



# MTC Congestion Control

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The SGSN's MTC (mobile type communications) Congestion Control feature implements General NAS-level congestion control and APN-based congestion control for both Session Management (SM) and Mobility Management (MM) in the SGSN. As well, the functionality associated with this feature also provides support for configuring and sending an Extended T3312 timer value to the MS.

This is an optional licensed feature. Speak with your Cisco Customer Representative for information about obtaining an MTC Feature license.

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## Feature Description

Congestion is detected based on various threshold-configurable parameters, such as (but not limited to) system CPU utilization, system memory utilization, service CPU utilization. This feature enables the operator to determine the SGSN's response to various congestion scenarios.

The MTC Congestion Control functionality gives the operator control over the congestion threshold settings and the actions taken in response to congestion. The operator defines a set of congestion actions in a congestion-action-profile. The selected actions are executed when congestion is detected.

Congestion control can be enabled as:

- General congestion control - applicable only for Mobility Management messages.
- APN-based congestion control for Mobility Management
- APN- based congestion control for Session Management

There are three levels of system-detected congestion: critical, major, and minor. The percentage at which these levels are hit is controlled via threshold configuration.

The operator defines the SGSN's congestion response actions for new calls, active calls, and SM-messages in congestion-action-profiles and association those congestion-action-profiles with the various congestion level.

In addition to system-detected congestion, the SGSN also provides a management option to trigger congestion. This option can be useful when testing system readiness and response.

## Relationships

**Other SGSN Features:** Low Access Priority Indicator (LAPI) in S-CDRs. The SGSN allows for the use of the LAPI bit in S-CDRs of the custom24 dictionary. Use of this functionality is CLI controlled. For details about this functionality, refer to the *GTPP Interface Administration and Reference for StarOS Release 17*.

**Other Products:** While specific operations may vary, MTC Congestion Control functionality is also supported by the MME. For details, refer to the *MME Administration Guide for StarOS Release 17*.

## How It Works

### SGSN Congestion Control

The deciding parameter for triggering congestion control in the SGSN will be the overall system CPU utilization, service CPU utilization, and system memory utilization. This information will be periodically monitored by the resource manager (ResMgr) which will inform the SGSN's IMSIMgr.

**Mobility Management (MM) Congestion Control** - For congestion control of MM messages, system-detected congestion is based on

- system CPU utilization,
- service CPU utilization
- system memory utilization

**Session Management (SM) Congestion Control** - For congestion control of session management messages, system-detected congestion is based only on system CPU utilization.

The MTC Congestion Control functionality enables the operator to configure different congestion-action-profiles, which applies at different threshold levels.

### APN-level Congestion Control for MM

APN-level congestion control for mobility management (MM) is applied to those UEs that have subscribed for APNs configured for congestion control.

During system-level congestion, if the chosen congestion-action-profile has the "apn-based" parameter configured as enabled, then APN-based congestion control is applied.

Once the SGSN receives the subscription for a subscriber, if any of the subscribed APNs are configured for congestion control, then the call is rejected with a backoff timer value sent to the UE in the Reject message according to the following scenario:

- A random MM backoff timer (T3346) value, derived from the selected min-max range configured for that APN, is sent to the UE in Reject messages.
  1. The minimum and maximum range for the MM backoff timer value is selected from the APN Profile configuration.
  2. If the timer is not configured at the APN Profile level, then the SGSN takes the MM backoff timer as configured at either the GPRS or SGSN service level.
  3. If timer is not configured at the service level, then the default values (min-15 max-4320) are applied.

- If the subscriber retries Attach when the backoff timer is running, then the SGSN rejects the Attach, sending the remaining time for backoff in the Reject message.
- If the subscriber retries Attach with a change in signaling priority when the backoff timer is running, then the SGSN accepts the Attach, based on configuration for example,
  1. if Reject is associated with LAPI and APN-based parameters,
  2. then subscriber sends a message without LAPI
  3. then the Attach is accepted.
- If the subscriber retries Attach while backoff timer is running and the SGSN is not under congestion, then the backoff timer is cleared and the call Accepted.
- If the subscriber retries Attach after backoff timer expires, and if the SGSN continues under congestion, then a new backoff timer value is assigned and sent in the Attach Reject message.

## APN-level Congestion Control for SM

APN-level congestion control for session management (SM) is applicable to both activation and modification types of SM messages. Detection of SM APN-based congestion is determined according to system utilization or O&M (triggered) congestion at any one of three levels: critical, major, minor with the following possible ropiness:

If congested:

