



Network Requested Secondary PDP Context Activation

This chapter describes SGSN support for the Network Requested Secondary PDP Context Activation (NRSPCA) feature.

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Feature Description

The SGSN supports Secondary PDP context activation by the network - NRSPCA.

3GPP TS 23.060 specifies two procedures for GGSN-initiated PDP Context Activation:

- **Network Requested PDP Context Activation (NRPCA)** is supported by SGSN but only for 3G access
- **Network Requested Secondary PDP Context Activation (NRSPCA)** is now supported by both Gn/Gp and S4 type SGSNs.

P-GW supports only the NRSPCA procedure. Network requested bearer control, used by P-GW and the SGSN, makes use of the NRSPCA procedure.

Benefits

NRSPCA allows the network to initiate secondary PDP context activation if the network determines that the service requested by the user requires activation of an additional secondary PDP context.

Network requested bearer control functionality is mandatory in EPC networks, requiring use of NRSPCA. With this feature S4-SGSN now supports network requested bearer control.

Relationships to Other Features

For NRSPCA on Gn/Gp SGSN, the sctp-service configuration must include common IE flags in GTP messages.

Network requested activation must be enabled in the call-control profile.

NRSPCA must be supported on the GGSN used for the PDP session. SGSN indicates support of NRSPCA by setting the NRSN flag in the common flags IE of the Create PDP Context Request and the Update PDP Context Request/Response messages to GGSN.

For S4-SGSN, network requested activation must be enabled in the call-control profile.

How It Works

Gn/Gp SGSN

During PDP Context Activation Procedure the Bearer Control Mode (BSM) is negotiated. BCM is applicable to all PDP Contexts within the activated PDP Address/APN pair. It is either "MS_only" or "MS/NW".

For "MS/NW" both the MS and the GGSN may request the creation of additional PDP contexts for the PDP Address/APN pair. The MS uses the Secondary PDP Context Activation Procedure, whereas the GGSN uses NRSPCA. When BCM is "MS_only", the GGSN does not initiate NRSPCA.

The MS indicates support of Network Requested Bearer control through the Network Request Support UE (NRSU) parameter. Using the PCO IE during Primary PDP context Activation, NRSU is applicable to all PDP contexts within the same PDP address/APN pair. The SGSN indicates support of the Network Requested Bearer control to the GGSN through the Network Request Support Network (NRSN) parameter in common flags of the Created PDP Context Request during PDP activation.

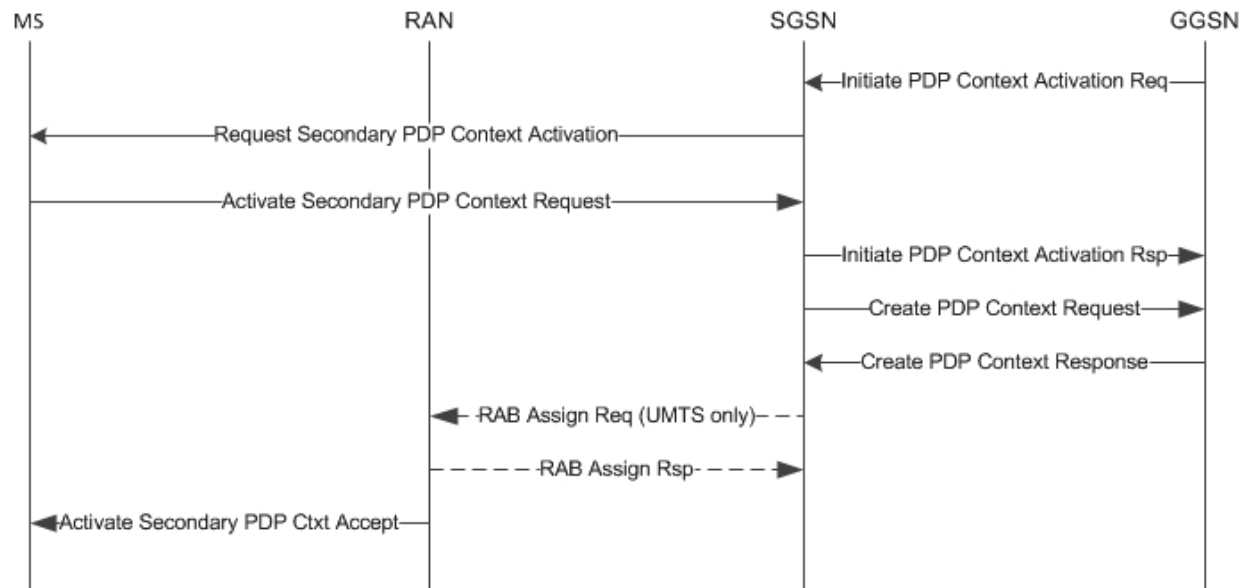
During a new SGSN RAU, the new SGSN indicates the support by means of the NRSN parameter in Update PDP Context Request. If common flags are not included in the Update PDP Context Request message, or the SGSN does not indicate support of the Network Requested Bearer control (NRSN flag is not set), the GGSN, following a SGSN-Initiated PDP Context Modification (triggered by SGSN change), performs a GGSN-Initiated PDP Context Modification to change the BCM to "MS-Only" for all PDP-Address/APN-pairs for which the current BCM is "MS/NW".

