# Application-based Alerts

# Feature Summary and Revision History

## Summary Data

**Table 1: Summary Data**

| | |
|---|---|
| Applicable Product(s) or Functional Area | SMF |
| Applicable Platform(s) | SMI |
| Feature Default Setting | Disabled - Configuration Required |
| Related Changes in this Release | Not Applicable |
| Related Documentation | Not Applicable |

## Revision History

**Table 2: Revision History**

| Revision Details | Release |
|---|---|
| First introduced. | Pre-2020.02.0 |

# Feature Description

When the system detects an anomaly, it generates an alert notification. The system statistics are the cause for these alert notifications. You can set an expression to trigger an alert when the expression becomes true.

# How it Works

The Common Execution Environment (CEE) uses the Prometheus Alert Manager for alerting operations. The CEE YANG model - either through CLI or API - allows users to view the active alerts, silenced alerts, and alert history. Also, the applications can call the alert API directly to add or clear alerts. The Prometheus Alert Manager API (v2) is the standard API used.

The Prometheus Alerts Manager includes the following options:

- **Defining Alert Rules**: This option defines the types of alerts that the Alert Manager should trigger. Use the Prometheus Query Language (PromQL) to define the alerts.

- **Defining Alert Routing**: This option defines the action the Alert Manager should take after receiving the alerts. At present, the SNMP Trapper is supported as the outbound alerting. Also, the CEE provides an Alert Logger for storing the generated alerts.

# Configuring Alert Rules

To configure the alert rules, use the following configuration:

```
configure
    alerts rules group alert_group_name
    interval-seconds seconds
    rule rule_name
        expression promql_expression
        duration duration
        severity severity_level
        type alert-type
        annotation annotation_name
        value annotation_value
        exit
    exit
```

**NOTES**:

- **alerts rules**: Specifies the Prometheus alerting rules.

- **group** *alert_group_name*: Specifies the Prometheus alerting rule group. One alert group can have multiple lists of rules. *alert-group-name* is the name of the alert group. The alert-group-name must be a string in the range of 0–64 characters.

- **interval-seconds** *seconds*: Specifies the evaluation interval of the rule group in seconds.

- **rule** *rule_name*: Specifies the alerting rule definition. *rule_name* is the name of the rule.

- **expression** *promql_expression*: Specifies the PromQL alerting rule expression. *promql_expression* is the alert rule query expressed in PromQL syntax.

- **duration** *duration*: Specifies the duration of a true condition before it is considered true. *duration* is the time interval before the alert is triggered.

- **severity** *severity_level*: Specifies the severity of the alert. *severity-level* is the severity level of the alert. The severity levels are critical, major, minor, and warning.

- **type** *alert_type*: Specifies the type of the alert. *alert_type* is the user-defined alert type. For example, Communications Alarm, Environmental Alarm, Equipment Alarm, Indeterminate Integrity Violation Alarm, Operational Violation Alarm, Physical Violation Alarm, Processing Error Alarm, Quality of Service Alarm, Security Service Alarm, Mechanism Violation Alarm, or Time Domain Violation Alarm.

- **annotation** *annotation_name*: Specifies the annotation to attach to the alerts. *annotation_name* is the name of the annotation.

- **value** *annotation_value*: Specifies the annotation value. *annotation_value* is the value of the annotation.

The following example configures an alert, which is triggered when the percentage of Unified Data Management (UDM) responses is less than the specified threshold limit.

**Example:**

```
configure terminal
 alerts rules group SMFUDMchk_incr
 interval-seconds 300
 rule SMFUDMchk_incr
 expression "sum(increase(smf_restep_http_msg_total{nf_type=\"udm\",
message_direction=\"outbound\", response_status=~\"2..\"}[3m])) /
sum(increase(smf_restep_http_msg_total{nf_type=\"udm\", message_direction=\"outbound\"}[3m]))
 < 0.95"
 severity major
 type "Communications Alarm"
 annotation summary
 value "This alert is fired when the percentage of UDM responses is less than threshold"
 exit
 exit
exit
```

You can view the configured alert using the **show running-config alerts** command.

**Example:**

The following example displays the alerts configured in the running configuration:

```
show running-config alerts
 interval-seconds 300
 rule SMFUDMchk_incr
 expression "sum(increase(smf_restep_http_msg_total{nf_type=\"udm\",
message_direction=\"outbound\", response_status=~\"2..\"}[3m])) /
sum(increase(smf_restep_http_msg_total{nf_type=\"udm\", message_direction=\"outbound\"}[3m]))
 < 0.95"
 severity major
 type "Communications Alarm"
 annotation summary
 value "This alert is fired when the percentage of UDM responses is less than threshold"

 exit
 exit
exit
```

# Viewing Alert Logger

The Alert Logger stores all the generated alerts by default. You can view the stored alerts using the following **show** command.

**show alert history [ filtering ]**

You can narrow down the result using the following filtering options:

- **annotations**: Specifies the annotations of the alert.

- **endsAt**: Specifies the end time of the alert.

- **labels**: Specifies the additional labels of the alert.

- **severity**: Specifies the severity of the alert.

- **source**: Specifies the source of the alert.

