



# Key Performance Indicators

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## Feature Summary and Revision History

### Summary Data

*Table 1: Summary Data*

Applicable Product(s) or Functional Area	cnSGW-C
Applicable Platform(s)	SMI
Feature Default Setting	Enabled - Always-on
Related Documentation	Not Applicable

### Revision History

*Table 2: Revision History*

Revision Details	Release
First introduced.	2021.02.0

## Feature Description

This chapter describes the Key Performance Indicators (KPIs/Bulkstats/Alerts) definitions for the Cloud Native Serving Gateway Control Plane Function (cnSGW-C).

## KPI Categories

cnSGW-C KPIs are divided into the following categories:

- Session
- Bearer Level
- PLMN Level
- Procedure KPIs
- Inter/Intra RAT Handover
- Failure (Rejection/Call Disconnect Reasons)
- Pod level

## Session and Bearer KPIs

The following table list the session and bearer KPIs.

**Table 3: Session and Bearer KPIs**

KPI Name	Description	Expression
SGW Total Number of Sessions	The total number of active UE sessions.	<code>sum(sgw_ue_counters{rat_type="EUTRAN",state="connected"}) by (namespace)</code>
SGW Total Current PDN	The total number of active PDNs.	<code>sum(sgw_pdn_counters{rat_type="EUTRAN"}) by (namespace)</code>
SGW Total Current Bearers	The total number of active bearers.	<code>sum(sgw_bearer_counters{qci!='null',service_name="sgw-service",status="active"}) by (namespace)</code>
SGW Total EPS Bearer Setup	The total number of bearer setups.	<code>sum(sgw_bearer_stats{qci!='null',service_name="sgw-service",status="setup"}) by (namespace)</code>

KPI Name	Description	Expression
SGW Total Current Dedicated Bearers	Total number of current active bearers – Total number of current active PDNs	sum(sgw_bearer_counters{qci!='null', service_name='sgw-service', status='active'}) by (namespace) - sum(sgw_pdn_counters{rat_type='EUTRAN'}) by (namespace)
SGW Total EPS Bearers Released	The total number of bearers released.	sum(sgw_bearer_stats{qci!='null', service_name='sgw-service', status='release'}) by (qci,namespace)
SGW Number of PDN teardown	The total number of PDN released.	sum(sgw_service_stats{pdn_type!='null', status='release'}) by (namespace)
SGW PDNs Rejected Reason Distribution	PDN disconnect reasons.	sum(sgw_pdn_disconnect_stats{reason!='null'}) by (reason,namespace)

## PLMN KPIs

The following table list the PLMN KPIs.

**Table 4: PLMN KPIs**

KPI Name	Description	Expression
SGW Home PDNs active	The total number of active homer PDNs.	sum(sgw_pdn_counters{pdn_plmn_type='homer', rat_type='EUTRAN'}) by (namespace)
SGW Roaming PDNs active	The total number of active roamer PDNs.	sum(sgw_pdn_counters{pdn_plmn_type='roamer', rat_type='EUTRAN'}) by (namespace)
SGW Visiting PDNs active	The total number of active visitor PDNs.	sum(sgw_pdn_counters{pdn_plmn_type='visitor', rat_type='EUTRAN'}) by (namespace)

## Procedure KPIs

The following table list the procedure KPIs.

**Table 5: Procedure KPIs**

KPI Name	Description	Expression
Attach Success Rate	The total number of attach success/total attaches attempted.	$\frac{\text{sum}(\text{rate}(\text{sgw\_service\_stats} \{ \text{sgw\_procedure\_type}=\backslash\text{"initial\_attach"}\backslash, \text{status}=\backslash\text{"success"}\backslash\} [5\text{m}])) \text{ by } (\text{namespace}) / \text{sum}(\text{rate}(\text{sgw\_service\_stats} \{ \text{sgw\_procedure\_type}=\backslash\text{"initial\_attach"}\backslash, \text{status}=\backslash\text{"attempted"}\backslash\} [5\text{m}])) \text{ by } (\text{namespace})}$
Detach Success Rate	The total number of detach success/total detaches attempted.	$\frac{\text{sum}(\text{rate}(\text{sgw\_service\_stats} \{ \text{interface}=\backslash\text{"interface\_sgw\_ingress"}\backslash, \text{sgw\_procedure\_type}=\backslash\text{"delete\_session\_request"}\backslash, \text{status}=\backslash\text{"success"}\backslash\} [5\text{m}])) \text{ by } (\text{namespace}) / \text{sum}(\text{rate}(\text{sgw\_service\_stats} \{ \text{interface}=\backslash\text{"interface\_sgw\_ingress"}\backslash, \text{sgw\_procedure\_type}=\backslash\text{"delete\_session\_request"}\backslash, \text{status}=\backslash\text{"attempted"}\backslash\} [5\text{m}])) \text{ by } (\text{namespace})}$
Bearer Creation Success Rate	The total number of bearer success/total bearers attempted.	$\frac{\text{sum}(\text{rate}(\text{sgw\_service\_stats} \{ \text{interface}=\backslash\text{"interface\_sgw\_ingress"}\backslash, \text{sgw\_procedure\_type}=\backslash\text{"create\_bearer"}\backslash, \text{status}=\backslash\text{"success"}\backslash\} [5\text{m}])) \text{ by } (\text{namespace}) / \text{sum}(\text{rate}(\text{sgw\_service\_stats} \{ \text{interface}=\backslash\text{"interface\_sgw\_ingress"}\backslash, \text{sgw\_procedure\_type}=\backslash\text{"create\_bearer"}\backslash, \text{status}=\backslash\text{"attempted"}\backslash\} [5\text{m}])) \text{ by } (\text{namespace})}$

