

Overload Control for N2 and NAS

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Feature Summary and Revision History

Summary Data

Table 1: Summary Data

Applicable Product(s) or Functional Area	AMF
Applicable Platform(s)	SMI
Feature Default Setting	Disabled – Configuration required to enable
Related Documentation	Not Applicable

Revision History

Table 2: Revision History

Revision Details	Release
First introduced.	2022.03.0

Feature Description

The congestion control feature lets you define the system conditions which when matched impacts the system's performance. To prevent an impact of the congestion on the subscriber sessions, you can configure the system policies that are to be invoked when facing congestion.

Congestion control monitors the system to detect situations that match the conditions which may potentially degrade the system's performance when it is under heavy load. Typically, these conditions are transient (for example, high CPU or memory utilization) and gets resolved faster. However, if these conditions persist longer or they occur frequently during the specific time interval, a severe congestion occurs.

The congestion control feature monitors the system resources, such as CPU usage, memory, the number of active sessions, and the number of Go routines.

Note AMF does not provide a configuration to set the congestion control threshold for system CPU usage, memory usage, and maximum number of goroutine processes.

How it Works

This section describes how this feature works.

N2 Overload Control

When the congestion control feature is enabled, and a congestion threshold is exceeded, the AMF invokes congestion control policies. The AMF informs the control policies to the gNB, which throttles the traffic using the NGAP Overload Start or Stop messages. The AMF sends an NGAP Overload Start message to the gNBs to which it is connected. In the Overload Response IE that the AMF sends to gNBs, the AMF requests the gNBs to reject or allow certain sessions.

After the congestion is cleared, the AMF sends the NGAP Overload Stop message to the NG-RAN node indicating that AMF is resuming regular operations.

NAS Congestion Control

In the overload condition, the AMF rejects the NAS messages from a UE using a 5G-RAN. When AMF rejects a NAS request due to congestion, AMF sends the T3346 IE using the specified T3346 value. With the Mobility Management back-off timer running, the UE can initiate only the Deregistration procedures and procedures that are not affected by the congestion control, such as emergency services and mobile-terminated services.

During a congestion situation, AMF rejects the following requests with the 5GMM cause as Congestion and the T3346 timer value in the Registration Request (including Mobility and Periodic Registration Request) and service requests. The AMF includes the timer value in the Deregistration Request, which UE invokes during the admin clear subscriber process.

Suppose the AMF rejects a Registration Request or service request with the T3346 timer value higher than the sum of the UE's Periodic Registration Update timer T3512 and the Implicit Deregistration timer. In that case, the AMF adjusts the mobile reachable timer and the implicit deregistration timer, or both. With this adjustment, the AMF does not implicitly deregister the UE while the Mobility Management back-off timer is in-progress.

The AMF does not preserve the back-off-timer value which is sent to UE.

For information on the T3346 timer, see the Session Timers chapter.

With the Overload Control feature configured:

- The protocol-ep pod has X minute timer running locally. On expiry of the timer, the protocol-ep pod identifies the system overload state and accordingly sends the overload start or stop message.
- On configuration change, AMF sends overload Stop if overload start was sent earlier. Further, AMF continues to monitor the overload state and send stop/start messages accordingly.
- When the standby Protocol-ep pod becomes active, it collects the system load, determines the overload state, and sends the corresponding message. If AMF identifies an overload situation, the Protocol-ep pod sends an Overload Start message, else, sends the overload stop message if AMF is no longer overloaded.

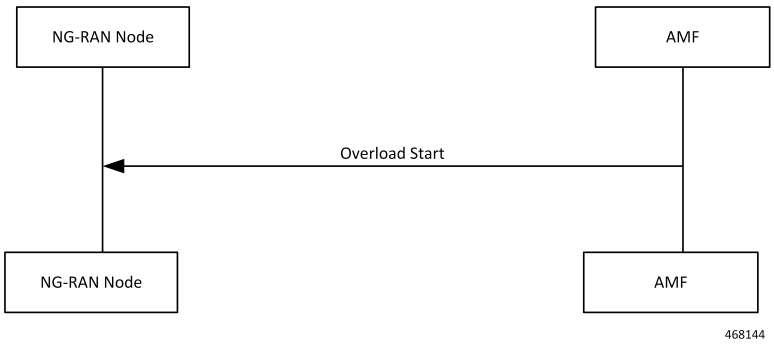
Call Flows

This section describes the key call flows for this feature.

Overload Start Message Call Flow

This section describes the Overload Start Message call flow.

Figure 1: Overload Start Message Call Flow

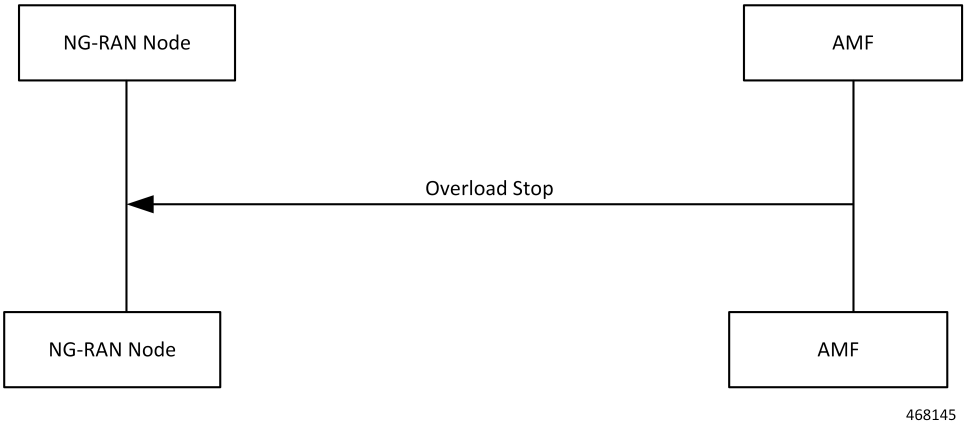


When the overload control is configured and the congestion threshold is reached, the AMF sends an Overload Start Message to the NG-RAN Node.