- **startsAt**: Specifies the start time of the alert.

- **type**: Specifies the type of the alert.

The following example displays the history of the alerts configured in the system:

**Example:**

```
show alerts history
alerts active SMFUDMchk_incr ac2a970ab621
state active
severity major
type "Communications Alarm"
startsAt 2019-11-15T08:26:48.283Z
source System
annotations [ "summary:This alert is fired when the percentage of UDM responses is less
than threshold." ]
```

You can view the active and silenced alerts with the **show alerts active** and **show alerts active** commands.

The following example displays the active alerts. The alerts remain active as long as the evaluated expression is true.

**Example:**

```
show alerts active
alerts active SMFUDMchk_incr ac2a970ab621
state active
severity major
type "Communications Alarm"
startsAt 2019-11-15T08:26:48.283Z
source System
annotations [ "summary:This alert is fired when the percentage of UDM responses is less
than threshold." ]
```

# Call Flow Procedure Alerts

This section provides detail of commands that are required to configure alerts related to various call flow procedures.

## 4G PDN Modify

Use the following commands to configure alerts related to the 4G PDN Modify procedure.

```
alerts rules group SMFPDN
   interval-seconds 300
   rule SMFPDNModify
   expression "sum(smf_service_stats{procedure_type=~\"pdn_ho_location_changed|
pdn_ho_rat_type_changed|pdn_inter_sgw_handover|pdn_mbr\" ,
status=\"success\"})/sum(smf_service_stats{procedure_type=~
\"pdn_ho_location_changed|pdn_ho_rat_type_changed |pdn_inter_sgw_handover|pdn_mbr\" ,
status=\"attempted\"}) < 0.95"
   severity major
   type "Communications Alarm"
   annotation summary
   value "This alert is fired when the percentage successful 4G PDN Modify is below
threshold"
   exit
exit
```

## 4G PDN Release Success

Use the following commands to configure alerts related to the 4G PDN Release Success procedure.

```
alerts rules group SMFPDN
   interval-seconds 300
   rule SMFPDNRelease
   expression "sum(smf_service_stats{procedure_type=~\".*pdn_sess_rel\" ,
status=\"success\"}) / sum(smf_service_stats{procedure_type=~\".*pdn_sess_rel\" ,
status=\"attempted\"} < 0.95 "
   severity major
   type "Communications Alarm"
   annotation summary
   value "This alert is fired when the percentage successful 4G PDN Release is below
threshold."
   exit
exit
```

## 4G PDN Setup Success

Use the following commands to configure alerts related to the 4G PDN Setup Success procedure.

```
alerts rules group SMFPDN
   interval-seconds 300
   rule SMFPDNSetup
   expression "sum(smf_service_stats{procedure_type=\"pdn_sess_create\" ,
status=\"success\"}) / sum(smf_service_stats{procedure_type=\"pdn_sess_create\" ,
status=\"attempted\"} < 0.95 "
   severity major
   type "Communications Alarm"
   annotation summary
   value "This alert is fired when the percentage successful 4G PDN Setup is below
threshold."
   exit
exit
```

## 4G to 5G HO Success

Use the following commands to configure alerts related to the 4G to 5G HO Success procedure.

```
alerts rules group Handover
  interval-seconds 300
  rule 4gTo5gHOSuccess
  expression
"sum(smf_service_stats{procedure_type=~\"n26_4g_to_5g_handover|n26_4g_to_5g_im_mobility\"
, status=\"success\"}) /
sum(smf_service_stats{procedure_type=~\"n26_4g_to_5g_handover|n26_4g_to_5g_im_mobility\" ,
 status=\"attempted\"}) < 0.95 "
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage successful 4G to 5G HO is below
threshold."
  exit
exit
```

## 4G To WiFi HO Success

Use the following commands to configure alerts related to the 4G to WiFi HO Success procedure.

```
alerts rules group Handover
  interval-seconds 300
  rule 4GtoWifiHOSuccess
  expression "sum(smf_service_stats{procedure_type=\"enb_to_untrusted_wifi_handover\"
, status=\"success\"}) /
sum(smf_service_stats{procedure_type=\"enb_to_untrusted_wifi_handover\" ,
status=\"attempted\"}) < 0.95 "
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage of N4 responses sent is lesser than 95
 %."
  exit
exit
```

## 5G N2 HO Success

Use the following commands to configure alerts related to the 5G N2 HO Success procedure.

```
alerts rules group Handover
  interval-seconds 300
  rule N2HOSuccess
  expression "sum(smf_service_stats{procedure_type=\"n2_handover\" , status=\"success\"})
 / sum(smf_service_stats{procedure_type=\"n2_handover\" , status=\"attempted\"}) < 0.95 "
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage successful 5G N2 HO is below threshold."

  exit
exit
```

## 5G PDU Idle Success

Use the following commands to configure alerts related to the 5G PDU Idle Success procedure.

```
alerts rules group SMFPDU
  interval-seconds 300
  rule SMFPDUIdleSuccess
  expression "sum(smf_service_stats{procedure_type=~\".*idle\" , status=\"success\"})
/ sum(smf_service_stats{procedure_type=~\".*idle\" , status=\"attempted\"}) < 0.95 "
  severity major
  type "Communications Alarm"
  annotation summary
   value "This alert is fired when the percentage successful 5G PDU Idle is below threshold"

  exit
exit
```