KPI Name	Description	Expression
Bearer Modification Success Rate	The total number of bearer update success/total bearers update attempted.	<pre>sum(rate(sgw_service_stats {interface="interface_sgw_ingress", sgw_procedure_type="update_bearer", status="success"}[5m])) by (namespace) / sum(rate(sgw_service_stats {interface="interface_sgw_ingress", sgw_procedure_type="update_bearer", status="attempted"}[5m])) by (namespace)</pre>
Bearer Deletion Success Rate	The total number of bearer delete success/total bearer delete attempted.	<pre>sum(rate(sgw_service_stats {interface="interface_sgw_ingress", sgw_procedure_type=" pgw_initiated_dedicated_ bearer_deletion",status="success"} [5m])) by (namespace) / sum(rate(sgw_service_stats {interface="interface_sgw_ingress", sgw_procedure_type="pgw_initiated_ dedicated_bearer_deletion", status="attempted"}[5m])) by (namespace)</pre>

KPI Name	Description	Expression
Handover Success Rate	The total number of successful handovers/Total handovers attempted.	<pre>sum(rate(sgw_service_stats {sgw_procedure_type=~'s1_sgw_relocation_attach  x2_sgw_relocation_attach inter_mme_handover  intra_mme_handover  inter_system_handover_attach  x2_gngp_to_lte_relocation_attach  s1_gngp_to_lte_relocation_attach', status="success"}[5m])) by (sgw_procedure_type, namespace)/ sum(rate(sgw_service_stats {sgw_procedure_type=~ 's1_sgw_relocation_attach x2_sgw_relocation_attach  inter_mme_handover intra_mme_handover  inter_system_handover_attach  x2_gngp_to_lte_relocation_attach  s1_gngp_to_lte_relocation_ attach',status="attempted"} [5m])) by (sgw_procedure_type,namespace)</pre>
Association Setup Failure	Association Setup Failure	<pre>sum(proto_udp_res_msg_total {message_name="association_ setup_res",status!= "accepted"}) by (namespace)</pre>
Association Release	Association Release	<pre>sum(sgw_ue_disconnect_stats {reason="sx_association_release", service_name="sgw-service"}) by (namespace)</pre>

KPI Name	Description	Expression
Session Establishment Failure Rate	Session Establishment Response Rejected/Total number of Session Establishment Requests	<pre>sum(proto_udp_res_msg_total {message_name= \"session_establishment_res\", status!=\"accepted\"}) by (namespace) / (proto_udp_res_msg_total {message_name= \"session_establishment_res\", status=\"accepted\"}) by (namespace) + sum(proto_udp_res_msg_total {message_name= \"session_establishment_res\", status!=\"accepted\"}) by (namespace))</pre>
Session Modification Failure Rate	Session Modification Response Rejected/Total number of Session Modification Requests	<pre>sum(proto_udp_res_msg_total {interface_type=\"SXA\", message_name= \"session_modification_res\", status!=\"accepted\"}) by (namespace) / sum (proto_udp_res_msg_total {interface_type=\"SXA\", message_name= \"session_modification_res\", status!=\"accepted\"}) by (namespace) + sum (proto_udp_res_msg_total {interface_type=\"SXA\", message_name= \"session_modification_res\", status=\"accepted\"}) by (namespace))</pre>

KPI Name	Description	Expression
Association Setup Failure Rate	Association Failure/(Association Failure + Association Success)	<pre>sum(proto_udp_res_msg_total {message_name= \"association_setup_res\", status!=\"accepted\"}) by (namespace) / sum ((proto_udp_res_msg_total {message_name=\"association _setup_res\",status!= \"accepted\"} by (namespace) + proto_udp_res_msg_total {message_name=\"association_ setup_res\",status!=\"accepted\"}) by (namespace))</pre>

## Failure/Rejection/Retransmission KPIs

The following table lists Failure/Rejection/Retransmission KPIs.