- If the configured response action indicates the low access priority indicator (LAPI), then only SM messages with LAPI are rejected during congestion. If LAPI is not configured then all SM messages are rejected.
- A random SM backoff timer (T3396) value, derived from the selected min-max range configured for that APN, is sent to the UE in Reject messages.
  1. The minimum and maximum range for the SM backoff timer value is selected from the APN Profile configuration.
  2. If the timer is not configured at the APN Profile level, then the SGSN takes the SM backoff timer as configured at either the GPRS or SGSN service level.
  3. If timer is not configured at the service level, then the default values (min-15 max-4320) are applied.
- If the UE attempts to retry before expiry of the SM backoff timer and if the SGSN is still congested, then a new random value is included in the rejection message.
- A UE that is attached as a LAPI device may override its priority for PDN activation / secondary PDP activation (if the UE is a dual access priority device). SGSN will only consider the value of LAPI received in PDP Activation message for applying congestion control on activation procedure.
- If a LAPI UE has activated a PDN without LAPI (i.e., the UE is dual access priority capable) but is sending PDP Modification Request with LAPI bit, then the SGSN will apply congestion control for the modification procedure if LAPI-based APN congestion control for SM messages is configured.
- Dual access priority devices can send PDN Activation with LAPI but subsequent SM procedures without LAPI. In this scenario, SGSN does not apply congestion based on LAPI.
- For LAPI devices, the SGSN sends LAPI indication to the AAA module for inclusion in S-CDRs if the appropriate GTPP dictionary is configured.

## Support for the Extended T3312 Timer

The SGSN supports sending the Extended T3312 timer value for Attach Accept and/or RAU Accept messages if the MS indicates support for extended periodic timer in the MS Network Feature Support.



### Important

The SGSN will not send an Extended T3312 value if offloading is enabled for that subscriber.

For both Gn-SGSN and S4-SGSN, a longer periodic RAU timer can be assigned to the M2M UEs based on subscription. The Subscribed-Period-RAU-TAU-Timer AVP is supported for the "Subscribed Period TAU/RAU Timer" via the SGSN's S6d interface. The Subscribed Period TAU/RAU Timer value can be included in the ISD (Insert Subscriber Data) from the HLR or in the ULA (Update Location Answer) from the HSS.

The maximum value for a standard T3312 timer value is 186 minutes and the new Extended T3312 timer maximum value is 18600 minutes. Using the longer value for routing area updates reduces network load from periodic RAU signaling.



### Important

Now, despite enabling the Extended T3312 timer in the SGSN's configuration, the SGSN may be prevented from sending the Extended T3312 timer value in messages as the SGSN also supports the "Subscribed Periodic TAU/RAU Timer Withdrawn" flag.

The SGSN also supports the Subscribed Periodic TAU-RAU Timer Withdrawn Flag in MAP DSD messages. When the flag is set in MAP DSD messages, it indicates to the SGSN that the subscriber no longer has a subscription for the "subscribed periodic RAU/TAU timer" (Extended T3312 timer) value, so

- the SGSN will delete any subscribed periodic RAU/TAU timer value information when it is received from the HLR, and
- the SGSN will no longer send Extended T3312 in Attach/RAU Accept messages for that subscriber even if the sending of the Extended T3312 is configured.

## Limitations

The following resources for congestion detection are not yet supported:

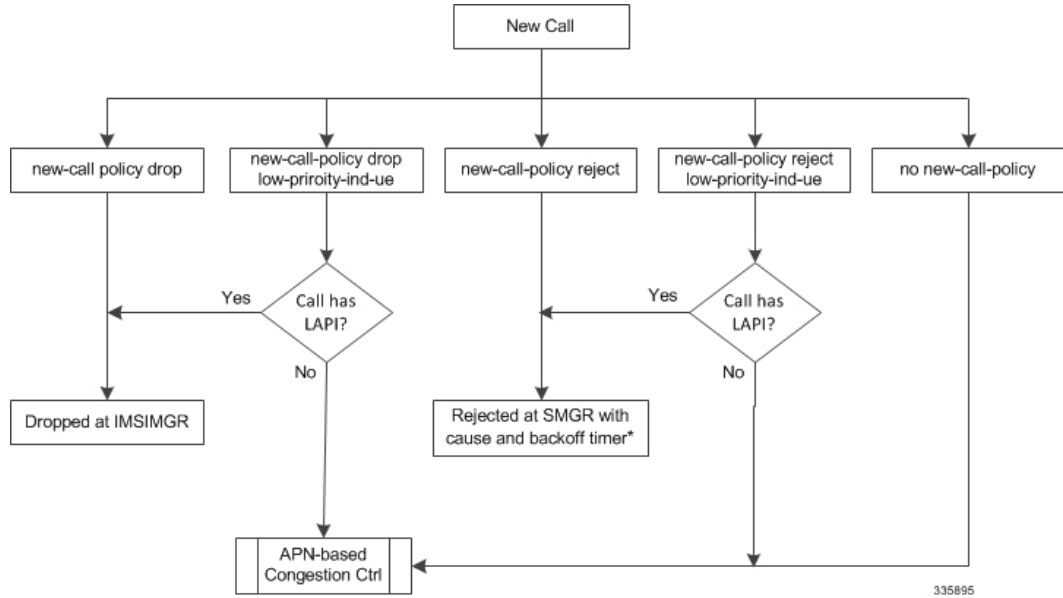
- License utilization
- Max session count

## Flows for SGSN Congestion Control

### New Call Policy for Congestion

The following flowchart explains how new calls are handled, during congestion, based on configuration.