## 5G PDU Modify Success

Use the following commands to configure alerts related to the 5G PDU Modify Success procedure.

```
alerts rules group SMFPDU
  interval-seconds 300
  rule SMFSessionModifySuccess
  expression "sum(smf_service_stats{procedure_type=~\".*pdu_sess_mod\" ,
status=\"success\"}) / sum(smf_service_stats{procedure_type=~\".*pdu_sess_mod\" ,
status=\"attempted\"}) < 0.95 "
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage successful 5G PDU Modify is below
threshold"
  exit
exit
```

## 5G PDU Release Success

Use the following commands to configure alerts related to the 5G PDU Release Success procedure.

```
alerts rules group SMFPDU
  interval-seconds 300
  rule SMFSessionReleaseFailure
  expression "sum(smf_service_stats{procedure_type=~\".*pdu_sess_rel\" ,
status=\"success\"}) / sum(smf_service_stats{procedure_type=~\".*pdu_sess_rel\" ,
status=\"attempted\"}) < 0.95 "
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage successful 5G PDU Setup is below
threshold"
  exit
exit
```

# 5G PDU Setup Success

Use the following commands to configure alerts related to the 5G PDU Setup Success procedure.

```
alerts rules group SMFPDU
  interval-seconds 300
  rule SMFSessionSetupFailure
  expression "sum(smf_service_stats{procedure_type=\"pdu_sess_create\" ,
status=\"success\"}) / sum(smf_service_stats{procedure_type=\"pdu_sess_create\" ,
status=\"attempted\"} < 0.95 "
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when failed to setup sessions is more than 5%"
  exit
exit
```

# 5G to 4G HO Success

Use the following commands to configure alerts related to the 5G to 4G HO Success procedure.

```
alerts rules group Handover
  interval-seconds 300
  rule 5gTo4gHOSuccess
  expression "sum(smf_service_stats{procedure_type=~\"pdn_5g_4g_handover
|pdn_5g_4g_handover_dft|eps_fb_5g_4g_handover_dft|eps_fb_5g_4g_handover_idft
|pdn_5g_4g_handover_idft\" , status=\"success\"}) /
sum(smf_service_stats{procedure_type=~\"pdn_5g_4g_handover
|pdn_5g_4g_handover_dft|eps_fb_5g_4g_handover_dft|
eps_fb_5g_4g_handover_idft|pdn_5g_4g_handover_idft\" , status=\"attempted\"}) < 0.95 "
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage successful 5G to 4G HO is below
threshold."
  exit
exit
```

# 5G To WiFi HO Success

Use the following commands to configure alerts related to the 5G to WiFi HO Success procedure.

```
alerts rules group Handover
  interval-seconds 300
  rule 5GtoWifiHOSuccess
  expression "sum(smf_service_stats{procedure_type=\"nr_to_untrusted_wifi_handover\" ,
 status=\"success\"}) / sum(smf_service_stats{procedure_type=\"nr_to_untrusted_wifi_handover\"
 , status=\"attempted\"}) < 0.95 "
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage of N4 responses sent is lesser than 95
%."
  exit
exit
```

## 5G Xn HO Success

Use the following commands to configure alerts related to the 5G Xn HO Success procedure.

```
alerts rules group Handover
  interval-seconds 300
  rule XnHOSuccess
  expression "sum(smf_service_stats{procedure_type=\"xn_handover\" , status=\"success\"})
 / sum(smf_service_stats{procedure_type=\"xn_handover\" , status=\"attempted\"}) < 0.95 "
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage successful 5G Xn HO is below threshold."

  exit
exit
```

## PDN Session Create

Use the following commands to configure alerts related to the PDN Session Create procedure.

```
alerts rules group SMFProcStatus
  interval-seconds 300
  rule PDNSessCreate
  expression "sum(increase(smf_service_stats{app_name=\"SMF\",procedure_type=
/\"pdn_sess_create\",status=\"success\"}[5m])) /
sum(increase(smf_service_stats{app_name=\"SMF\
/",procedure_type=\"pdn_sess_create\",status=\"  /attempted\"}[5m])) < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the success percentage of pdn_sess_create procedure is
 lesser threshold."
  exit
exit
```

## PDU Session Create

Use the following commands to configure alerts related to the PDU Session Create procedure.

```
alerts rules group SMFProcStatus
  interval-seconds 300
  rule PDUSessCreate
  expression "sum(increase(smf_service_stats{app_name=\"SMF\",procedure_type=
/\"pdu_sess_create\",status=\"success\"}[5m]))sum
/(increase(smf_service_stats{app_name=\"SMF\", /procedure_type=\"pdu_sess_create\",status=\
 /"attempted\"}[5m])) < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the success percentage of pdu_sess_create procedure is
 lesser threshold."
  exit
exit
```