**Table 6: Failure/Rejection/Retransmission KPIs**

KPI Name	Description	Expression
UE Disconnect Reasons	UE disconnection reasons.	<pre>sum(sgw_ue_disconnect_stats {reason!=\"null\"}) by (reason, namespace)</pre>



KPI Name	Description	Expression
PDN Failure Rate	Total attach attempted – Total attach success/Total attach attempted	<pre>sum(sgw_service_stats {interface= \"interface_sgw_egress\", sgw_procedure_type= \"initial_attach\", status=\"attempted\"} by (namespace))-um(sgw_service_stats {interface=\"interface_sgw_egress\", sgw_procedure_type=\"initial_attach\", status=\"success\"} by (namespace))/sum(sgw_service_stats {interface=\"interface_sgw_egress\", sgw_procedure_type=\"initial_attach\", status=\"attempted\"} by (namespace))</pre>
PDN Disconnect Reason	PDN disconnection reason	<pre>sum(sgw_pdn_disconnect_stats {reason!=\"null\"}) by (reason,namespace)</pre>
GTPC Path Failure	GTPC path failure	<pre>sum(rate(sgw_ue_disconnect_stats {reason=~'s11_path_failure  s5e_path-failure  s11_path_failure_local_purge  s5e_path_failure_local_purge  s5e_recovery s11_recovery  s5e_recovery_local_purge  s11_recovery_local_purge'} [5m])) by (namespace)</pre>

KPI Name	Description	Expression
Intra EUTRAN Handover Failure Rate	(S1 HO SGW Relocation Success + TAU HO SGW Relocation + X2 HO SGW Relocation + Inter/Intra MME HO failure) / (S1 HO SGW Relocation Attempted + TAU HO SGW Relocation Attempted + TAU HO SGW Relocation Attempted + Inter/Intra MME HO Attempted)	$\frac{\text{sum}(\text{rate}(\text{sgw\_service\_stats} \{ \text{sgw\_procedure\_type}=\sim \text{'s1\_sgw\_relocation\_attach}   \text{x2\_sgw\_relocation\_attach}   \text{inter\_mme\_handover}   \text{intra\_mme\_handover}' , \text{status}=\text{"rejected"} \} [5\text{m}])) \text{ by } (\text{sgw\_procedure\_type}, \text{namespace})}{\text{sum}(\text{rate}(\text{sgw\_service\_stats} \{ \text{sgw\_procedure\_type}=\sim \text{'s1\_sgw\_relocation\_attach}   \text{x2\_sgw\_relocation\_attach}   \text{inter\_mme\_handover}   \text{intra\_mme\_handover}' , \text{status}=\text{"attempted"} \} [5\text{m}])) \text{ by } (\text{sgw\_procedure\_type}, \text{namespace})}$
Inter System Handover Failure Rate	(WiFi HO Failure + GnGp HO Failure) / (WiFi HO Attempted + GnGp HO Attempted)	$\frac{\text{sum}(\text{rate}(\text{sgw\_service\_stats} \{ \text{sgw\_procedure\_type}=\sim \text{'inter\_system\_handover\_attach}   \text{x2\_gngp\_to\_lte\_relocation\_attach}   \text{s1\_gngp\_to\_lte\_relocation\_attach}' , \text{status}=\text{"success"} \} [5\text{m}])) \text{ by } (\text{sgw\_procedure\_type}, \text{namespace})}{\text{sum}(\text{rate}(\text{sgw\_service\_stats} \{ \text{sgw\_procedure\_type}=\sim \text{'inter\_system\_handover\_attach}   \text{x2\_gngp\_to\_lte\_relocation\_attach}   \text{s1\_gngp\_to\_lte\_relocation\_attach}' , \text{status}=\text{"attempted"} \} [5\text{m}])) \text{ by } (\text{sgw\_procedure\_type}, \text{namespace})}$

## Handover KPIs

The following table lists the handover KPIs.

**Table 7: Handover KPIs**

KPI Name	Description	Expression
SGW Relocation Success Rate	Total SGW Relocation Success/Total Relocation Attempted	$\frac{\text{sum}(\text{rate}(\text{sgw\_service\_stats} \{ \text{sgw\_procedure\_type}=\sim \text{'s1\_sgw\_relocation\_attach  x2\_sgw\_relocation\_attach'} \text{, status}=\text{"success"} \} [5\text{m}])) \text{ by } (\text{sgw\_procedure\_type}, \text{namespace})}{\text{sum}(\text{rate}(\text{sgw\_service\_stats} \{ \text{sgw\_procedure\_type}=\sim \text{'s1\_sgw\_relocation\_attach  x2\_sgw\_relocation\_attach'} \text{, status}=\text{"attempted"} \} [5\text{m}])) \text{ by } (\text{sgw\_procedure\_type}, \text{namespace})}$
Intra EUTRAN Handover Success Rate without SGW Relocation	Total Handover Success without SGW Relocation/Total Handover Attempted without SGW Relocation	$\frac{\text{sum}(\text{rate}(\text{sgw\_service\_stats} \{ \text{sgw\_procedure\_type}=\sim \text{'inter\_mme\_handover  intra\_mme\_handover'} \text{, status}=\text{"success"} \} [5\text{m}])) \text{ by } (\text{sgw\_procedure\_type}, \text{namespace})}{\text{sum}(\text{rate}(\text{sgw\_service\_stats} \{ \text{sgw\_procedure\_type}=\sim \text{'inter\_mme\_handover  intra\_mme\_handover'} \text{, status}=\text{"attempted"} \} [5\text{m}])) \text{ by } (\text{sgw\_procedure\_type}, \text{namespace})}$