When BCM is "MS/NW", the GGSN may trigger activation of secondary PDP context based on local configuration or on PCRF/PCEF direction.

Successful Activation for Gn/Gp SGSN

The call flow below illustrates the NRSPCA procedure for a successful activation.

Figure 1: Call Flow: Successful Network Requested Secondary Activation (Gn/Gp)



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GGSN initiates secondary PDP activation by sending an Initiate PDP Context Activation Request (linked NSAPI, requested QoS, TFT, PCO, correlation-Id) to SGSN. The SGSN sends a Requested Secondary PDP Context Activation (linked Ti, Ti, QoS Requested, TFT, PCO) message to MS. The QoS Requested, TFT and PCO are transparently passed through the SGSN.

The TFT sent by the GGSN contains the uplink packet filters to be applied at the MS. The GGSN uses the Correlation-Id to correlate the subsequent Secondary PDP Context Activation procedure with the Initiate PDP Context Activation Request. The SGSN includes this correlation-Id in the subsequent Create PDP Context Request to GGSN.

The MS sends an Activate Secondary PDP Context Request (linked Ti, Ti, NSAPI, PCO, QoS Requested). Linked Ti, Ti, QoS Requested will be the same as received in a previous message from SGSN. The TFT sent by the MS will contain the downlink packet filters to be applied at GGSN.

On receiving a successful response (Activate Secondary PDP Context Request), the SGSN sends an Initiate PDP Context Activation Response with cause as Accepted to the GGSN. Additionally the SGSN sends a Create PDP Context Request (correlation-Id, linked NSAPI, NSAPI, TFT, PCO) to the GGSN. After the GGSN responds with a Create PDP Response with cause Accepted, the SGSN completes the procedure by sending an Activate Secondary PDP Context Accept to the MS.

Unsuccessful Activation for Gn/Gp SGSN

After sending a Requested Secondary PDP Context Activation to the MS, the SGSN starts the T3385 radio interface retransmission timer. Upon expiry the SGSN re-sends the message with a limit of maximum four retries. Upon the fifth expiry, the SGSN releases all allocated resources and sends an Initiate PDP Context Activation Response to the GGSN with cause as "MS is not GPRS responding".