## PDU Session Modify

Use the following commands to configure alerts related to the PDU Session Modify procedure.

```
alerts rules group SMFProcStatus
  interval-seconds 300
  rule PDUSessModify
  expression "sum(increase(smf_service_stats{app_name=\"SMF\",procedure_type=~\".
/*req_pdu_sess_mod\",status=\"success\"}[5m]))sum(increase
/(smf_service_stats{app_name=\"SMF\",procedure_type=~
/\".*req_pdu_sess_mod\",status=\"attempted\"}[5m]))  / < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the success percentage of req_pdu_sess_mod procedure
is lesser threshold."
  exit
exit
```

## PDU Session Release

Use the following commands to configure alerts related to the PDU Session Release procedure.

```
alerts rules group SMFProcStatus
  interval-seconds 300
  rule PDUSessRelease
  expression
"sum(increase(smf_service_stats{app_name=\"SMF\",procedure_type=~\".*req_pdu_sess_rel\",status=\
 /"success\"}[5m]))sum(increase(smf_service_stats{app_name=\"SMF
/\",procedure_type=~\".*req_pdu_sess_rel\",status=\  /"attempted\"}[5m])) < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the success percentage of req_pdu_sess_rel procedure
is lesser threshold."
  exit
exit
```

# Interface Specific Alerts

This section provides detail of commands that are required to configure alerts related to various interfaces.

## GTPC Peer Down

Use the following commands to configure alerts related to the GTPC Peer Down procedure.

```
alerts rules group GTPCPeerDown
  interval-seconds 300
  rule GTPCPeerDown
  expression nodemgr_gtpc_peer_status{gtpc_peer_status=\"gtpc_peer_path_down\"})
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the GTPC Path failure detected for peer crosses
```

```
threshold"
    exit
exit
```

## N4 Message Success

Use the following commands to configure alerts related to the N4 Message Success procedure.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
  rule SMFN4MessageSuccess
  expression "sum(smf_protocol_udp_res_msg_total{message_direction=\"inbound\",
status=\"accepted\"}) / sum(smf_protocol_udp_res_msg_total{message_direction=\"inbound\",
 status=~\"accepted|denied\"}) < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage of N4 responses sent is lesser than 95
%."
  exit
exit
```

## N4 UPF Association Down

Use the following commands to configure alerts related to the N4 UPF Association Down query by N4 address.

```
alerts rules group N4Association
  interval-seconds 300
  rule SMFAssociationRelease
  expression "smf_proto_udp_res_msg_total{procedure_type=\"n4_association_release_res\",
 message_direction= \"inbound\", status=\"accepted\"}) "
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the N4 Association with UPF is released"
  exit
exit
```

## N4 UPF Association Up

Use the following commands to configure alerts related to the N4 UPF Association Up query by N4 address.

```
alerts rules group N4Association
  interval-seconds 300
  rule N4AssociationUP
  expression "smf_proto_udp_res_msg_total{procedure_type=\"n4_association_setup_res\",
 message_direction= \"inbound\", status=\"accepted\"}"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the N4 Association with UPF is established"
  exit
exit
```

# N7 Interface Outbound

Use the following commands to configure alerts related to an outbound N7 interface.

```
alerts rules group SMFSvcStatus
   interval-seconds 300
   rule SMFN7Outbound
   expression "sum(increase(smf_restep_http_msg_total{nf_type=\"pcf\",
message_direction=\"outbound\", response_status=~\"2..\"}[5m])) /
sum(increase(smf_restep_http_msg_total{nf_type=\"pcf\", message_direction=\"outbound\"}[5m]))
 < 0.95"
   severity major
   type "Communications Alarm"
   annotation summary
   value "This alert is fired when the percentage of N7 responses received is lesser
threshold."
   exit
exit
```

# N7 Interface Inbound

Use the following commands to configure alerts related to an inbound N7 interface.

```
alerts rules group SMFSvcStatus
   interval-seconds 300
   rule SMFN7Inbound
   expression "sum(increase(smf_restep_http_msg_total{nf_type=\"pcf\",
message_direction=\"inbound\", response_status=~\"2..\"}[5m])) /
sum(increase(smf_restep_http_msg_total{nf_type=\"pcf\", message_direction=\"inbound\"}[5m]))
 < 0.95"
   severity major
   type "Communications Alarm"
   annotation summary
   value "This alert is fired when the percentage of N7 responses sent is lesser threshold."

   exit
exit
```

# N7 Message Timed Out

Use the following commands to configure alerts related to the N7 Message Timed Out procedure.

```
alerts rules group MessageTimeout
   interval-seconds 300
   rule SMFN7Timeout
   expression "sum(irate(smf_restep_http_msg_total{nf_type=\"pcf\",
message_direction=\"inbound\", response_status=\"504\"}[5m])) > 5"
   severity major
   type "Communications Alarm"
   annotation summary
   value "This alert is fired when the increase in timeout for N7 messages toward PCF
crosses threshold"
   exit
exit
```

## N10 Interface

Use the following commands to configure alerts related to the N10 interface.

```
alerts rules group SMFSvcStatus
   interval-seconds 300
   rule SMFN10
   expression "sum(increase(smf_restep_http_msg_total{nf_type=\"udm\",
message_direction=\"outbound\", response_status=~\"2..\"}[5m])) /
sum(increase(smf_restep_http_msg_total{nf_type=\"udm\", message_direction=\"outbound\"}[5m]))
 < 0.95"
   severity major
   type "Communications Alarm"
   annotation summary
   value "This alert is fired when the percentage of N10 responses received is lesser
threshold."
   exit
exit
```

## N11 Interface Inbound

Use the following commands to configure alerts related to an inbound N11 interface.

