behavior and apply network and specific service function troubleshooting, if necessary.

- If bypass and drop ratio is low and the values are near to 1 , it means that one or more of the server service functions in the SC injects packets into the network.

Check what is the expected behavior and apply network and specific service function troubleshooting, if necessary.

- To achieve more accurate calculations, use byte counters instead of packet counters.

5.3.10 Service Chaining Ingress or Egress SC Downlink Ratio Traffic

To determine if the Service Chain (SC) drops or generates packets, use the following formula:

$$\frac{DIPktIn - DIPktOut}{DIPktIn}$$

Equation 116 Service Chaining Ingress or Egress SC Downlink Ratio

The parameters and the corresponding counters are listed in Table 135.

Table 135 Description of Parameters for Service Chaining Ingress or Egress SC Downlink Ratio

Parameter	Counters (Group:Counter)
DIPktIn	pgw-sc-apn-serv-chain:d1-pkt-in
DIPktOut	pgw-sc-apn-serv-chain:d1-pkt-out

**Note:**

- For SCs with one or more service functions that generates packets, the ratio is greater than 0.
- For SCs with one or more service functions that drops packets, the ratio is lower than 0.
- The resulting value depends on the specific policy of the service functions in the SC and the number of bypass and drop actions performed by the GGSN or PGW. To check the bypass or drop ratios, see Section 5.1 on page 12.
 - If bypass and drop ratio is low and the values are near to -1 , it means that almost all traffic is dropped by one or more of the service functions in the SC.

Check what is the expected behavior and apply network and specific service function troubleshooting, if necessary.
 - If bypass and drop ratio is low and the values are near to 1 , it means that one or more of the server service functions in the SC injects packets into the network.

Check what is the expected behavior and apply network and specific service function troubleshooting, if necessary.
- To achieve more accurate calculations, use byte counters instead of packet counters.

5.3.11 Service Chaining Service Function Packet Throughput Ratio

The percentage of the total traffic that traverse a specific service function. To validate dimensioning, use the following formula:

$$\frac{\text{Total Packet Throughput for Service Function}}{\text{Total Packet Throughput for GGSN/PGW}} * 100$$

Equation 117 Service Function Packet Throughput Ratio

Note: To achieve more accurate calculations, use byte counters instead of packet counters.

5.3.12 Service Chaining SC Packet Throughput Ratio

The percentage of the total traffic that traverse a specific Service Chain (SC). To validate dimensioning, use the following formula:

$$\frac{\text{Total Packet Throughput for Service Chain}}{\text{Total Packet Throughput for GGSN/PGW}} * 100$$

Equation 118 SC Packet Throughput Ratio



Note: To achieve more accurate calculations, use byte counters instead of packet counters.

5.3.13 Service Chaining Total Service Chaining Packet Throughput Ratio

The percentage of the total traffic that traverse any Service Chain (SC). To validate dimensioning, use the following formula:

$$\frac{\sum_{\text{All APNs}} \sum_{\text{Service Chains}} \text{Total Packet Throughput for Service Chain}}{\text{Total Packet Throughput for GGSN/PGW}} * 100$$

Equation 119 Total Service Chaining Packet Throughput Ratio

Note: To achieve more accurate calculations, use byte counters instead of packet counters.

5.3.14 Service Chaining Service Function PDN Connections Ratio

The percentage of the total PDN connections that traverse a specific service function. To validate dimensioning in terms of PDN connections, use the following formula:

$$\frac{\sum_{\text{All APNs}} \text{Number of Currently Active PDN Connections Using a Service Function per APN in GGSN/PGW}}{(\text{NbrOfPgwPdnConnections} + \text{NbrOfGgsnPdnConnections})} * 100$$

Equation 120 Service Function PDN Connections Ratio

For more information, see Section 5.2.1.29 on page 68.

5.3.15 Service Chaining SC PDN Connections Ratio

The percentage of the total PDN connections that traverse a specific Service Chain (SC). To validate dimensioning in terms of PDN connections, use the following formula:

$$\frac{\sum_{\text{All APNs}} \text{Number of Currently Active PDN Connections Using an SC per APN in GGSN/PGW}}{(\text{NbrOfPgwPdnConnections} + \text{NbrOfGgsnPdnConnections})} * 100$$

Equation 121 SC PDN Connections Ratio

For more information, see Section 5.2.1.30 on page 68.