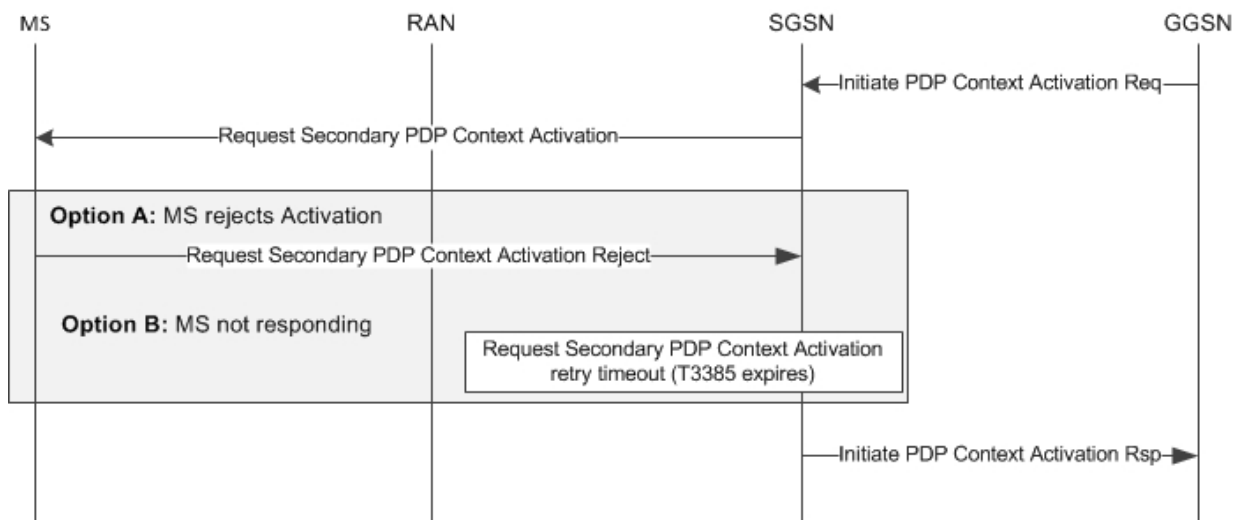
The MS may choose to reject the Secondary Activation by the network. In such cases, the MS sends a Requested Secondary PDP Context Activation Reject message with an appropriate cause. The SGSN informs the GGSN by sending an Initiate PDP Context Activation Response with an appropriate GTP cause mapped from Session Management (SM) cause. SM-to-GTP cause mapping is listed in the table below.

Table 1: SM-to-GTP Cause Mapping

| SM Cause | GTP Cause |
|---|--|
| 26, Insufficient resources | 199, No resources available |
| 31, activation rejected, unspecified | 197, MS refuses |
| 40, feature not supported | 200, Service not supported |
| 41, semantic error in TFT operation | 215, semantic error in TFT operation |
| 42, syntactical error in TFT operation | 216, syntactical error in TFT operation |
| 43, unknown PDP context | 210, Context not found |
| 44, semantic error in packet filter(s) | 217, semantic error in packet filter(s) |
| 45, syntactical error in packet filter(s) | 218, syntactical error in packet filter(s) |
| 46, PDP context without TFT already activated | 221, PDP context without TFT already activated |
| 48, activation rejected, BCM violation | 227, BCM violation |
| 95 - protocol error | 197, MS refuses |

Upon receipt of an Activate Secondary PDP Context Request or Requested Secondary PDP Context Activation Reject message, the SGSN stops the T3385 timer.

Figure 2: Call Flow: Unsuccessful Network Requested Secondary Activation (Gn/Gp)



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The SGSN will reject the IPCA for the following conditions:

- Subscriber has switched to CS call with cause "GPRS connection suspended".
- Old SGSN RAU/SRNS is ongoing with cause "MS is not GPRS responding".
- IPCA Request is received when BCM is MS only with "BCM mode violation".
- The received Correlation Id is the same as that for another ongoing NRSPCA request for the same bundle with "Invalid Correlation Id".
- Linked context is in deactivating state (collision case), with "context not found".

- Failure conditions such as "memory allocation failure" are encountered with "No resources available".
- An operator policy restriction causes IPCA Req to be rejected with the configured cause under the call-control profile.

The following table lists the GTP causes in the Initiate PDP Context Activation Response that will initiate SGSN rejects.

Table 2: SGSN GTP Reject Causes

| GTP Cause | Scenario |
|---|--|
| 225, Invalid Correlation Id | SGSN stores the Correlation Id until completion of Activation. It rejects the newer NRSPCA activation if the GGSN uses the same value for two NRSPCA activations (uniquely identified by sequence number). |
| 199, No resources available | Rejection is due to insufficient memory, the maximum number of temporary Ti allocations has been reached, or the NRSPCA procedure collides with a new SGSN RAU procedure. |
| 210, Context not found | Rejection occurs because the PDP bundle identified by a linked NSAPI does not have any active PDP context. |
| 197, GPRS connection Suspended | MS is in suspended state (CS call active). |
| 196, MS is not GPRS responding | Rejection occurs if the Request Secondary PDP Context Activation message times out (T3385 timer), no response to Paging, PPF flag is set to 0, or the NRSPCA procedure collides with an old SGSN RAU/SRNS, intra-SGSN intersystem/RAT RAU. |
| Configured GTP cause, or 200, Service not supported (default) | Rejection is based on operator policy. |
| 227, BCM violation | IPCA Request is received for a bundle with BCM set to MS only. |

S4-SGSN

Successful Activation for S4-SGSN

A P-GW initiates a Secondary PDP activation by sending a Create Bearer Request (linked Bearer Identity, Bearer Ctx(s), PCO etc) to the S-GW. The S-GW then forwards the request to the S4-SGSN.