```
alerts rules group SMFSvcStatus
   interval-seconds 300
   rule SMFN11Inbound
   expression "sum(increase(smf_restep_http_msg_total{nf_type=\"amf\",
message_direction=\"inbound\", response_status=~\"2..\"}[5m])) /
sum(increase(smf_restep_http_msg_total{nf_type=\"amf\", message_direction=\"inbound\"}[5m]))
 < 0.95"
   severity major
   type "Communications Alarm"
   annotation summary
   value "This alert is fired when the percentage of N11 responses sent is lesser
threshold."
   exit
exit
```

## N11 Interface Outbound

Use the following commands to configure alerts related to an outbound N11 interface.

```
alerts rules group SMFSvcStatus
   interval-seconds 60
   rule SMFN11Outbound
   expression "sum(increase(smf_restep_http_msg_total{nf_type=\"amf\",
message_direction=\"outbound\", response_status=~\"2..\"}[5m])) /
sum(increase(smf_restep_http_msg_total{nf_type=\"amf\", message_direction=\"outbound\"}[5m]))
 < 0.95"
   severity major
   type "Communications Alarm"
   annotation summary
   value "This alert is fired when the percentage of N11 responses received is lesser
threshold."
   exit
exit
```

## N11 Message Timed Out

Use the following commands to configure alerts related to the N11 Message Timed Out procedure.

```
alerts rules group MessageTimeout
  interval-seconds 300
  rule SMFN40Timeout
  expression "sum(irate(smf_restep_http_msg_total{nf_type=\"chf\",
message_direction=\"inbound\", response_status=\"504\"}[5m])) > 5"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the increase in timeout for N11 messages toward AMF
crosses threshold"
  exit
exit
```

## N40 Interface Inbound

Use the following commands to configure alerts related to an inbound N40 interface.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
  rule SMFN40Inbound
  expression "sum(increase(smf_restep_http_msg_total{nf_type=\"chf\",
message_direction=\"inbound\", response_status=~\"2..\"}[5m])) /
sum(increase(smf_restep_http_msg_total{nf_type=\"chf\", message_direction=\"inbound\"}[5m]))
 < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage of N40 responses sent is lesser
threshold."
  exit
exit
```

## N40 Interface Outbound

Use the following commands to configure alerts related to an outbound N40 interface.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
  rule SMFN40Outbound
  expression "sum(increase(smf_restep_http_msg_total{nf_type=\"chf\",
message_direction=\"outbound\", response_status=~\"2..\"}[5m])) /
sum(increase(smf_restep_http_msg_total{nf_type=\"chf\", message_direction=\"outbound\"}[5m]))
 < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage of N40 responses received is lesser
threshold."
  exit
exit
```

## N40 Message Timed Out

Use the following commands to configure alerts related to the N40 Message Timed Out procedure.

```
alerts rules group MessageTimeout
  interval-seconds 300
  rule SMFN11Timeout
  expression "sum(irate(smf_restep_http_msg_total{nf_type=\"chf\",
message_direction=\"inbound\", response_status=\"504\"}[5m])) > 5"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired the increase in timeout for N40 messages toward CHF crosses
 threshold"
  exit
exit
```

## NRF Discovery

Use the following commands to configure alerts related to the NRF Discovery procedure.

```
alerts rules group NRF
  interval-seconds 300
  rule NRFDiscovery
  expression
"sum(nf_discover_messages_total{result=~\"success|failure\",svc_name=\"nnrf-disc\",
service_name=\"smf-rest-ep\"}) < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage of N4 responses sent is lesser than 95
 %."
  exit
exit
```

## SMF Service Start

Use the following commands to configure alerts related to the SMF Service Start procedure.

```
alerts rules group SMFService
  interval-seconds 300
  rule SMFServiceStart
  expression "irate(outgoing_response_msg_total{msg_type=\"NrfNfmRegistration\"}[5m])"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when SMF-Service starts upon registration with NRF"
  exit
exit
```

# IP Pool

This section provides detail of commands that are required to configure alerts related to IP Pool.

## IP Pool Used

Use the following commands to configure alerts related to the IP Pool used procedure.