KPI Name	Description	Expression
Inter System Handover Success Rate	Wifi Handover Success + GnGp Handover Success)/Wifi Handover Attempted + GnGp Handover Attempted	<pre>sum(rate(sgw_service_stats {sgw_procedure_type=~ 'inter_system_handover_attach  x2_gnnp_to_lte_relocation_attach  s1_gnnp_to_lte_relocation_attach', status=\"success\"}[5m])) by (sgw_procedure_type, namespace)/sum(rate(sgw_service_stats {sgw_procedure_type=~ 'inter_system_handover_attach  x2_gnnp_to_lte_relocation_attach  s1_gnnp_to_lte_relocation_attach', status=\"attempted\"}[5m])) by (sgw_procedure_type,namespace)</pre>
SGW IDFT Creation Success Rate	Total IDFT Success/Total IDFT Attempted	<pre>sum(rate(sgw_service_stats {sgw_procedure_type=\ \"create_indirect_data_ forwarding_tunnel\", status=\"success\"}[5m])) by (namespace)/sum(rate (sgw_service_stats {sgw_procedure_type= \"create_indirect_data_ forwarding_tunnel\", status=\"attempted\"}[5m])) by (namespace)</pre>

## Pod Level KPIs

The following table lists pod level KPIs.

Table 8: Pod Level KPIs

KPI Name	Description	Expression
Average cpu_usage	Average CPU percent usage for pods.	sum(cpu_percent{ service_name=\"sgw-service\"}) by (namespace)
Average Memory_usage	Average memory usage for pods in kb.	sum(mem_usage_kb {service_name=\"sgw-service \"}) by (namespace)

## Bulkstats Categories

cnSGW-C bulkstats are divided into the following categories:

- Session/Bearer/UE
- Procedural
- Handover
- Collision
- Disconnect Reason/Failures/Retransmissions

## Session/Bearer/UE Bulkstats

The following table lists Session/Bearer/UE bulkstats.

Table 9: Session/Bearer/UE Bulkstats

Bulkstats Query Name	Type	Expression	Label
active_pdns_ per_pdn_type	Gauge	sum(sgw_pdn_counters {pdn_type!=\"null\"}) by (pdn_type,namespace)	rat_type
pdns_released_ per_pdn_type	Counter	sum(sgw_service_stats {pdn_type!=\"null\", status=\"release\"}) by (pdn_type,namespace)	pdn_type

Bulkstats Query Name	Type	Expression	Label
pdns_setup_ per_pdn_type	Counter	sum(sgw_service_stats {pdn_type!=null,status= \'setup\'}) by (pdn_type, namespace)	pdn_type
ue_active	Gauge	sum(sgw_ue_counters {rat_type=\'EUTRAN\', state=\'connected\'}) by (namespace)	state
ue_active_ per_svc_pod	Gauge	sum(sgw_ue_counters {rat_type=\'EUTRAN\'}) by (instance_id,namespace)	instance_id
ue_idle	Gauge	sum(sgw_ue_counters {rat_type=\'EUTRAN\' ,state=\'idle\'}) by (namespace)	state
ue_released	Counter	sum(sgw_ue_counters {rat_type=\'EUTRAN\', state=\'release\'}) by (namespace)	status
ue_setup	Counter	sum(sgw_ue_counters {rat_type=\'EUTRAN\', state=\'setup\'}) by (namespace)	status
active_pdn_ per_plmn_type	Gauge	sum(sgw_pdn_counters {rat_type=\'EUTRAN\', pdn_plmn_type!=null'}) by (pdn_plmn_type,namespace)	pdn_plmn_type
pdns_released_ per_plmn_type	Counter	sum(sgw_pdn_counters {rat_type=\'EUTRAN\', pdn_plmn_type!=null'}) by (pdn_plmn_type,namespace)	pdn_plmn_type

Bulkstats Query Name	Type	Expression	Label
pdns_setup_ per_plmntype	Counter	sum(sgw_pdn_setup {rat_type="EUTRAN", pdn_plmn_type!='null', status="setup"}) by (pdn_plmn_type,namespace)	pdn_plmn_type
active_ pdn_emps	Gauge	sum(sgw_pdn_emps_ counters {status="active"}) by (namespace)	status
pdn_ setup_emps	Counter	sum(sgw_pdn_emps_ stats {status="setup"}) by (namespace)	status
pdn_ released_emps	Counter	sum(sgw_pdn_emps_ stats {status="release"}) by (namespace)	status

## Procedural Bulkstats

The following table lists procedural bulkstats.