The Bearer Contexts contain Bearer level parameters such as TFT, Bearer level QoS, S5/8-U PGW FTeid, PCO, etc. The S-GW includes the S12-U SGW FTeid or S4-U SGW FTeid depending on whether an S12 or S4 interface is used. The S4-SGSN sends the Requested Secondary PDP Context Activation (linked Ti, Ti, Qos Requested, TFT, and PCO) message to MS.

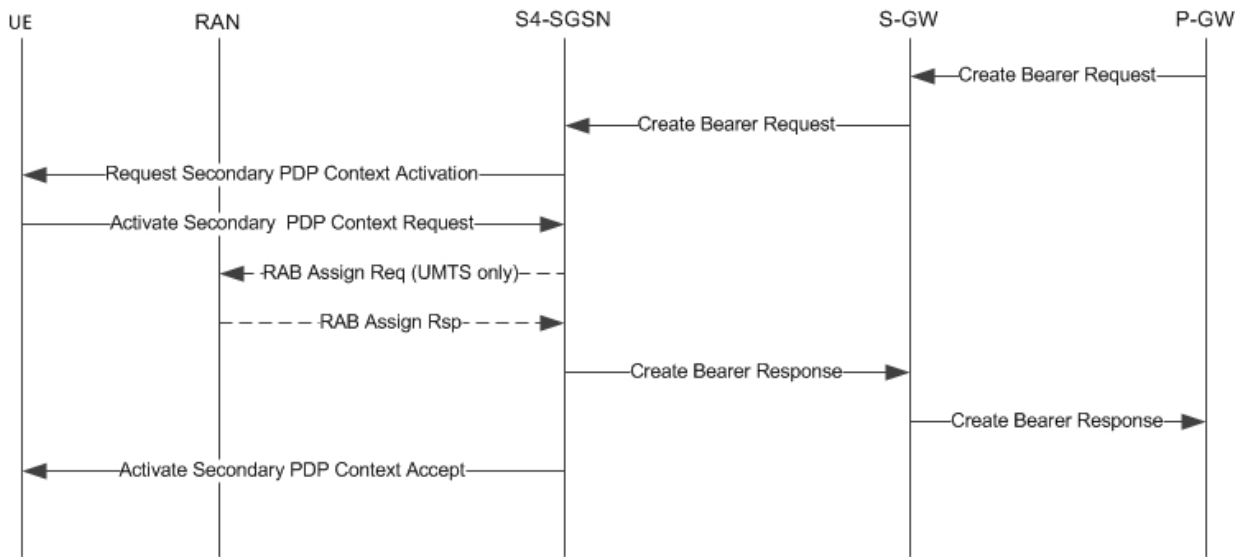
The QoS Requested, TFT and PCO are transparently passed through the S4-SGSN. The MS sends an Activate Secondary PDP Context Request (linked Ti, Ti, NSAPI, PCO, and QoS Requested). Linked Ti, Ti, Qos Requested will be as same as received in a previous message from the S4-SGSN. The TFT sent to MS may contain both the uplink and downlink packet filters.

On receiving a successful response (Activate Secondary PDP Context Request) in UMTS access, the S4-SGSN establishes RAB with the serving RNC and then sends a Create Bearer Response with Accepted cause to S-GW. For GPRS access, the RAB establishment is skipped.

The S4-SGSN includes the S4-U SGW FTeid (received in Create Bearer Request) in the Create Bearer Response to S-GW. S-GW uses this to correlate the Bearer Contexts in Response with that of Request. The S4-SGSN completes the procedure by sending an Activate Secondary PDP Context Accept to the MS.

A successful Network Requested Secondary PDP Context Activation Procedure is illustrated in the figure below.

Figure 3: Call Flow: Successful Network Requested Secondary Activation (S4-SGSN)



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Unsuccessful Activation for S4-SGSN

After sending a Requested Secondary PDP Context Activation to the MS, the S4-SGSN starts the T3385 radio interface retransmission timer. Upon expiry the S4-SGSN resends the message, a maximum of four retries. Upon the fifth expiry, the S4-SGSN releases all allocated resources and sends a Create Bearer Response to the S-GW/P-GW with cause as "UE not responding".