```
alerts rules group IPPool
  interval-seconds 300
  rule IPPool
  expression "sum(IPAM_address_allocations_current) > THRESHOLD"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage IP pool addresses used is above the
threshold"
  exit
exit
```

# Message Level Alerts

This section provides detail of commands that are required to configure alerts related to various messages.

## N11 SM Create

Use the following commands to configure alerts related to N11 SM Create.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
  rule SMFN11Success
  expression "sum(increase(smf_restep_http_msg_total{api_name=\"amf_create_sm_context\",
 message_direction=\"inbound\", response_status=\"201\"}[5m])) /
sum(increase(smf_restep_http_msg_total{api_name=\"amf_create_sm_context\",
message_direction=\"inbound\"}[5m])) < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage of amf_create_sm_context responses sent
 is lesser threshold."
  exit
exit
```

## N11 SM Update

Use the following commands to configure alerts related to N11 SM Update.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
  rule SMFN11Update
  expression "sum(increase(smf_restep_http_msg_total{api_name=\"amf_update_sm_context\",
 message_direction=\"inbound\", response_status=\"200\"}[5m])) /
sum(increase(smf_restep_http_msg_total{api_name=\"amf_update_sm_context\",
message_direction=\"inbound\"}[5m])) < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage of amf_update_sm_context responses sent
```

```
    is lesser threshold.”
      exit
  exit
```

## N11 SM Release

Use the following commands to configure alerts related to N11 SM Release.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
  rule SMFN11Release
  expression "sum(increase(smf_restep_http_msg_total{api_name=\"amf_release_sm_context\",
 message_direction=\"inbound\", response_status=\"204\"}[5m])) /
sum(increase(smf_restep_http_msg_total{api_name=\"amf_release_sm_context\",
message_direction=\"inbound\"}[5m])) < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage of amf_release_sm_context responses sent
 is lesser threshold.”
  exit
exit
```

## N1 N2 Message Transfer

Use the following commands to configure alerts related to N1 N2 Message Transfer.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
  rule SMFN1N2Transfer
  expression "sum(increase(smf_restep_http_msg_total{api_name=\"amf_n1_n2_transfer\",
message_direction=\"outbound\", response_status=\"200\"}[5m])) /
sum(increase(smf_restep_http_msg_total{api_name=\"amf_n1_n2_transfer\",
message_direction=\"outbound\"}[5m])) < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage of amf_n1_n2_transfer responses received
 is lesser threshold.”
  exit
exit
```

## N11 EBI Assignment

Use the following commands to configure alerts related to N11 EBI Assignment.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
  rule SMFN11EBI
  expression "sum(increase(smf_restep_http_msg_total{api_name=\"amf_assign_ebi\",
message_direction=\"outbound\", response_status=\"200\"}[5m])) /
sum(increase(smf_restep_http_msg_total{api_name=\"amf_assign_ebi\",
message_direction=\"outbound\"}[5m])) < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
```

```
      value "This alert is fired when the percentage of amf_assign_ebi responses received is
    lesser threshold."
      exit
  exit
```

## N11 SM Status Notify

Use the following commands to configure alerts related to N11 SM Status Notify.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
  rule SMFN11StatusNotify
  expression "sum(increase(smf_restep_http_msg_total{api_name=\"amf_status_notify\",
message_direction=\"outbound\", response_status=\"201\"}[5m])) /
sum(increase(smf_restep_http_msg_total{api_name=\"amf_status_notify\",
message_direction=\"outbound\"}[5m])) < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage of amf_status_notify responses received
 is lesser threshold."
  exit
exit
```

## N11 SM Context Retrieve

Use the following commands to configure alerts related to N11 SM Context Retrieve.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
  rule SMFN11ContextRetrieve
  expression "sum(increase(smf_restep_http_msg_total{api_name=\"amf_retrieve_sm_context\",
 message_direction=\"inbound\", response_status=\"201\"}[5m])) /
sum(increase(smf_restep_http_msg_total{api_name=\"amf_retrieve_sm_context\",
message_direction=\"inbound\"}[5m])) < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage of amf_retrieve_sm_context responses
sent is lesser threshold."
  exit
exit
```

## N7 SM Policy Create

Use the following commands to configure alerts related to N7 SM Policy Create.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
  rule SMFN7PolicyCreate
  expression
"sum(increase(smf_restep_http_msg_total{api_name=\"pcf_sm_policy_control_create\",
message_direction=\"outbound\", response_status=\"201\"}[5m])) /
sum(increase(smf_restep_http_msg_total{api_name=\"pcf_sm_policy_control_create\",
message_direction=\"outbound\"}[5m])) < 0.95"
  severity major
```

```
    type "Communications Alarm"
    annotation summary
    value "This alert is fired when the percentage of pcf_sm_policy_control_create responses
 received is lesser threshold."
    exit
  exit
```

# N7 SM Policy Update

Use the following commands to configure alerts related to N7 SM Policy Update.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
  rule SMFN7PolicyUpdate
  expression
"sum(increase(smf_restep_http_msg_total{api_name=\"pcf_sm_policy_control_update\",
message_direction=\"outbound\", response_status=\"200\"}[5m])) /
sum(increase(smf_restep_http_msg_total{api_name=\"pcf_sm_policy_control_update\",
message_direction=\"outbound\"}[5m])) < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage of pcf_sm_policy_control_update responses
 received is lesser threshold."
  exit
exit
```