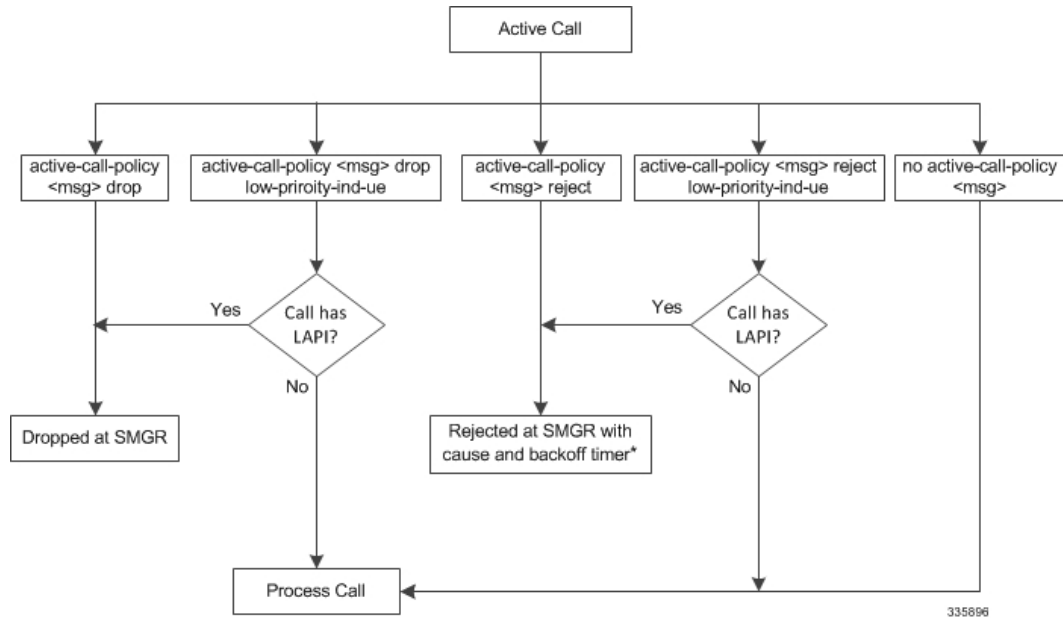
Figure 1: New Call Handling during Congestion



**Active Call Policy for Congestion**

The following flowchart explains how active calls are handled, during congestion, based on configuration.

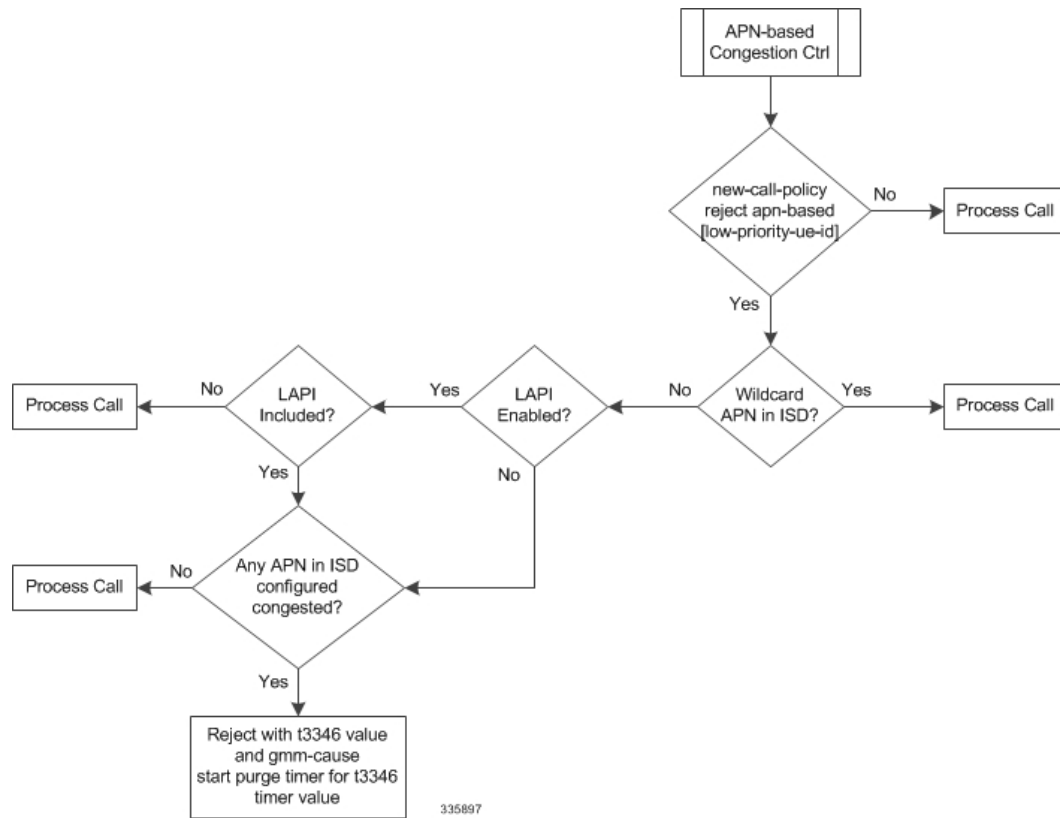
Figure 2: Active Call Handling during Congestion



**Flows for APN-level Congestion Control for MM**

The following flow chart illustrates the APN-level congestion control for mobility management.