The MS may choose to reject a Secondary Activation by network. In such cases, the MS sends a Requested Secondary PDP Context Activation Reject message with an appropriate cause. S4-SGSN informs the SGW/PGW by sending a Create Bearer Response with an appropriate GTPv2 cause mapped from an SM cause as shown in the table below.

Table 3: SM Cause to GTPv2 Cause Mapping

| SM Cause | GTPv2 Cause |
|--------------------------------------|-------------------------------------|
| 26, Insufficient resources | 73, No resources available |
| 31, activation rejected, unspecified | 88, UE refuses |
| 40, feature not supported | 68, service not supported |
| 41, semantic error in TFT operation | 74, semantic error in TFT operation |

| SM Cause | GTPv2 Cause |
|---|--|
| 42, syntactical error in TFT operation | 75, syntactic error in TFT operation |
| 43, unknown PDP context | 64, context not found |
| 44, semantic error in packet filter(s) | 76, semantic error in packet filter(s) |
| 45, syntactical error in packet filter(s) | 77, syntactic error in packet filter(s) |
| 46, PDP context without TFT already activated | 85, UE context without TFT already activated |
| 48, activation rejected, BCM violation | 88, UE refuses |
| 95 - protocol error | 88, UE refuses |

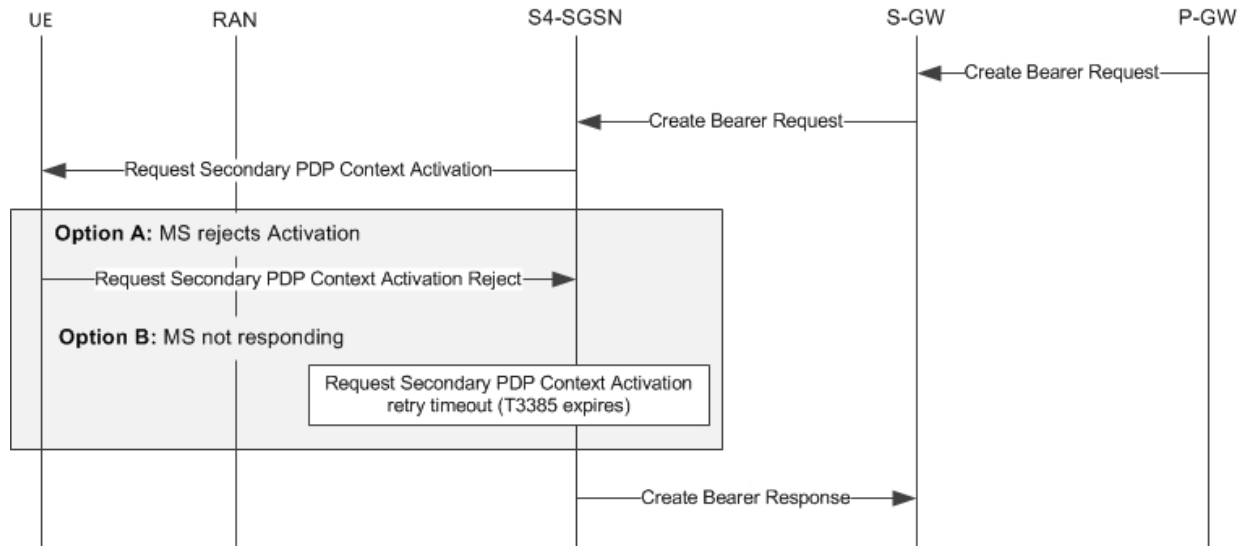
Upon receipt of an Activate Secondary PDP Context Request or Requested Secondary PDP Context Activation Reject message, the S4-SGSN stops the T3385 timer.

The S4-SGSN will reject a Create Bearer Request for the following conditions:

- Subscriber has switched to CS call with cause "Unable to page UE due to suspension".
- A collision occurs with an old SGSN RAU/SRNS with cause "Temporarily rejected due to handover procedure in progress".
- Linked context is in deactivating state (collision case) with "context not found".
- A failure conditions such as 'memory allocation failure' is encountered with "No resources available".
- Operator policy restriction rejects the CBR Req with the configured cause under the call-control profile.
- PPF flag is cleared with cause "Unable to Page UE".
- Paging failure or Request Secondary PDP activation request times out with cause "UE not responding".