**Table 10: Procedural Bulkstats**

Bulkstats Query Name	Type	Expression	Label
ue_attach_ attempt	Counter	sum(sgw_service_stats {interface="interface_sgw_egress", sgw_procedure_type= "initial_attach", status="attempted"}) by (namespace)	status
ue_attach_ success	Counter	sum(sgw_service_stats {interface="interface_sgw_egress", sgw_procedure_type= "initial_attach",status="success"}) by (namespace)	status

Bulkstats Query Name	Type	Expression	Label
ue_detach_attempt	Counter	sum(sgw_service_stats {interface="interface_sgw_ingress", sgw_procedure_type="delete_session_request", status="attempted"}) by (namespace)	status
ue_detach_success	Counter	sum(sgw_service_stats {interface="interface_sgw_ingress", sgw_procedure_type="delete_session_request", status="success"}) by (namespace)	status
modify_bearer_request_attempt	Counter	sum(sgw_service_stats {interface="interface_sgw_egress", sgw_procedure_type=~'modify_bearer_req_uli_tz_change modify_bearer_req_initial_attach service_request',status="attempted"}) by (sgw_procedure_type, namespace)	sgw_procedure_type
modify_bearer_request_success	Counter	sum(sgw_service_stats {interface="interface_sgw_egress", sgw_procedure_type=~'modify_bearer_req_uli_tz_change modify_bearer_req_initial_attach service_request',status="success"}) by (sgw_procedure_type, namespace)	sgw_procedure_type



Bulkstats Query Name	Type	Expression	Label
sx_association_ success	Counter	sum(proto_udp_res_msg_ total{message_name= \"association_setup_res\", status=\"accepted\"}) by (namespace)	status
sx_association_ failure	Counter	sum(proto_udp_res_msg_total {message_name= \"association_setup_res\", status!=\"accepted\"}) by (namespace)	status
sx_session_ establishment_success	Counter	sum(proto_udp_res_msg_total {message_name= \"session_establishment_res\", status=\"accepted\"}) by (namespace)	status
sx_session_ establishment_failure	Counter	sum(proto_udp_res_msg_total {message_name= \"session_establishment_res\", status!=\"accepted\"}) by (namespace)	status
sx_session_ modification_success	Counter	sum(proto_udp_res_msg_total {interface_type=\"SXA\", message_name= \"session_modification_res\", status=\"accepted\"}) by (namespace)	status
sx_session_ modification_failure	Counter	sum(proto_udp_res_msg_total {interface_type=\"SXA\", message_name= \"session_modification_res\", status!=\" accepted\"}) by (namespace)	status

Bulkstats Query Name	Type	Expression	Label
sx_session_deletion_success	Counter	sum(proto_udp_res_msg_total {message_name= \"session_deletion_res\", status=\"accepted\"}) by (namespace)	status
sx_session_deletion_failure	Counter	sum(proto_udp_res_msg_total {message_name= \"session_deletion_res\", status!=\"accepted\"}) by (namespace)	status
sx_session_report_success	Counter	sum(proto_udp_res_msg_total {message_name= \"session_report_res\", status!=\"accepted\"}) by (namespace)	status
sx_session_report_failure	Counter	sum(proto_udp_res_msg_total {message_name= \"session_report_res\", status=\"accepted\"}) by (namespace)	status
create_bearer_attempt	Counter	sum(sgw_service_stats {interface=\"interface_sgw_egress\", sgw_procedure_type=\"create_bearer\", status=\"attempted\"}) by (namespace)	status
create_bearer_success	Counter	sum(sgw_service_stats {interface=\"interface_sgw_egress\", sgw_procedure_type=\"create_bearer\", status=\"success\"}) by (namespace)	status

Bulkstats Query Name	Type	Expression	Label
create_bearer_ reject	Counter	sum(sgw_service_stats {fail_reason='gtp_cause_fail  gtp_validation_fail sx_cause_fail  timeout',interface= \"interface_sgw_ingress\", reject_cause!='null', service_name=\"sgw-service\", sgw_procedure_type= \"create_bearer\",status=\"failure\"}) by (reject_cause,fail_ reason,namespace)	reject_cause
bearer_active_ per_qci	Gauge	sum(sgw_bearer_counters {qci!='null',service_name= \"sgw-service\",status= \"active\"}) by (qci,namespace)	qci
bearer_setup_ per_qci	Counter	sum(sgw_bearer_stats {qci!='null',service_name= \"sgw-service\",status= \"setup\"}) by (qci,namespace)	qci
bearer_released_ per_qci	Counter	sum(sgw_bearer_stats {qci!='null',service_name=\"sgw- service\",status=\"release\"}) by (qci,namespace)	qci
bearer_modified_ per_qci	Counter	sum(sgw_bearer_stats {qci!='null',service_name= \"sgw-service\",status=\"modify\"}) by (qci,namespace)	qci
bearer_attempted_ per_qci	Counter	sum(sgw_bearer_stats {qci!='null',service_name=\"sgw- service\",status=\"attempted\"}) by (qci,namespace)	qci