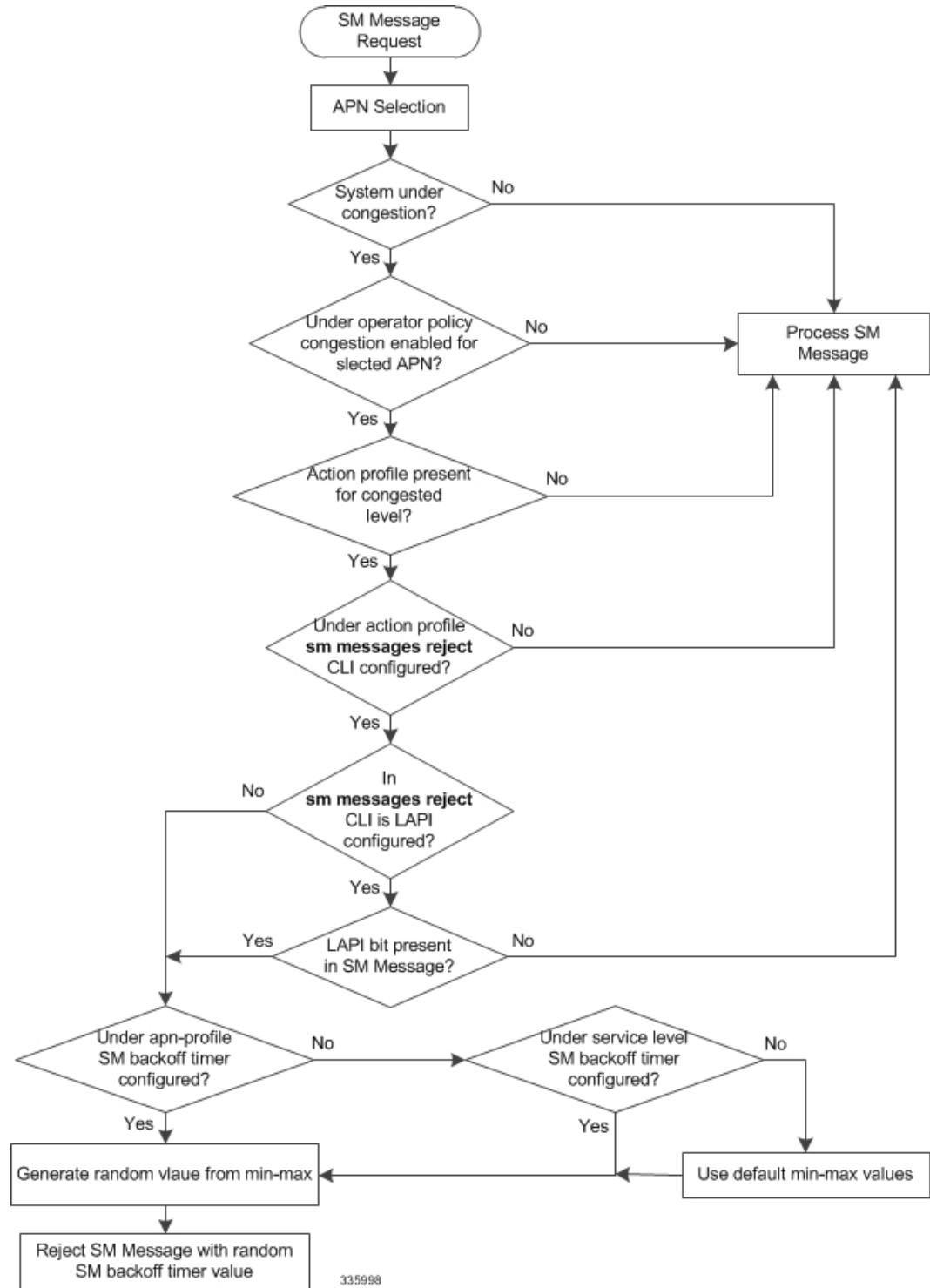
Figure 3: APN-level Congestion Control for MM



## Flows for APN-level Congestion Control for SM

The following flow chart illustrates the APN-level congestion control for session management.