An unsuccessful NRSPCA procedure is illustrated in the figure below.

Figure 4: Call Flow: Unsuccessful Network Requested Secondary Activation (S4-SGSN)



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Limitations

Security function during NRSPCA procedure is not supported.

Standards Compliance

The NRSPCA feature complies with the following standards:

- 3GPP TS 23.060 version 10 General Packet Radio Service (GPRS)
- 3GPP TS 24.008 version 10 Mobile radio interface Layer 3 specification Core network protocols
- 3GPP TS 29.060 version 10 General Packet Radio Service (GPRS) GPRS Tunnelling Protocol (GTP) across the Gn and Gp interface
- 3GPP TS 29.278 version 10 Customized Applications for Mobile network Enhanced Logic (CAMEL) CAMEL Application Part (CAP) specification for IP Multimedia Subsystems (IMS)

Configuring NRSPCA

Configuration of the NRSPCA feature requires:

- Enabling the common flags IE in SGTP service
- Including the NRSPCA feature in a specific call control profile

Sample NRSPCA Configuration

The first set of commands enables the common flags IE:

```
config
  context <context-name>
    sgtp-service <sgtp-service-name>
      gtpc send common-flags
    end
```

The second set of commands includes a new keyword (**secondary**) to configure NRSPCA in a call control profile.

```
config
  call-control-profile <profile_name>
    network-initiated-pdp-activation secondary access-type <gprs|umts>
  { all failure-code <failure_code> | location-area-list instance <instance>
  failure-code <failure_code> }
  end
```

NOTES:

- **remove** added to the command disables NRSPCA by removing the network-initiated-pdp-activation definition from the configuration.
- There is no default form of the command.

Verifying the NRSPCA Configuration

show sgtp-service name <sgtp-service-name>

```

Service name                : <sgtp-service-name>
Service-Id                  : 3
Context                      : source
Status                       : STARTED

Sending RAB Context IE      : Enabled
Sending Common Flags IE     : Enabled
Sending Target Identification Preamble : Disabled

```

show call-control-profile full name <cc-profile-name>

```

Call Control Profile Name = <cc-profile-name>
Accounting Mode (SGW)                : None
Accounting stop-trigger (SGW)        : Not configured

UMTS Secondary PDP Context Activation All      : Allow
UMTS PDP Context Activation All Failure Code   : 8
GPRS Nw Init Primary PDP Context Activation All : Allow
GPRS Nw Init Primary PDP Ctxt Activation All Failure Code : 200
GPRS Nw Init Secondary PDP Context Activation All      : Allow
GPRS Nw Init Secondary PDP Ctxt Activation All Failure Code : 200
UMTS Nw Init Primary PDP Context Activation All      : Allow
UMTS Nw Init Primary PDP Ctxt Activation All Failure Code : 200
UMTS Nw Init Secondary PDP Context Activation All      : Allow
UMTS Nw Init Secondary PDP Ctxt Activation All Failure Code : 200
SRNS Intra All                                     : Allow

```

Monitoring and Troubleshooting the NRSPCA Feature

- The **show subscriber sgsn-only/gprs-only full** command indicates whether or not the Secondary PDP context was network initiated. The last received BCM from the GGSN (applicable for Gn/Gp only) is also be displayed.
- Two new disconnect reasons have been introduced:
 - sgsn-nrspca-actv-rej-by-ms MS sends a Request Secondary PDP Context Activation Reject message
 - sgsn-nrspca-actv-rej-by-sgsn For all other cases where NRSPCA context activation does not complete successfully
- Additional counters have been added to session management statistics in the output of the **show gmm-sm statistics** command to represent the session management messages used by NRSPCA. Similarly, counters have been added to the tunnel management statistics in the output of the **show sgtpc statistics** command. These counters are described in the next section.
- For NRSPCA activation failures, the Abort statistics in the verbose mode of the **show gmm-sm statistics** or **show gmm-sm statistics sm-only** command outputs provide reasons for the failure. The various counters are described in next section.
- Network initiated flag in SCDRs will be set for NRSPCA PDP contexts. Note that network initiated flag is present in only a few dictionaries, such custom24, custom13, and custom6.