5.3.16 Service Chaining Total Service Chaining PDN Connections Ratio

The percentage of the total PDN connections that traverse any Service Chain (SC). To validate dimensioning in terms of PDN connections, use the following formula:



$$\frac{\sum_{\text{All APNs}} \text{Number of Currently Active PDN Connections Using Service Chaining per APN in GGSN}}{(\text{NbrOfPgwPdnConnections} + \text{NbrOfGgsnPdnConnections}) * 100}$$

Equation 122 Total Service Chaining PDN Connections Ratio

For more information, see Section 5.2.1.31 on page 69.

5.3.17

Service Chaining Purged Flows in a Period of Time

To indicate the number of time the purge mechanism is triggered during the measurement interval, use the following formula:

$$\frac{\text{deltaPurgedFlows}}{\text{measurementInterval}}$$

Equation 123 Purged Flows in a Period of Time [flows per second]

Table 136 Description of Parameters for Purged Flows in a Period of Time [flows per second]

Parameter	Counters (Group:Counter)
deltaPurgedFlows	pgw-sc-apn:purged-flows(stop time) – pgw-sc-apn:purged-flows(start time)
measurementInterval	measurement interval (in seconds)

Near to 0 values are expected when the node is not heavily loaded.

For information about internal dimensioning, refer to [Service Chaining Configuration](#).

5.3.18

RADIUS Failure Ratio

The RADIUS failure ratio is the summarized access request failure ratio for all RADIUS servers serving the APN.

RADIUS Access Request failure ratio per APN:

$$1 - \frac{\sum_{\text{RADIUSservers}} \text{GgsnApnRadAcc}}{\sum_{\text{RADIUSservers}} \text{GgsnApnRadReq}}$$

Equation 124 RADIUS Access Request Failure Ratio per APN

The parameters and the corresponding counters are listed in Table 137.



Table 137 Description of Parameters for RADIUS Access Request Failure Ratio per APN

Parameter	Counters (Group:Counter)
GgsnApnRadAcc	ggsn-apn-radius-auth-servers-stats:ggsn-apn-radius-auth-server-access-accepts
GgsnApnRadReq	ggsn-apn-radius-auth-servers-stats:ggsn-apn-radius-auth-server-access-requests

RADIUS Accounting Request failure ratio per APN:

$$\frac{\text{GgsnApnRadAccFail}}{\sum_{\text{RADIUSservers}} \text{GgsnApnRadAccServAccReq}}$$

Equation 125 RADIUS Accounting Request Failure Ratio per APN

The parameters and the corresponding counters are listed in Table 138.

Table 138 Description of Parameters for RADIUS Accounting Request Failure Ratio per APN

Parameter	Counters (Group:Counter)
GgsnApnRadAccFail	ggsn-apn-stats:ggsn-apn-radius-accounting-failure
GgsnApnRadAccServAccReq	ggsn-apn-radius-acct-servers-stats:ggsn-apn-radius-acct-server-accounting-requests

5.3.19 Gy Transaction Failure Ratio

The number of failed start, update, or stop requests towards the OCS for an APN.

$$\frac{\sum_{(CC-AS)} (\text{CcrInitialFailed} + \text{CcrUpdateFailed} + \text{CcrTerminationFailed})}{\sum_{(CC-AS)} (\text{CcrInitialSent} + \text{CcrUpdateSent} + \text{CcrTerminationSent})}$$

Equation 126 Gy Transaction Failure Ratio per APN

The parameters and the corresponding counters are listed in Table 139.

Table 139 Description of Parameters for Gy Transaction Failure Ratio per APN

Parameter	Counters (Group:Counter)
CcrInitialFailed	pgw-apn-gy:ccr-initial-failed
CcrUpdateFailed	pgw-apn-gy:ccr-update-failed
CcrTerminationFailed	pgw-apn-gy:ccr-termination-failed



Parameter	Counters (Group:Counter)
CcrInitialSent	pgw-apn-gy:ccr-initial-sent
CcrUpdateSent	pgw-apn-gy:ccr-update-sent
CcrTerminationSent	pgw-apn-gy:ccr-termination-sent

5.3.20 Gx Transaction Failure Ratio

To calculate the number of failed start, update, or stop requests towards the PCRF for an APN, use the following formula:

$$\frac{\sum_{(PR-AS)} (CcrInitialFailed + CcrUpdateFailed + CcrTerminationFailed)}{\sum_{(PR-AS)} (CcrInitialSent + CcrUpdateSent + CcrTerminationSent)}$$

Equation 127 Gx Transaction Failure Ratio per APN

The parameters and the corresponding counters are listed in Table 140.