Bulkstats Query Name	Type	Expression	Label
update_bearer_attempt	Counter	sum(sgw_service_stats {interface=\"interface_sgw_egress\", sgw_procedure_type=\"update_bearer\",status=\"attempted\"}) by (namespace)	status
update_bearer_success	Counter	sum(sgw_service_stats {interface=\"interface_sgw_egress\", sgw_procedure_type=\"update_bearer\",status=\"success\"}) by (namespace)	status
update_bearer_reject	Counter	sum(sgw_service_stats {fail_reason=~'gtp_cause_fail gtp_validation_fail sx_cause_fail timeout',interface=\"interface_sgw_ingress\", reject_cause!=\"null\",service_name=\"sgw-service\",sgw_procedure_type=\"update_bearer\",status=\"failure\"}) by (reject_cause, fail_reason,namespace)	reject_cause
delete_dedicated_bearer_attempt	Counter	sum(sgw_service_stats {interface=\"interface_sgw_egress\", sgw_procedure_type=\"pgw_initiated_dedicated_bearer_deletion\",status=\"attempted\"}) by (namespace)	status
delete_dedicated_bearer_success	Counter	sum(sgw_service_stats {interface=\"interface_sgw_egress\", sgw_procedure_type=\"pgw_initiated_dedicated_bearer_deletion\",status=\"success\"}) by (namespace)	status

Bulkstats Query Name	Type	Expression	Label
delete_dedicated_bearer_reject	Counter	sum(sgw_service_stats {fail_reason=~'gtp_cause_fail gtp_validation_fail sx_cause_fail timeout',interface=\"interface_sgw_ingress\", reject_cause!=null',service_name=\"sgw-service\", sgw_procedure_type=\"pgw_initiated_dedicated_bearer_deletion\",status=\"failure\"}) by (reject_cause,fail_reason, namespace)	reject_cause
modify_bearer_command_attempt	Counter	sum(sgw_service_stats {interface=\"interface_sgw_ingress\", sgw_procedure_type=\"modify_bearer_command\", status=\"attempted\"}) by (namespace)	status
modify_bearer_command_success	Counter	sum(sgw_service_stats {interface=\"interface_sgw_ingress\", sgw_procedure_type=\"modify_bearer_command\", status=\"success\"}) by (namespace)	status
modify_bearer_command_rejected	Counter	sum(sgw_service_stats {interface=\"interface_sgw_ingress\", sgw_procedure_type=\"modify_bearer_command\", status=\"rejected\"}) by (namespace)	status

Bulkstats Query Name	Type	Expression	Label
delete_bearer_command_attempt	Counter	sum(sgw_service_stats {interface="interface_sgw_ingress", sgw_procedure_type= "delete_bearer_command", status="attempted"}) by (namespace)	status
delete_bearer_command_success	Counter	sum(sgw_service_stats {interface="interface_sgw_ingress", sgw_procedure_type= "delete_bearer_command", status="success"}) by (namespace)	status
delete_bearer_command_rejected	Counter	sum(sgw_service_stats {interface="interface_sgw_ingress", sgw_procedure_type= "delete_bearer_command", status="rejected"}) by (namespace)	status
ddn_attempted	Counter	sum(sgw_service_stats {interface="interface_sgw_ingress", sgw_procedure_type= "downlink_data_notification", status="attempted"}) by (namespace)	status
ddn_success	Counter	sum(sgw_service_stats {interface="interface_sgw_ingress", sgw_procedure_type= "downlink_data_notification", status="success"} ) by (namespace)	status

Bulkstats Query Name	Type	Expression	Label
ddn_failure	Counter	sum(sgw_service_stats {fail_reason!='null', interface="interface_sgw_ingress", sub_fail_reason!='null', service_name="sgw-service", sgw_procedure_type= "downlink_data_notification", status="failure"}) by (sub_fail_reason, namespace)	sub_fail_ reason
secondary_pdn_ request_attempt	Counter	sum(sgw_service_stats {interface="interface_sgw_ingress", sgw_procedure_type= "secondary_pdn_creation", status="attempted"}) by (namespace)	status
secondary_pdn_ response_success	Counter	sum(sgw_service_stats {interface="interface_sgw_ingress", sgw_procedure_type= "secondary_pdn_creation", status="success"}) by (namespace)	status
context_ replacement_attempt	Counter	sum(sgw_service_stats {interface="interface_sgw_ingress", sgw_procedure_type= "context_replacement", status="attempted"}) by (namespace)	status

Bulkstats Query Name	Type	Expression	Label
context_replacement_success	Counter	sum(sgw_service_stats {interface=\"interface_sg_ingress\", sgw_procedure_type=\"context_replacement\", status=\"success\"}) by (namespace)	status

## Handover Bulkstats

The following table lists handover bulkstats.