NRSPCA show Commands

The following **show** commands are available in support of the NRSPCA feature:

- **show gmm-sm statistics sm-only** displays the Session Management messages exchanged for NRSPCA activation.
- **show sgtpc statistics** displays the GTPC messages exchanged for NRSPCA activation.
- **show subscribers sgsn-only/gprs-only full** indicates whether or not the Secondary PDP context was network initiated. Displays the last received BCM from the GGSN (applicable for Gn/Gp only).

show gmm-sm statistics sm-only

The following counters are included in the **show gmm-sm statistics sm-only** command output to support the NRSPCA feature. For detailed descriptions of these statistics, refer to the *Statistics and Counters Reference*.

Table 4: NRSPCA SM Statistics

| NRSPCA SM Statistics | |
|--|-------------------------------|
| Activate Context Request | |
| Actv-Request-Nrspca | |
| 3G-Actv-Request-Nrspca | 2G-Actv-Request-Nrspca |
| Activate Context Request Retransmitted | |
| 3G-Secondary-Actv-Drop-Nrspca | 2G-Secondary-Actv-Drop-Nrspca |
| Activate Context Accept | |
| Actv-Accept-Nrspca | |
| 3G-Actv-Accept-Nrspca | 2G-Actv-Accept-Nrspca |
| Activate Context Reject | |
| Actv-Reject-Nrspca | |
| 3G-Actv-Reject-Nrspca | 2G-Actv-Reject-Nrspca |
| Network Initiated Secondary Activation Aborted (verbose only) | |

| NRSPCA SM Statistics | |
|---|------------------------------------|
| 3G-NRSPCA-Abort-GTP-Suspend | 2G-NRSPCA-Abort-GTP-Suspend |
| 3G-NRSPCA-Abort-Handoff | 2G-NRSPCA-Abort-Handoff |
| 3G-NRSPCA-Abort-Max-Retry-Attempts | 2G-NRSPCA-Abort-T3385-Expiry |
| 3G-NRSPCA-Abort-Paging-Expiry | 2G-NRSPCA-Abort-Paging-Expiry |
| 3G-NRSPCA-Abort-Linked-Ctx-Deactv | 2G-NRSPCA-Abort-Linked-Ctx-Deactv |
| 3G-NRSPCA-Abort-Linked-Ctx-Detach | 2G-NRSPCA-Abort-Linked-Ctx-Detach |
| 3G-NRSPCA-Abort-Inter-RAT-Handoff | 2G-NRSPCA-Abort-Inter-RAT-Handoff |
| 3G-NRSPCA-Abort-Iu-release | 2G-NRSPCA-Abort-Intra-RAU |
| 3G-NRSPCA-Abort-SRNS-Handoff | 2G-NRSPCA-Abort-Ready-Tmr-Expiry |
| 3G-NRSPCA-Abort-Intra-RAU | 2G-NRSPCA-Abort-Radio-Status |
| 3G-NRSPCA-Abort-Intra-SRNS | 2G-NRSPCA-Abort-BVC-Block-Or-Reset |
| 3G-NRSPCA-Abort-RAB-Failure | |
| 3G-NRSPCA-Abort-Ctx-Deactv | |
| Request Secondary Pdp Context Activation | |
| Total-Request-Sec-Pdp-Ctxt-Req | |
| 3G-Request-Sec-Pdp-Ctxt-Req | 2G-Request-Sec-Pdp-Ctxt-Req |
| Retransmission | |
| Total-Request-Sec-Pdp-Ctxt-Req | |
| 3G-Request-Sec-Pdp-Ctxt-Req | 2G-Request-Sec-Pdp-Ctxt-Req |
| Request Secondary Pdp Context Activation Reject | |
| Total-Request-Sec-Pdp-Ctxt-Reject | |
| 3G-Request-Sec-Pdp-Ctxt-Reject | 2G-Request-Sec-Pdp-Ctxt-Reject |
| Request Secondary Pdp Context Activation Denied (verbose only) | |