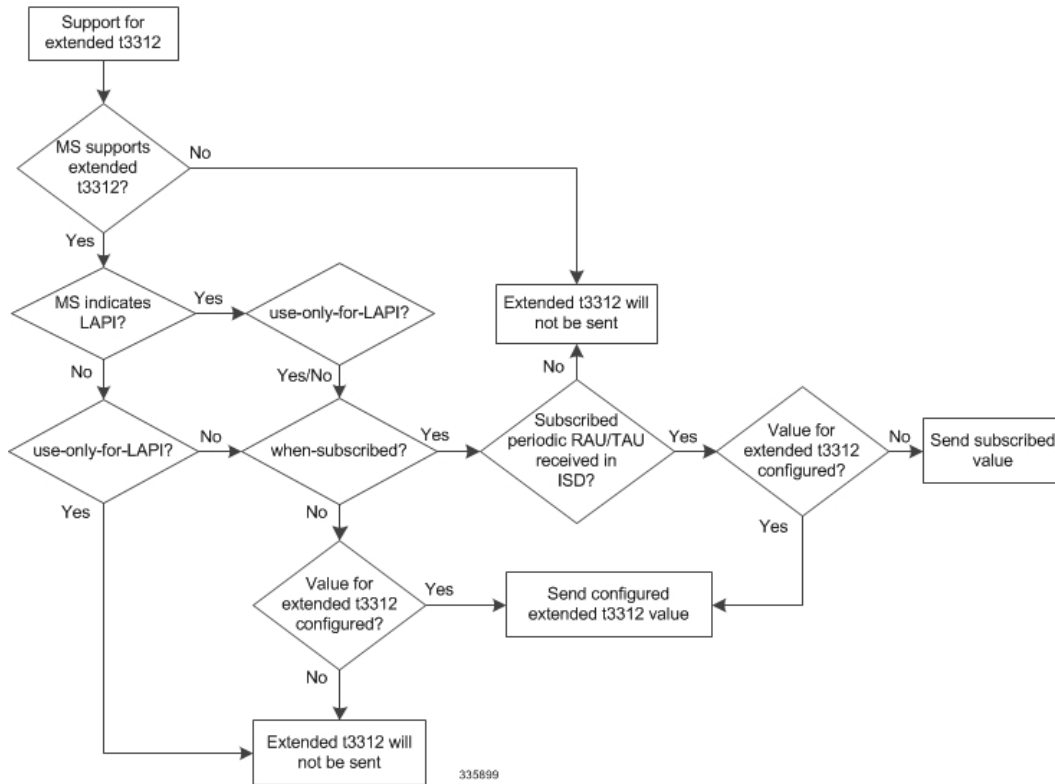
Figure 4: APN-level Congestion Control for SM



## Handling Value for Extended T3312 Timer

The following flow chart explains how and when t3312 extended value is sent in Attach and RAU Accepts

Figure 5: Handling Value for Extended T3312 Timer



## Standards Compliance

The MTC Congestion Control feature only implements some of the MTC overload control mechanisms defined by the 3GPP but for those it implements, they are in compliance with the 3GPP TS23.060 R10 specification.

## Configuring MTC Congestion Control

This section illustrates the required and optional configuration steps for setting up MTC Congestion Control on the SGSN.

The following is broken into the following configuration components:

- Enabling Global-level Congestion Control
- Configuring System-detected Congestion Thresholds
- Configuring SGSN Congestion Control
- Configuring APN-based Congestion Control
- Configuring Extended T3312 Timer
- Configuring Backoff Timers



- Configuring O&M Triggered Congestion


**Important**

Details for each of the commands listed in the following sections are available in the *Command Line Interface Reference*.

## Enabling Global-level Congestion Control

The following configuration is *mandatory* to enable congestion control on the SGSN.

The following configuration accomplishes several tasks, all of which must be performed to enable congestion control on the SGSN.

1. Enables or disables global-level congestion control for the SGSN and the IMSIMgr.
2. Associates the SGSN's congestion-response action-profile with each of the three possible levels of congestion - critical, major, and minor.

**configure**

```

congestion-control
  congestion-control policy { critical | major | minor } sgsn-service
action-profile action_profile_name
end

```

Notes:

- **sgsn-service**: Identifies the StarOS service type in this case, the SGSN (Gn-SGSN and/or S4-SGSN).
- *action\_profile\_name*: Enter a string of 1 to 64 alphanumeric characters to identify the congestion-action-profile to associate with the congestion-control policy. *We recommend* that you remember the name(s) that you assign so that you will have them when you actually create and configure your congestion-action-profiles.
- Repeat the **congestion-control policy** command as needed to associate one or more congestion-action-profile(s) with each congestion level.

## Verifying the Global-level Congestion Control Configuration

Use the command illustrated below to verify that congestion control has been enabled and to view the SGSN's congestion-control policy with the congestion-action-profile names association with the level of congestion severity.

The following command is entered from the Exec mode:

```
[local]SGSN1-NH show congestion-control configuration
```

The following provides a sample of the display generated by the command illustrated above:

```

[local]R16sgsn-Sim show congestion-control configuration
Congestion-control: enabled

Congestion-control Critical threshold parameters
  system cpu utilization:          80
  ...
  ...
Congestion-control Policy
  ...
  sgsn-service:
    Minor   Action-profile : ActProf6

```

## Configuring System-detected Congestion Thresholds

The following configuration accomplishes several tasks, all of which are *optional*:

1. Associates utilization threshold(s) with a congestion severity level - critical, major, minor.
2. Enables detection based on System CPU Usage.
3. Enables detection based on System Memory Utilization.
4. Enables detection based on Service Control CPU Utilization

```
configure
  congestion-control threshold system-cpu-utilization { critical | major
  | minor } threshold_value
  congestion-control threshold system-memory-utilization { critical |
major | minor } threshold_value
  congestion-control threshold service-control-cpu-utilization { critical
  | major | minor } threshold_value
end
```

Notes:

- *threshold\_value*: Enter an integer from 1 to 100 to define a percentage threshold value.
- For congestion control of mobility management messages, any of the above parameters can be configured.
- For congestion control of session management messages, only "system-cpu-utilization" is supported.
- At present, only APN-based congestion control is applicable for session management messages.

