



UPF Path Management and Restoration

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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.	2020.02.0

Feature Description

A heartbeat is used to monitor the status of a UPF node in terms of its responsiveness. The heartbeat initiates a bilateral flow of request and response between the SMF and UPF.

The SMF periodically sends a signal in the form of a heartbeat request to the registered UPF node to determine if it is active. If the SMF does not receive a response from UPF after the retransmission attempts are exhausted, then SMF recognizes that a failure has occurred and purges the subscribers that are mapped to that UPF node.

You can control the number of heartbeat requests that SMF sends to UPF, the interval between the consecutive requests, and the duration until which SMF waits for a response.

Standards Compliance

The heartbeat transmission between SMF and UPF complies with the following standards:

- *3GPP TS 23.527*
- *3GPP TS 23.007, version 15.4.0*

How it Works

You can configure the heartbeat capability at the interface-level, UPF profile group-level, or both. The interface-level configuration is mandatory. If the interface-level configuration is unavailable, then the heartbeat parameters get configured with the default values. The profile-level configuration overrides the interface-level configuration.

The heartbeat feature is also extended to achieve high-availability for the Node Manager.

Interface and profile-level heartbeat

The SMF-UPF interaction to detect the UPF path failure using the heartbeat messages involves the following steps:

1. The SMF sends a heartbeat request message to the discovered UPF instances or profile groups based on the configured schedule.
2. If the UPF instance or profile is alive, it sends a heartbeat response to the SMF indicating that it is operational. In case the UPF does not send a heartbeat response, then SMF retransmits the heartbeat request based on the configured interval and the number of permitted attempts.
3. After the configured count of heartbeat message reattempts is exhausted and the SMF does not receive a response from UPF, then SMF starts 'Network requested PDU Session Release' procedure for the subscribers that are associated with that UPF.

Heartbeat and high-availability in Node Manager

Each UPF instance is associated with a primary and secondary Node Manager. The secondary Node Manager acts as a standby system on which the primary manager fails over. The primary Node Manager is responsible for the IP allocation and managing the association-specific messages such as association create, update, or delete request.

Configuration Support for UPF Path Management and Restoration

This section describes how to configure the support for monitoring the UPF status.

Configuring the support for detecting the UPF status using the heartbeat feature involves the following steps:

- Configuring the Heartbeat Parameters for UPF
- Configuring the Heartbeat Parameters for UPF Profile
- Associating UPF Group to Individual UPF Network Configuration

Configuring the Heartbeat at the Interface Level

To configure the heartbeat at the interface-level, use the following sample configuration:

```

config
  instance instance-id gr_instance_id
    endpoint pfcp
      interface { n4 | sxa }
        heartbeat
          interval interval
          max-retransmissions max_retry_count
          retransmission-timeout retry_interval
        end
      end
    end
  
```

NOTES:

- **endpoint pfcp**: Enters the endpoint configuration mode.
- **interface**: Configures the N4 or Sxa interface over which the heartbeat messages are exchanged between SMF and UPF.
- **heartbeat**: Enters the heartbeat configuration.
- **interval** *interval*: Specify the heartbeat interval in seconds. The accepted range is 60–360. The default value is 60 seconds.
Setting the *interval* to "0" disables the heartbeat feature.
- **max-retransmissions** *max_retry_count*: Specify the maximum retries for the Packet Forwarding Control Protocol (PFCP) heartbeat request. The accepted range is 0–10. The default value is 3.
- **retransmission-timeout** *retry_interval*: Specify the heartbeat retransmission timeout in seconds. The accepted range is 1–20. The default value is 5.

Verifying the Heartbeat Configuration for UPF

This section describes how to verify the heartbeat configuration for UPF.

To view the configuration, use the **show running-config instance instance-id gr_instance_id endpoint pfcp** command.

The following is a sample output of the **show running-config instance instance-id gr_instance_id endpoint pfcp** command.

```

show running-config instance instance-id 1 endpoint pfc
instance instance-id 1
  endpoint pfc
  interface n4
    heartbeat
      interval          61
      retransmission-timeout 3
      max-retransmissions 5
    exit
  exit
exit
interface sxa
  heartbeat
    interval          300
    retransmission-timeout 15
    max-retransmissions 0
  exit
exit
exit

```

Configuring the Heartbeat at the UPF Profile Level

To configure the heartbeat at the UPF profile level, use the following sample configuration:

```

config
  profile upf-group group_name
    heartbeat
      interval interval
      retransmission-timeout max_retry
      max-retransmissions retry_count
    end

```

NOTES:

- **profile upf-group** *group_name*: Specify the UPF group for which the heartbeat feature must be enabled.
- **interface**: Configure the N4 interface over which the heartbeat messages are exchanged between SMF and UPF.
- **heartbeat** : Enter the heartbeat configuration.
- **interval** *interval*: Specify the heartbeat interval in seconds. The accepted range is 60–360. The default value is 60 seconds.
Setting the *interval* to "0", disables the heartbeat feature.
- **max-retransmissions** *max_retry*: Specify the maximum retries for the Packet Forwarding Control Protocol (PFCP) heartbeat request. The accepted range is 0–10. The default value is 3.
- **retransmission-timeout** *retry_count*: Specify the heartbeat retransmission timeout in seconds. The accepted range is 1–20. The default value is 5.

Verifying the Heartbeat Configuration for UPF Group

This section describes how to verify the heartbeat configuration for the UPF group.

To view the configuration, use the **show running-config profile upf-group** command.

The following is a sample output of the **show running-config profile upf-group** command.

```

show running-config profile upf-group
profile upf-group upfGroup1
heartbeat
  interval          62
  retransmission-timeout 3
  max-retransmissions 2
exit
exit

```

Associating UPF Group to Individual UPF Network Configuration

This section describes how to associate a UPF group with a UPF configuration.

Each UPF network configuration includes the UPF profile that associates each UPF instance with a UPF profile.

To associate an UPF group profile with a network configuration, use the following sample configuration:

```

config
  profile network-element upf upf_profile_name
    upf-group-profile upf_group
  end

```

NOTES:

- **profile network-element upf** *upf_profile_name*: Configure the UPF network configuration.
- **upf-group-profile** *upf_group*: Configures the UPF group name that must be associated to the specified UPF network configuration.

Verifying the Association of the UPF Group with the Individual UPF

This section describes how to verify the association of the UPF group with the individual UPF.

To view the association, use the **show running-config profile network-element upf** command.

The following is a sample output of the **show running-config profile network-element upf** command.

```

profile network-element upf upf1
n4-peer-address ipv4 209.165.200.238
n4-peer-port      8805
upf-group-profile upfGroup1
dnn-list          [ intershat intershat1 intershat2 ]
capacity          65535
priority          65535

```

OAM Support

This section describes the operations, administration, and maintenance information for this feature.

Bulk Statistics

The SMF maintains the following bulk statistics triggered during the heartbeat request and response procedure.

- **nodemgr_upf_heartbeat_fail_stats**— Counter that gets updated per UPF when it fails to respond to a heartbeat request.

- `nodemgr_upf_hb_msg_stats`— Counter for all the heartbeat messages for the specified UPF.

The `nodemgr_upf_heartbeat_fail_stats` counter supports the following labels:

- `upf_heartbeat_req_tx`— Label for the heartbeat request that the SMF sends.
- `upf_heartbeat_req_retx`— Label for the retransmitted heartbeat request.
- `upf_heartbeat_rsp_rx`— Label for the heartbeat response that the SMF receives.