| NRSPCA SM Statistics | |
|--|-------------------------------------|
| 3G-Insufficient Resources | 2G-Insufficient Resources |
| 3G-Actv Rej Unspecified | 2G-Actv Rej Unspecified |
| 3G-Feature Not Supported | 2G-Feature Not Supported |
| 3G-Sem Err in TFT OP | 2G-Sem Err in TFT OP |
| 3G-Syntactic Err in TFT OP | 2G-Syntactic Err in TFT OP |
| 3G-Unknown Ctx | 2G-Unknown Ctx |
| 3G-Sem Err in Pkt Filter | 2G-Sem Err in Pkt Filter |
| 3G-Syntactic Err in Pkt Filter | 2G-Syntactic Err in Pkt Filter |
| 3G-Ctx No-Tft Already Activated | 2G-Ctx No-Tft Already Activated |
| 3G-Actv Rej BCM violation | 2G-Actv Rej BCM violation |
| 3G-Proto Err Unspecified | 2G-Proto Err Unspecified |
| Request Secondary Pdp Context Activation Rejects Dropped | |
| 3G-Request-Sec-Pdp-Ctxt-Rej-Dropped | 2G-Request-Sec-Pdp-Ctxt-Rej-Dropped |
| Request Secondary Pdp Context Activation Aborted | |
| 3G-NRSPCA-Abort-Subs-Detach | 2G-NRSPCA-Abort-Subs-Detach |
| 3G-NRSPCA-Abort-Linked-Ctx-Deactiv | 2G-NRSPCA-Abort-Linked-Ctx-Deactiv |
| 3G-NRSPCA-Abort-Max-Retry-Attempts | 2G-NRSPCA-Abort-Max-Retry-Attempts |
| 3G-NRSPCA-Abort-Paging-Expiry | 2G-NRSPCA-Abort-Paging-Expiry |
| 3G-NRSPCA-Abort-Subs-Suspend | 2G-NRSPCA-Abort-Subs-Suspend |
| 3G-NRSPCA-Abort-Handoff | 2G-NRSPCA-Abort-Handoff |
| 3G-NRSPCA-Abort-Inter-RAT-Handoff | 2G-NRSPCA-Abort-Inter-RAT-Handoff |
| 3G-NRSPCA-Abort-Intra-RAU | 2G-NRSPCA-Abort-Intra-RAU |
| 3G-NRSPCA-Abort-Iu-release | 2G-NRSPCA-Abort-Ready-Tmr-Expiry |
| 3G-NRSPCA-Abort-SRNS-Handoff | 2G-NRSPCA-Abort-Radio-Status |
| 3G-NRSPCA-Abort-Intra-SRNS | 2G-NRSPCA-Abort-BVC-Block-Or-Reset |
| 3G-NRSPCA-Abort-RAB-Failure | |
| 3G-NRSPCA-Abort-Ctx-Deactiv | |
| Secondary Pdp Context Activation Request Ignored (verbose only) | |
| Total-Actv-Request-Nrspca-Ignored | |
| 3G-Actv-Request-Nrspca-Ignored | 2G-Actv-Request-Nrspca-Ignored |

show sgtpc statistics

The following counters are included in the **show sgtpc statistics** command output to support the NRSPCA feature. For detailed descriptions of these statistics, refer to the *Statistics and Counters Reference*.

Table 5: NRSPCA SGTPC Statistics

| NRSPCA SGTC Statistics | |
|---|--------------------------------|
| Initiate PDP Context Activation Request | |
| Total IPCA Req | |
| Initial IPCA Req | Retrans IPCA Req |
| Initiate PDP Context Activation Response: | |
| Total Accepted | |
| Initial IPCA Rsp | Retrans IPCA Rsp |
| Total Denied | |
| Initial IPCA Rsp | Retrans IPCA Rsp |
| Initiate PDP Context Activation Response Not Sent (verbose only) | |
| Linked PDP deact coll | Retrans IPCA Req bef MS rsp |
| Initiate PDP Context Activation Request Denied (verbose only) | |
| IPCA Req Denied | |
| No Resources Available | Service Not Supported |
| System Failure | Mandatory IE Incorrect |
| Mandatory IE Mis | Optional IE Incorrect |
| Invalid Message Format | Context not Found |
| Semantic Error in TFT | Syntactic Error in TFT |
| Semantic Error in Pkt Fltr | Syntactic Error in Pkt Fltr |
| MS Not GPRS Responding | MS Refuses |
| Invalid Correlation Id | PDP without TFT already Active |
| BCM Violation | MS GPRS Suspended |
| Unknown cause | |

show sgtpc statistics