## Verifying System-detected Congestion Thresholds Configuration

Use the command illustrated below to verify thresholds you may have configured with the commands illustrated above. The display will include a section for Critical threshold parameters, Major threshold parameters, and Minor threshold parameters. The following display only illustrates samples for Critical threshold parameters.

The following command is entered from the Exec mode:

```
[local]SGSN1-NH show congestion-control configuration
```

The following provides a sample of the display generated by the command illustrated above:

```
[local]R16sgsn-Sim show congestion-control configuration
Congestion-control: enabled
Congestion-control Critical threshold parameters
  system cpu utilization:      80
  service control cpu utilization: 80
  system memory utilization: 80
  message queue utilization: 80
  message queue wait time: 5 seconds
  port rx utilization: 80
  port tx utilization: 80
  license utilization: 100
  max-session-per-service utilization: 80
  tolerance limit: 10
```

Notes:

- At this time, you are only setting the values for the first three displayed parameters.

## Configuring SGSN Congestion Control

The following configuration is *mandatory* to enable congestion control on the SGSN.



### Important

Remember, congestion control must *also* be enabled with the **congestion-control** command in the Global Configuration mode. The following is not sufficient to enable congestion control on the SGSN.

The following configuration accomplishes several tasks, all of which must be performed to enable congestion control on the SGSN.

1. Enables or disables SGSN-level congestion control.
2. Creates and configures congestion-action-profiles.

```
configure
  sgsn-global
    congestion-control
      congestion-action-profile action_profile_name
        active-call-policy { rau | service-req } { drop |
reject } [ low-priority-ind-ue ]
        new-call-policy { drop | reject } [ low-priority-ind-ue
] [ apn-based ]
        sm-messages reject [ low-priority-ind-ue ] [ apn-based
]
      end
```

Notes:

- **congestion-control**: Opens the Congestion-Control configuration mode, in which the congestion control action-profile can be created.
- **congestion-action-profile** *action\_profile\_name*: Enter a string of 1 to 64 alphanumeric characters to create or identify a congestion-action-profile and/or to open the Congestion-Action-Profile configuration mode, which accesses the commands that define the congestion responses for:
  - active calls
  - new calls
  - SM messages
- A maximum of 16 action-profiles can be defined.
- **active-call-policy**: This command instructs the SGSN to drop or reject any active call messages when congestion occurs during an active call. The active call instructions in the congestion-action-profile can be refined to only drop or reject active call messages with LAPI.
- **new-call-policy**: This command instructs the SGSN to drop or reject any new calls (Attach Request messages or new Inter SGSN RAU messages) if new call messages are received during congestion. The new call instructions in the congestion-action-profile can be refined to only drop or reject new call messages with low access priority indicator (LAPI).
- **sm-messages**: This command instructs the SGSN to reject any SM signaling messages (activation or modification) during congestion. The congestion-action-profile parameter can be refined to only reject SM signaling messages with LAPI.




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**Important** For SM congestion to work, the **apn-based** option must be configured with the **sm-messages reject** command .

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- **rau | service-req** : Defines congestion response for Routing Area Update messages or Service Request messages.
- **drop | reject**: Defines the congestion response action, drop or reject, to be taken when RAU or Service Request messages are received during an active call.
- **low-priority-ind-ue**: Instructs the SGSN to only take defined action if messages include LAPI.
- **apn-based**: Instructs the SGSN to reject a new call based on the subscribed APN *if* congestion control is configured for that APN under an applicable Operator Policy.
- If both the LAPI and APN-based options are included in the action-profile, then the call event will only be rejected if both conditions are matched.

## Verifying the SGSN Congestion Control Configuration

Use the command illustrated below to verify the configuration created with the commands in the *Configuring SGSN Congestion Control* section above.

The following command is entered from the Exec mode. NOTE that the entire command must be typed, tabbing does not function for this command.

```
[local]SGSN1-NH show sgsn-mode
```

The following provides a sample of the display generated by the command illustrated above:

```
[local]R16sgsn-Sim show sgsn-mode
Congestion Action Profile
-----
Congestion Action Profile Name:profile1
New Call Policy                :Reject only LAPI devices
Active Call Policy             :
Routing Area Update            :Not configured
Service Request                :Reject
APN Based Congestion Control   :
MM messages                    :Not configured
SM messages                    :Reject
```

## Configuring APN-based Congestion Control

The following configuration associates congestion control functionality with a specific APN so that congestion responses can be applied per APN.

```
configure
  operator-policy name op_policy_name
    apn network-identifier apn_name congestion-control
  end
```

Notes:

- *op\_policy\_name*: Enter a string of 1 to 64 alphanumeric characters to create or identify an operator policy.
- *apn\_name*: Enter a string of 1 to 63 characters, including dots (.) and dashes (-), to identify a specific APN network ID.