# N7 SM Policy Delete

Use the following commands to configure alerts related to N7 SM Policy Delete.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
  rule SMFN7PolicyDelete
  expression
"sum(increase(smf_restep_http_msg_total{api_name=\"pcf_sm_policy_control_delete\",
message_direction=\"outbound\", response_status=\"204\"}[5m])) /
sum(increase(smf_restep_http_msg_total{api_name=\"pcf_sm_policy_control_delete\",
message_direction=\"outbound\"}[5m])) < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage of pcf_sm_policy_control_delete responses
 received is lesser threshold."
  exit
exit
```

# N7 SM Policy Notify Update

Use the following commands to configure alerts related to N7 SM Policy Notify Update.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
  rule SMFN7PolicyUpdateNotify
  expression
"sum(increase(smf_restep_http_msg_total{api_name=\"pcf_sm_policy_control_update_notify\",
```

```
message_direction=\"inbound\", response_status=\"201\"}[5m])) /
sum(increase(smf_restep_http_msg_total{api_name=\"pcf_sm_policy_control_update_notify\",
message_direction=\"inbound\"}[5m])) < 0.95"
    severity major
    type "Communications Alarm"
    annotation summary
    value "This alert is fired when the percentage of pcf_sm_policy_control_update_notify
 responses sent is lesser threshold."
    exit
exit
```

# N7 SM Policy Notify Terminate

Use the following commands to configure alerts related to N7 SM Policy Terminate.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
  rule SMFN7PolicyTerminateNotify
  expression
"sum(increase(smf_restep_http_msg_total{api_name=\"pcf_sm_policy_control_terminate_notify\",
 message_direction=\"inbound\", response_status=\"201\"}[5m])) /
sum(increase(smf_restep_http_msg_total{api_name=\"pcf_sm_policy_control_terminate_notify\",
 message_direction=\"inbound\"}[5m])) < 0.95"
    severity major
    type "Communications Alarm"
    annotation summary
    value "This alert is fired when the percentage of pcf_sm_policy_control_terminate_notify
 responses sent is lesser threshold."
    exit
exit
```

# N10 UE Register

Use the following commands to configure alerts related to N10 UE Register.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
  rule SMFN10UERegister
  expression "sum(increase(smf_restep_http_msg_total{api_name=\"register_ue\",
message_direction=\"outbound\", response_status=\"201\"}[5m])) /
sum(increase(smf_restep_http_msg_total{api_name=\"register_ue\",
message_direction=\"outbound\"}[5m])) < 0.95"
    severity major
    type "Communications Alarm"
    annotation summary
    value "This alert is fired when the percentage of register_ue responses received is
lesser threshold."
    exit
exit
```

# N10 UE DeRegister

Use the following commands to configure alerts related to N10 UE DeRegister.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
```

```
   rule SMFN10UEDeRegister
   expression "sum(increase(smf_restep_http_msg_total{api_name=\"deregister_ue\",
message_direction=\"outbound\", response_status=\"201\"}[5m])) /
sum(increase(smf_restep_http_msg_total{api_name=\"deregister_ue\",
message_direction=\"outbound\"}[5m])) < 0.95"
   severity major
   type "Communications Alarm"
   annotation summary
   value "This alert is fired when the percentage of deregister_ue responses received is
 lesser threshold."
   exit
exit
```

## N10 SM Subscription Fetch

Use the following commands to configure alerts related to N10 Subscription Fetch.

```
alerts rules group SMFSvcStatus
   interval-seconds 300
   rule SMFN10SubscriptionFetch
   expression "sum(increase(smf_restep_http_msg_total{api_name=\"subscription_req\",
message_direction=\"outbound\", response_status=\"200\"}[5m])) /
sum(increase(smf_restep_http_msg_total{api_name=\"subscription_req\",
message_direction=\"outbound\"}[5m])) < 0.95"
   severity major
   type "Communications Alarm"
   annotation summary
   value "This alert is fired when the percentage of subscription_req responses received
 is lesser threshold."
   exit
exit
```

## N10 SM Subscribe for Notification

Use the following commands to configure alerts related to N10 Subscribe for Notification.

```
alerts rules group SMFSvcStatus
   interval-seconds 300
   rule SMFN10SubscriptionNotification
   expression "sum(increase(smf_restep_http_msg_total{api_name=\"sdm_subscription_req\",
 message_direction=\"outbound\", response_status=\"201\"}[5m])) /
sum(increase(smf_restep_http_msg_total{api_name=\"sdm_subscription_req\",
message_direction=\"outbound\"}[5m])) < 0.95"
   severity major
   type "Communications Alarm"
   annotation summary
   value "This alert is fired when the percentage of sdm_subscription_req responses received
 is lesser threshold."
   exit
exit
```

## N10 Charging Data Request

Use the following commands to configure alerts related to N10 Charging Data Request.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
  rule SMFN10ChargingRequest
  expression
"sum(increase(smf_restep_http_msg_total{api_name=\"chf_charging_data_request\",
message_direction=\"outbound\", response_status=\"201\"}[5m])) /
sum(increase(smf_restep_http_msg_total{api_name=\"chf_charging_data_request\",
message_direction=\"outbound\"}[5m])) < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage of chf_charging_data_request responses
 received is lesser threshold."
  exit
exit
```

## N10 Charging Data Notify

Use the following commands to configure alerts related to N10 Charging Data Notify.

```
alerts rules group SMFSvcStatus
  interval-seconds 300
  rule SMFN10ChargingDataNotify
  expression "sum(increase(smf_restep_http_msg_total{api_name=\"chf_abort_notify\",
message_direction=\"inbound\", response_status=\"201\"}[5m])) /
sum(increase(smf_restep_http_msg_total{api_name=\"chf_abort_notify\",
message_direction=\"inbound\"}[5m])) < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage of chf_abort_notify responses sent is
lesser threshold."
  exit
exit
```

# Policy Rule Alerts

This section provides detail of commands that are required to configure alerts related to various policy rules.