*Table 11: Handover Bulkstats*

Bulkstats Query Name	Type	Expression	Label
handover_attempt	Counter	sum(sgw_service_stats {sgw_procedure_type=~ 's1_sgw_relocation_attach  x2_sgw_relocation_attach  inter_mme_handover  intra_mme_handover  inter_system_handover_attach  x2_gngp_to_lte_relocation_attach  s1_gngp_to_lte_relocation_attach', status=\"attempted\"}) by (sgw_procedure_type,namespace)	sgw_procedure_type



Bulkstats Query Name	Type	Expression	Label
handover_ success	Counter	sum(sgw_service_stats {sgw_procedure_type=~ 's1_sgw_relocation_attach  x2_sgw_relocation_attach  inter_mme_handover  intra_mme_handover  inter_system_handover_attach  x2_gngp_to_lte_relocation_attach  s1_gngp_to_lte_relocation_attach', status=\"success\"}) by (sgw_procedure_type,namespace)	sgw_procedure_ type
handover_ failures	Counter	sum(sgw_service_stats {interface=\"interface_sgw_ingress\", sgw_procedure_type=~ 's1_sgw_relocation_attach  x2_sgw_relocation_attach  inter_mme_handover  intra_mme_handover  inter_system_handover_attach  x2_gngp_to_lte_relocation_attach  s1_gngp_to_lte_relocation_attach', fail_reason!=\"null\",reject_cause!= 'null',status=\"rejected\"}) by (reject_cause,fail_reason, namespace)	reject_cause

Bulkstats Query Name	Type	Expression	Label
handover_modify_ bearer_attempted	Counter	sum(sgw_service_stats {sgw_procedure_type=~ 'modify_bearer_req_s1_ ho_with_sgw_relocation  modify_bearer_req_t au_ho_with_ sgw_relocation  modify_bearer_req_x2_ ho_with_sgw_relocation modify_ bearer_req_x2_gngp_to_lte_relocation  modify_bearer_req_s1_ gngp_to_lte_relocation', status=\"attempted\"}) by (sgw_procedure_type,namespace)	status
handover_modify_ bearer_success	Counter	sum(sgw_service_stats {sgw_procedure_type=~ 'modify_bearer_req_s1_ho_ with_sgw_relocation  modify_bearer_ req_tau_ho_with_sgw_relocation  modify_bearer_req_x2_ho_with_ sgw_relocation modify_bearer_req_x2_ gngp_to_lte_relocation modify_ bearer_req_s1_gngp_to_ lte_relocation',status= \"success\"}) by (sgw_procedure_type,namespace)	status

## Interaction Bulkstats

The following table lists interaction bulkstats.

Table 12: Interaction Bulkstats

Bulkstats Query Name	Type	Expression	Label
collision_abort_ svc_stats	Counter	sum(sgw_service_stats {fail_reason!=null, service_name="sgw-service"}) by (sgw_procedure_type, interface, namespace)	sgw_procedure_ type
collision_abort_ collision_stats	Counter	sum(sgw_collision_stats {action_type!=null,new_ proc!=null,old_proc!=null, service_name="sgw-service"}) by (action_type,new_ proc,old_proc,namespace)	action_type

## Failure Bulkstats

The following table lists failure bulkstats.

Table 13: Failure Bulkstats

Bulkstats Query Name	Type	Expression	Label
attach_ failure	Counter	sum(sgw_service_stats {fail_reason!=null, interface="interface_sgw_ingress", reject_cause!=null,service_name= "sgw-service",sgw_procedure_type= "initial_attach",status= "rejected"}) by (reject_cause, fail_reason,namespace)	reject cause
ue_disconnect_ reason	Counter	sum(sgw_ue_disconnect_ stats {reason!=null'}) by (reason,namespace)	reason
pdn_disconnect_ reason	Counter	sum(sgw_pdn_disconnect_ stats {reason!=null'}) by (reason,namespace)	reason

Bulkstats Query Name	Type	Expression	Label
retransmissions	Counter	sum(sgw_service_stats {interface!='null', status!="rejected", fail_reason!="gtp_peer_not_responding"}) by (interface,namespace)	interface

## Alerts

cnSGW-C alerts are divided into the following categories:

- Procedural
- Handovers
- Disconnect Reasons
- Interface

## LTE Procedure Alerts

The following table lists LTE procedure alerts.

**Table 14: LTE Procedure Alerts**

Alert Rule	Severity	Duration (in mins)	Type
attach_success_rate	Major	15	Communication Alarm
<p><b>Expression:</b> sum(rate(sgw_service_stats {sgw_procedure_type="initial_attach", status="success"}[5m])) by (namespace)/sum(rate(sgw_service_stats {sgw_procedure_type="initial_attach",status="attempted"}[5m])) by (namespace) &lt; 0.90</p> <p><b>Description:</b> This alert is triggered when attach success rate is less than 90%.</p>			

Alert Rule	Severity	Duration (in mins)	Type
detach_success_rate	Major	15	Communication Alarm
	<p><b>Expression:</b> sum(rate(sgw_service_stats{interface="interface_sgw_ingress",sgw_procedure_type="delete_session_request",status="success"}[5m])) by (namespace) / sum(rate(sgw_service_stats{interface="interface_sgw_ingress",sgw_procedure_type="delete_session_request",status="attempted"}[5m])) by (namespace) &lt; 0.90</p> <p><b>Description:</b> This alert is triggered when detach success rate is less than 90%.</p>		
bearer_creation_success_rate	Major	15	Communication Alarm
	<p><b>Expression:</b> sum(rate(sgw_service_stats{interface="interface_sgw_ingress",sgw_procedure_type="create_bearer",status="success"}[5m])) by (namespace) / sum(rate(sgw_service_stats{interface="interface_sgw_ingress",sgw_procedure_type="create_bearer",status="attempted"}[5m])) by (namespace) &lt; 0.90</p> <p><b>Description:</b> This alert is triggered when bearer creation rate is less than 90%.</p>		
bearer_deletion_success_rate	Major	15	Communication Alarm
	<p><b>Expression:</b> sum(rate(sgw_service_stats{interface="interface_sgw_ingress",sgw_procedure_type="pgw_initiated_dedicated_bearer_deletion",status="success"}[5m])) by (namespace) / sum(rate(sgw_service_stats{interface="interface_sgw_ingress",sgw_procedure_type="pgw_initiated_dedicated_bearer_deletion",status="attempted"}[5m])) by (namespace) &lt; 0.90</p> <p><b>Description:</b> This alert is triggered when bearer deletion success rate is less than 90%.</p>		