- **congestion-control**: Including this keyword associates congestion control functionality with the identified APN.
- During an Attach Request, new Inter SGSN RAU, or when receiving sm-messages, all subscribed APNs for mobility management (MM) or selected APNs for session management (SM) will be checked to determine if any of them is configured for congestion control, in which case the new call or sm-messages would be rejected.

## Verifying the APN-based Congestion Control Configuration

Use the command illustrated below to verify the configuration created with the commands in the *Configuring APN-based Congestion Control* section above.

The following is entered from the Exec mode.

```
[local]SGSN1-NH show operator-policy full all
```

The following provides a sample of the display generated by the command illustrated above:

```
...
APN NI internet.com
APN Profile Name      :
Congestion-control   : Yes
...
```

## Configuring Extended T3312 Timer

The Extended T3312 timer can be configured at two different levels: Call-Control Profile or Service-level (GPRS or SGSN).

### Extended T3312 Timer Values for a 2G GPRS Network

Use the following configuration to enable Extended T3312 timer values in a 2G GPRS network environment.

```
configure
  context context_name
    gprs-service service_name
      gmm Extended-T3312-timeout { value exT3312_minutes |
when-subscribed } [ low-priority-ind-ue ]
    end
```

Notes:

- **value** : This keyword instructs the SGSN to send the defined Extended T3312 timer value in Attach or RAU Accept messages to the MS if the subscriber has a subscription for the Extended T3312 timer (Subscribed Periodic RAU/TAU Timer in ISD) and indicates support for the extended periodic timer via the MS Network Feature Support.
- *exT3312\_minutes* : Enter an integer from 0 to 18600 to identify the number of minutes for the timeout default is 186 minutes.
- **when-subscribed**: This keyword instructs the SGSN to only send the Extended T3312 period RAU timer value in Attach or RAU Accept messages if the SGSN receives the timeout value in an ISD (Insert Subscriber Data) when the MS has indicated support in "MS Network Feature Support".
- **low-priority-ind-ue**: This keyword instructs the SGSN to include the Extended T3312 timer value only if the Attach/RAU Request messages include a LAPI (low access priority indicator) in the "MS Device Properties".

### Extended T3312 Timer Values for a 3G GPRS Network

Use the following configuration to enable Extended T3312 timer values in a 3G UMTS network environment.

```
configure
  context context_name
    sgsn-service service_name
      gmm Extended-T3312-timeout { value exT3312_minutes |
when-subscribed } [ low-priority-ind-ue ]
    end
```

Notes:

- **value** : This keyword instructs the SGSN to send the defined Extended T3312 timer value in Attach or RAU Accept messages to the MS if the subscriber has a subscription for the Extended T3312 timer (Subscribed Periodic RAU/TAU Timer in ISD) and indicates support for the extended periodic timer via the MS Network Feature Support.
- *exT3312\_minutes* : Enter an integer from 0 to 18600 to identify the number of minutes for the timeout default is 186 minutes.
- **when-subscribed**: This keyword instructs the SGSN to only send the Extended T3312 period RAU timer value in Attach or RAU Accept messages if the SGSN receives the timeout value in an ISD (Insert Subscriber Data) when the MS has indicated support in "MS Network Feature Support".
- **low-priority-ind-ue**: This keyword instructs the SGSN to include the Extended T3312 timer value only if the Attach/RAU Request messages include a LAPI (low access priority indicator) in the "MS Device Properties".

### Extended T3312 Timer Values in the Call-Control Profile

(Reminder: a configuration in the Call-Control Profile would override an **Extended-T3312-timeout** configuration done for either the GPRS or SGSN services. As well, a Call-Control Profile configuration enables the operator to fine-tune for Homers and Roamers.)

Use the following configuration to enable Extended T3312 timer values for all subscribers:

```
configure
  call-control-profile profile_name
    gmm Extended-T3312-timeout { value exT3312_minutes | when-subscribed
} [ low-priority-ind-ue ]
  end
```

Notes:

- **value** : This keyword instructs the SGSN to send the defined Extended T3312 timer value in Attach or RAU Accept messages to the MS if the subscriber has a subscription for the Extended T3312 timer (Subscribed Periodic RAU/TAU Timer in ISD) and indicates support for the extended periodic timer via the MS Network Feature Support.
- *exT3312\_minutes* : Enter an integer from 0 to 18600 to identify the number of minutes for the timeout default is 186 minutes.
- **when-subscribed**: This keyword instructs the SGSN to only send the Extended T3312 period RAU timer value in Attach or RAU Accept messages if the SGSN receives the timeout value in an ISD (Insert Subscriber Data) when the MS has indicated support in "MS Network Feature Support".
- **low-priority-ind-ue**: This keyword instructs the SGSN to include the Extended T3312 timer value only if the Attach/RAU Request messages include a LAPI (low access priority indicator) in the "MS Device Properties".

