Heartbeat Support for N4/Sx Interface

Feature Summary and Revision History

Summary Data

Table 1: Summary Data

Applicable Product (s) or Functional Area	5G-UPF
Applicable Platforms	VPC-SI
Feature Default Setting	Disabled – Configuration Required
Related Changes in this Release	Not Applicable
Related Documentation	*UCC 5G UPF Configuration and Administration Guide*

Revision History

Revision Details	Release
First introduced.	2021.01.0

Feature Description

In accordance with 3GPP TS 29.244, support has been added for node-level Heartbeat procedures between the Session Management Function (SMF) and User Plane Function (UPF) over N4/Sx interface.

The Heartbeat procedure contains the following two messages:

1. Heartbeat Request

2. Heartbeat Response

Heartbeat Request

The SMF or the UPF sends a Heartbeat Request on a path to the peer node to find out if it is alive. The Heartbeat Request messages are sent for each peer with which a Packet Forwarding Control Protocol (PFCP) control association is established.

For each peer with which a PFCP control association is established, an SMF or UPF is prepared to receive a Heartbeat Request at any time, and replies with a Heartbeat Response.

Heartbeat Response

This message is sent as a response to a Heartbeat Request.

How It Works

The SMF and UPF sends Heartbeat messages after configurable time duration. If the peer does not respond, the message is retried for configured number of times with the retry-interval and then the configured action is taken for the calls associated with the corresponding peer.

Recovery Time Stamp Information Element (IE), which contains the start time of the node, is supported by both Heartbeat Request and Heartbeat Response. Heartbeat Request contains its own Recovery Time Stamp value and sends it to the peer while Heartbeat Response contains the peers Recovery Time Stamp value.

Path Failure Detection

Path failure is detected in following conditions:

1. Heartbeat failure: This condition occurs when the peer does not respond to the Heartbeat that is sent and also retires.

2. Recovery Time stamp change in Heartbeat: This condition occurs when the Heartbeat Request or Heartbeat Response has a new larger value than the previously received value.

3. Recovery Time stamp change in N4/Sx Association message: This condition occurs when the N4/Sx association message is received again from the peer with a new Recovery Time Stamp.

Path Failure Handling

When the Recovery Time Stamp value received is more than the previously received value, then the peer restart is detected. If the Recovery Time Stamp value is lower than the previously received value then the value is ignored and peer restart is not detected.

When a peer restart is detected, an SNMP Trap is generated to indicate the path failure for the peer. Also, based on the path failure configuration (refer Configuring Heartbeat for N4/Sx Interface, on page 3), all the calls connected to that peer can be cleared.

Configuring Heartbeat for N4/Sx Interface

This section provides information about the CLI commands available in support of this feature.

Enabling Heartbeat for Sx Interface

Use the following commands under Sx Service Configuration mode to enable Heartbeat parameters for N4/Sx interface.

```
configure
  context context_name
    sx-service service_name
      [ default ] sx-protocol heartbeat { interval seconds |
max-retransmissions number | path-failure detection-policy {
control-recovery-timestamp-change | heartbeat-retry-failure |
heartbeat-recovery-timestamp-change } | retransmission-timeout seconds }
      no sx-protocol heartbeat { interval | path-failure detection-policy
 { control-recovery-timestamp-change | heartbeat-retry-failure |
heartbeat-recovery-timestamp-change }
      end
```

Notes:

- **default**: Sets/restores default value assigned for specified parameter.

- **no**: Disables the followed option.

- **heartbeat**: Configures N4/Sx Heartbeat parameters.

- **interval** *seconds*: Configures Heartbeat interval (in seconds) for N4/Sx Service. *seconds* must be an integer in the range of 1 to 3600.

- **max-retransmissions** *number*: Configures maximum retries for N4/Sx Heartbeat request. Must be followed by integer, ranging from 0 to 15. Default is 4.

- **retransmission-timeout** *seconds*: Configures the Heartbeat retransmission timeout for N4/Sx service, in seconds, ranging from 1 to 20. Default is 5.

- **path-failure**: Specifies the policy to be used when path failure happens through Heartbeat request timeout.

Configuring Detection Policy for Path Failure

Use the following commands under Sx Service Configuration mode to specify detection policy to be used for path failure.

```
configure
  context context_name
    sx-service service_name
      [ default | no ] sx-protocol heartbeat path-failure detection-policy
 { control-recovery-time-stamp-change | heartbeat-retry-failure |
heartbeat-recovery-
timestamp-change }
        end
```

NOTES:

  • **default**: Sets/restores default value assigned for specified parameter.

  • **no**: Disables the followed option.

  • **detection-policy**: Specifies the policy to be used. Default action is to do cleanup upon Heartbeat request timeout.

  • **control-recovery-time-stamp-change**: Path failure is detected when the recovery timestamp in control request/response message changes.

  • **heartbeat-retry-failure**: Path failure is detected when the retries of Heartbeat messages times out.

  • **heartbeat-recovery-timestamp-change**: Path failure is detected when the recovery timestamp in Heartbeat request/response message changes.

Monitoring and Troubleshooting

This section provides information about CLI commands available for monitoring and troubleshooting the feature.

Show Command(s) and/or Outputs

This section provides information regarding show commands and/or their outputs in support of this feature.

show sx-service all

The output of this show command has been enhanced to include the following fields introduced in support of this feature.

  • SX Heartbeat

    • Interval

    • Retransmission Timeout

    • Max Retransmission

  • SX path failure detection policy

- Heartbeat Timeout

- Heartbeat Req/Rsp Recovery timestamp change

- Control Msg Recovery timestamp counter change

show sx-service statistics all

The output of this show command has been enhanced to include the following fields introduced in support of this feature.

- Heartbeat Request

  - Total TX

  - Total RX

  - Initial TX

  - Initial RX

  - Retrans TX

- Heartbeat Response

  - Total TX

  - Total RX

Disconnect Reasons

The following disconnect reason has been added in support of this feature:

- sx-path-failure - When the Recovery timestamp changes or heartbeat failure is detected, based on the configuration, calls are cleared with this disconnect reason.

SNMP Traps

The following SNMP traps have been added in support of this feature:

- SxPathFailure - This trap is generated when the peer path failure is detected.

- SxPathFailureClear - This trap is generated when the path is restored for the peer.