Alert Rule	Severity	Duration (in mins)	Type
bearer_modification_ success_rate	Major	15	Communication Alarm
	<p><b>Expression:</b> sum(rate(sgw_service_stats {interface="interface_sgw_ingress",sgw_procedure_type="update_bearer",status="success"}[5m])) by (namespace) / sum(rate(sgw_service_stats {interface="interface_sgw_ingress",sgw_procedure_type="update_bearer",status="attempted"}[5m])) by (namespace) &lt; 0.90</p> <p><b>Description:</b> This alert is triggered when bearer modification success rate is less than 90%.</p>		
ddn_failure_rate	Major	15	Communication Alarm
	<p><b>Expression:</b> sum(rate(sgw_service_stats {fail_reason!='null',interface="interface_sgw_ingress",sub_fail_reason!='null',service_name="sgw-service",sgw_procedure_type="downlink_data_notification",status="failure"}[5m])) by (sub_fail_reason,fail_reason,namespace) &gt; 0.10</p> <p><b>Description:</b> This alert is triggered when DDN failure rate is greater than 10%.</p>		

## Handover Alerts

The following table lists Handover alerts.

Table 15: Handover Alerts

Alert Rule	Severity	Duration (in mins)	Type
handover_ success_rate	Major	15	Communication Alarm
<p><b>Expression:</b> sum(rate(sgw_service_stats{sgw_procedure_type='s1_sgw_relocation_attach x2_sgw_relocation_attach inter_mme_handover intra_mme_handover inter_system_handover_attach x2_gngp_to_lte_relocation_attach s1_gngp_to_lte_relocation_attach', status='success'}[5m])) by (sgw_procedure_type,namespace)/sum(rate(sgw_service_stats{sgw_procedure_type='s1_sgw_relocation_attach x2_sgw_relocation_attach inter_mme_handover intra_mme_handover inter_system_handover_attach x2_gngp_to_lte_relocation_attach s1_gngp_to_lte_relocation_attach', status='attempted'}[5m])) by (sgw_procedure_type,namespace) &lt; 0.90</p> <p><b>Description:</b> This alert is triggered when handover success rate is less than 90%.</p>			

## Disconnect Reason Alerts

The following table lists disconnect reason alerts.

Table 16: Disconnect Reason Alerts

Alert Rule	Severity	Duration (in mins)	Type
up_path_failure	Major	15	Communication Alarm
<p><b>Expression:</b> sum(rate(sgw_ue_disconnect_stats{reason='sx_association_release'}[5m])) by (namespace) &gt; 10</p> <p><b>Description:</b> This alert is triggered when up path failure is detected.</p>			
gtpc_path_failure	Major	15	Communication Alarm
<p><b>Expression:</b> sum(rate(sgw_ue_disconnect_stats{reason=~'s11_path_failure s5e_path-failure s11_path_failure_local_purge s5e_path_failure_local_purge s5e_recovery s11_recovery s5e_recovery_local_purge s11_recovery_local_purge'}[5m])) by (namespace) &gt; 1</p> <p><b>Description:</b> This alert is triggered when GTPC path failure is detected.</p>			

## Sx Procedure Alerts

The following table lists disconnect reason alerts.

**Table 17: Disconnect Reason Alerts**

Alert Rule	Severity	Duration (in mins)	Type
sx_association_ failure	Major	15	Communication Alarm
<b>Expression:</b> sum(proto_udp_res_msg_total {message_name="association_setup_res",status!="accepted"}) by (namespace) > 0 <b>Description:</b> This alert is triggered when Sx association failure is detected.			
sx_peer_ status_down	Major	15	Communication Alarm
<b>Expression:</b> sum(nodemgr_up_peer_status {interface_type="SXA",service_name="nodemgr",up_peer_ip!='null',up_peer_status="up_peer_path_down"}) by (up_peer_ip,namespace) > 0 <b>Description:</b> This alert is triggered when up path is down.			
sx_peer_ status_up	Major	15	Communication Alarm
<b>Expression:</b> sum(nodemgr_up_peer_status {interface_type="SXA",service_name="nodemgr",up_peer_ip!='null',up_peer_status="up_peer_path_up"}) by (up_peer_ip,namespace) > 0 <b>Description:</b> This alert is triggered when up path failure is detected.			