## Verifying the Extended T3312 Configurations

To verify the configuration for the 2G network environment, use the following command:

```
[local]SGSN1-NH show gprs-service name service_name
```

To verify the configuration for the 3G network environment, use the following command:

```
[local]SGSN1-NH show sgsn-service name service_name
```

To verify the configuration for the Extended T3312 in the Call-Control Profile, use the following command:

```
[local]SGSN1-NH show call-control-profile full name profile_name
```

## Configuring Backoff Timers

There are two backoff timers and they can each be configured at two different levels: Call-Control Profile or Service-level (GPRS or SGSN).

- T3346 MM Backoff Timer
- T3349 SM Backoff Time

### T3346Timer Values at the Service Level

Use the following configuration to enable T3346 timer values for a 2G GPRS-service or for a 3G SGSN-service.

```
configure
  context context_name
    ( gprs-service | sgsn-service ) service_name
      gmm t3346 min minimum_minutes max maximum_minutes
    end
```

Notes:

- *minimum\_minutes*: Enter an integer from 1 to 15 to identify the minimum number of minutes default is 15 minutes.
- *maximum\_minutes*: Enter an integer from 1 to 30 to identify the maximum number of minutes default is 30 minutes.
- If an Attach Request or RAU Request or Service Request is rejected due to congestion, then the T3346 value will be included in the reject message with GMM cause code 22 (congestion). The MM backoff timer value sent will be chosen randomly from within the configured T3346 timer value range.
- The timer will be ignored if an Attach Request or RAU Request is received after congestion has cleared.
- If T3346 timer value is configured in a Call-Control Profile then that value will override the backoff timer values defined for this GPRS Service configurations.

### T3346Timer Values at the Call-Control Profile Level

Use the following configuration to enable T3346 timer values in a the Call-Control Profile.

```
configure
  call-control-profile ccpolicy_name
    gmm t3346 min minimum_minutes max maximum_minutes
  end
```

Notes:

- *minimum\_minutes*: Enter an integer from 1 to 15 to identify the minimum number of minutes default is 15 minutes.
- *maximum\_minutes*: Enter an integer from 1 to 30 to identify the maximum number of minutes default is 30 minutes.
- If an Attach Request or RAU Request or Service Request is rejected due to congestion, then the T3346 value will be included in the reject message with GMM cause code 22 (congestion). The backoff timer value sent will be chosen randomly from within the configured T3346 timer value range.
- If T3346 timer value is configured in a Call-Control Profile then it will override the backoff timer values defined for either the SGSN Service or GPRS Service configurations.
- The timer will be ignored if an Attach Request or RAU Request is received after congestion has cleared.

## Verifying the T3346 Configurations

To verify the configuration for the 2G service, use the following command:

```
[local]SGSN1-NH show gprs-service name service_name
```

To verify the configuration for the 3G service, use the following command:

```
[local]SGSN1-NH show sgsn-service name service_name
```

To verify the configuration for the in the Call-Control Profile, use the following command:

```
[local]SGSN1-NH show call-control-profile full name profile_name
```

## Configuring O&M Triggered Congestion

### Enabling Congestion

For operations and maintenance purposes (e.g., testing), this command triggers a congestion state at the global level.

```
sgsn trigger-congestion level { critical | major | minor }
```

Notes:

- **critical | major | minor**: Selecting one of the three congestion severity levels indicates the associated congestion-action-profile to be chosen and applied. Reminder: the profile is associated with the severity level with the **congestion-control policy** command.

### Disabling Congestion

For operations and maintenance purposes (e.g., testing), this command clears congestion triggered using the **sgsn trigger congestion** command.

```
sgsn clear-congestion
```

Notes:

- If the command is applied then the SGSN resumes normal operations and does not apply any congestion control policy.



# Monitoring MTC Congestion Control

The commands and displays illustrated below are additional commands that can be used to monitor the operations of the MTC Congestion Control functionality.

## show session disconnect-reasons

The following disconnect reason peps calls (Attach and new Inter SGSN RAU) rejected due to APN-based congestion control. The following display is an example of what you might see when you issue the show command:

```
[local]bngnc3 show session disconnect-reasons
Session Disconnect Statistics
Total Disconnects: 1
Disconnect Reason                               Num Disc  Percentage
-----
mm-apn-congestion-control                       1         100.00000
```

## show congestion-control statistics imsimgr all full

The following illustrates the fields for statistics generated if congestion control is engaged.

```
show congestion-control statistics imsimgr all full
Current congestion status:                Cleared
Current congestion Type  :                None
Congestion applied:                      0 times
Critical Congestion Control Resource Limits
  system cpu use exceeded:
  service cpu use exceeded:
  system memory use exceeded:

SGSN Congestion Control:
  MM Congestion Level:                    None
  Congestion Resource:                    None
  SM Congestion Level:                    None
  O&M Congestion Level:                    None
```

show congestion-control statistics imsimgr all full