## Addition of Dynamic PCC Rules

Use the following commands to configure alerts related to addition of dynamic PCC rules.

```
alerts rules group SMFPolicyStatus
  interval-seconds 300
  rule AddPCCRule
  expression
"sum(increase(policy_dynamic_pcc_rules_total{app_name=\"SMF\",event=\"success\",operation=\"install\"}[5m]))
 /
sum(increase(policy_dynamic_pcc_rules_total{app_name=\"SMF\",event=\"attempted\",operation=\"install\"}[5m]))
 < 0.95"
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the percentage of successful addition of dynamic pcc
```

```
rules is lesser threshold."
   exit
exit
```

## Modification of Dynamic PCC Rules

Use the following commands to configure alerts related to modification of dynamic PCC rules.

```
alerts rules group SMFPolicyStatus
   interval-seconds 300
   rule ModifyPCCRule
   expression
"sum(increase(policy_dynamic_pcc_rules_total{app_name=\"SMF\",event=\"success\",operation=\"modify\"}[5m]))
  /
sum(increase(policy_dynamic_pcc_rules_total{app_name=\"SMF\",event=\"attempted\",operation=\"modify\"}[5m]))
 < 0.95"
   severity major
   type "Communications Alarm"
   annotation summary
   value "This alert is fired when the percentage of successful modification of dynamic
pcc rules is lesser threshold."
   exit
exit
```

## Removal of Dynamic PCC Rules

Use the following commands to configure alerts related to removal of dynamic PCC rules.

```
alerts rules group SMFPolicyStatus
   interval-seconds 300
   rule RemovePCCRule
   expression
"sum(increase(policy_dynamic_pcc_rules_total{app_name=\"SMF\",event=\"success\",operation=\"remove\"}[5m]))
  /
sum(increase(policy_dynamic_pcc_rules_total{app_name=\"SMF\",event=\"attempted\",operation=\"remove\"}[5m]))
 < 0.95"
   severity major
   type "Communications Alarm"
   annotation summary
   value "This alert is fired when the percentage of successful removal of dynamic pcc
rules is lesser threshold."
   exit
exit
```

# SMF Overload/Congestion

This section provides detail of commands that are required to configure alerts related to various SMF Overload/Congestion.

## SMF Overload

Use the following commands to configure alerts related to the SMF Overload procedure.

```
alerts rules group SMFSvcStatus
   interval-seconds 300
```

```
    rule SMFOverload
    expression "sum by (component) (system_overload_status) == true"
    severity major
    type "Communications Alarm"
    annotation summary
   value "This alert is fired when increase in events not processed due to system overload"

    exit
exit
```

# SMF Sessions

This section provides detail of commands that are required to configure alerts related to various SMF sessions.

## Session Release Rate

Use the following commands to configure alerts related to the Session Release Rate procedure.

```
alerts rules group SMFSession
  interval-seconds 300
  rule SMFSessionReleaseRate
  expression "sum(rate(smf_service_stats{procedure_type=~\".*pdu_sess_rel|.*pdn_sess_rel\"
, status=\"attempted\"}[5m])) >  THRESHOLD "
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when the session release rate exceeds the threshold"
  exit
exit
```

## Session Setup Failure

Use the following commands to configure alerts related to the Session Setup Failure procedure.

```
alerts rules group SMFSession
  interval-seconds 300
  rule SMFSessionSetupFailure
  expression "sum(smf_service_stats{procedure_type=~\"pdu_sess_create|pdn_sess_create\"
, status=\"failures\"}) /
sum(smf_service_stats{procedure_type=\"pdu_sess_create|pdn_sess_create\" ,
status=\"attempted\"}) >  0.05 "
  severity major
  type "Communications Alarm"
  annotation summary
  value "This alert is fired when failed to setup sessions is more than 5%"
  exit
exit
```

## Session Setup Rate

Use the following commands to configure alerts related to the Session Setup Rate procedure.

```
alerts rules group SMFSession
  interval-seconds 300
```

```
    rule SMFSessionSetupRate
    expression
"sum(rate(smf_service_stats{procedure_type=~\"pdu_sess_create|pdn_sess_create\" ,
status=\"attempted\"}[5m]))>  THRESHOLD "
    severity major
    type "Communications Alarm"
    annotation summary
    value "This alert is fired when the session setup rate exceeds the threshold"
    exit
exit
```

## Subscriber Limit

Use the following commands to configure alerts related to the Subscriber Limit procedure.

```
alerts rules group SMFSession
   interval-seconds 300
   rule SMFSubscriberLimit
   expression "sum(smf_session_counters{pdu_type=~\"ipv4v6|ipv4|ipv6\"}) > THRESHOLD"
   severity major
   type "Communications Alarm"
   annotation summary
   value "This alert is fired when the max number of subscribers is more
   than the threshold"
   exit
exit
```