Table 140 Description of Parameters for Gx Transaction Failure Ratio per APN

Parameter	Counters (Group:Counter)
CcrInitialFailed	pgw-apn-gx:ccr-initial-failed
CcrUpdateFailed	pgw-apn-gx:ccr-update-failed
CcrTerminationFailed	pgw-apn-gx:ccr-termination-failed
CcrInitialSent	pgw-apn-gx:ccr-initial-sent
CcrUpdateSent	pgw-apn-gx:ccr-update-sent
CcrTerminationSent	pgw-apn-gx:ccr-termination-sent

5.3.21 SACC Statistics

This section contains information on how to calculate SACC statistics.

5.3.21.1 SACC Ratio

There are two ways to calculate the SACC ratio, that is, the bearer ratio and the payload ratio. The summation over SACC_APN denotes the sum of the SACC-enabled APNs.

Bearer Ratio



$$SACC_{PDP} = \frac{\text{TotalNoOfSaccPdp}}{\text{TotalNoOfPdp}} = \frac{\sum_{APN} GgsnApnActCxtCount}{\sum_{APN} GgsnApnActCxtCount}$$

Equation 128 SACC Bearer Ratio

The parameters and the corresponding counters are listed in Table 141.

Table 141 Description of Parameters for SACC Bearer Ratio

Parameter	Counters (Group:Counter)
GgsnApnActCxtCount	pgw-number-of-bearers-apn:active-pdp

Payload Ratio

$$SACC_{Payload} = \frac{\text{TotalNoOfSaccBytes}}{\text{TotalNoOfBytes}} = \frac{\sum_{APN} (GgsnApnSaccDnlk + GgsnApnSaccUplk)}{\sum_{APN} (GgsnApnDnlk + GgsnApnUplk)}$$

Equation 129 SACC Payload Ratio

The parameters and the corresponding counters are listed in Table 142.

Table 142 Description of Parameters for SACC Payload Ratio

Parameter	Counters (Group:Counter)
GgsnApnSaccDnlk	ggsn-apn-sacc-rs-stats:ggsn-apn-sacc-rs-downlink-bytes ggsn-apn-sacc-rs-stats:ggsn-apn-sacc-rs-downlink-bytes
GgsnApnSaccUplk	ggsn-apn-sacc-rs-stats:ggsn-apn-sacc-rs-uplink-bytes
GgsnApnDnlk	pgw-traffic-apn:d1-bytes
GgsnApnUplk	pgw-traffic-apn:ul-bytes

5.3.21.2

DPI Ratio

To calculate the Deep Packet Inspection (DPI) ratio, it is necessary to look into filter configurations or documents that define Service Data Flow IDs (SDF-IDs) in order to identify which SDF-ID is generated by DPI and which is generated by header inspection.

Note: Packets that are deep inspected without finding a match (default DPI) are identified as DPI packets. Therefore the default SDF-ID for header inspection must be different from the default SDF-ID for DPI.

For further information on DPI or header inspection ratio, contact Ericsson Support.



5.3.21.3 Header Inspection Ratio

To calculate the header inspection ratio it is necessary to look into filter configurations or documents that define SDF-IDs in order to identify which SDF-ID is generated by DPI and which is generated by header inspection.

Observe that packets that are deep inspected but without finding a match (default DPI) are identified as DPI packet. Therefore the default SDF-ID for header inspection must be different from the default SDF-ID for DPI.

5.3.21.4 Filter Depth

The filter depth has to be manually calculated. For further information, contact Ericsson Support.

6 System Limits

Regardless of activated functions and installed capacity on the EPG, the following system limitations always apply.

Table 143 shows the CPU utilization limits during busy hours for vSFOs as CPBs and PPBs.

Table 143 CPU Utilization Limits During Busy Hours for vSFOs as CPBs and PPBs

Attribute	Limit	Associated Gauge (Group: Counter)
CPB CPU peak usage	80% ⁽¹⁾	board-information:peak-cpu-usage
CPB CPU average usage	80%	board-information:average-cpu-usage
PPB CPU peak usage	80%	board-information:peak-cpu-usage
PPB CPU average usage	80%	board-information:average-cpu-usage

(1) This limit value is in general. The CPU usage can be above 80% during the peak hours.

Table 144 shows the memory utilization limits during busy hours.



Table 144 Memory Utilization During Busy Hours

Attribute	Limit	Associated Gauge (Group: Counter)
CPB memory installed	90%	board-information:memory
CPB memory in use	90%	board-information:memory-used
PPB memory installed	90%	board-information:memory
PPB memory in use	90%	board-information:memory-used

Table 145 shows the NMB utilization limits during busy hours.

Table 145 NMB Utilization Limits During Busy Hours

Attribute	Limit
NMB CPU utilization during busy hours	80%
NMB memory utilization during busy hours	90%
NMB disk usage	An average of 80% for the /var partition

For more information on gauges, refer to [Counters and Gauges for the EPG on Node Level](#).