Overload Stop Message Call Flow

This section describes the Overload Stop Message call flow.

Figure 2: Overload Stop Message Call Flow



After the overload situation is resolved, the AMF sends an Overload Stop Message to the NG-RAN node indicating that the AMF is ready to resume the process the sessions.

NAS Congestion Control Call Flow

This section describes the NAS Congestion Control call flow.

Figure 3: NAS Congestion Control Call Flow

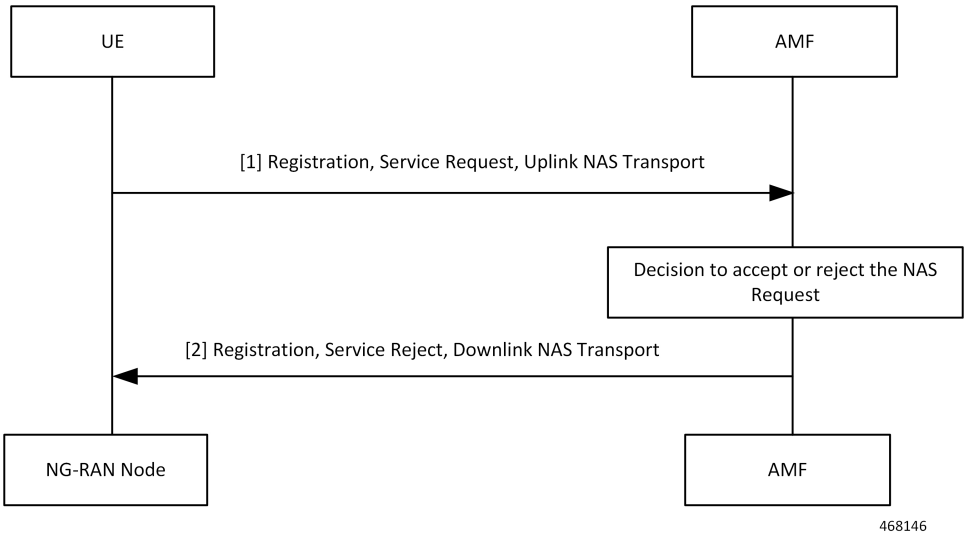


Table 3: NAS Congestion Control Call Flow Description

Step	Description
1	UE sends the Registration Request, Service Request, and Uplink NAS Transaction Request to AMF. When the NAS congestion configuration is enabled, the AMF accepts the following: • Requests received for emergency services. • De-Registration Request that originated in the UE. • Mobility Registration Update requests received when UE is in the CM-CONNECTED state. • Service request received when UE is in the CM-CONNECTED state. • Service request that is received in response to a paging request. • UL NAS Transport (Payload container type: N1 SM information) PDU Release.
2	Depending on AMF's overload capacity, it may reject the following requests: • Service request received when UE is in CM-IDLE state. • Periodic Registration Requests. • Mobility Registration Update requests received when UE is in the CM-IDLE state. • Nonemergency Initial Registration Requests. • Uplink NAS Transport requests with payload container type as N1 SM information. • Uplink NAS Transport requests with payload container type as SMS) dropped on AMF.

Standards Compliance

This feature complies with the following standards specifications:

- *3GPP TS 23.501 "System architecture for the 5G System (5GS)"*
- *3GPP TS 38.413 "NG-RAN; NG Application Protocol (NGAP)"*
- *3GPP TS 24.501 "Non-Access-Stratum (NAS) protocol for 5G System (5GS)"*
- *3GPP TS 24.008 "Mobile radio interface Layer 3 specification; Core network protocols"*

Limitations

This feature has the following limitations in this release:

- The N2 Overload Control is applied at the system-level and not supported at individual S-NSSAI.
- The NAS Congestion Control is not supported per DNN, S-NSSAI, DNN—S-NSSAI, and at certain UE groups.
- Overload Control does not support congestion clearance of the REST interface.

Feature Configuration

Configuring this feature involves the following steps:

1. Configure the action profile, system load threshold and define the load stages as critical, major, and minor.

   The Protocol-ep pod periodically fetches the current system load and identifies the system overload state (minor, major, critical) and associated action profile. The Protocol-ep pod compares the new system load with last recorded system load, updates the locally stored overload information, and sends the determines whether to send the overload start or stop message.

   For more information, see Configuring Congestion Control Threshold, on page 6.

2. Configure the actions that must take an effect when the overload situation arises in N2 and NAS. For more information, see Configuring Congestion Action Profile, on page 7.

Configuring Congestion Control Threshold

To configure this feature, use the following configuration:

```
config
   amf-global congestion-control-threshold { critical | major | minor }
      action-profile action_profile value integer_value
      end
```

NOTES:

- **amf-global**—Enter the AMF global configuration mode.
- **congestion-control-threshold { critical | major | minor }** —Specify the system load stage for which the threshold is set.
- **action-profile** *action_profile* —Specify the action profile name.
- **value** *integer_value*—Specify the threshold value in the range 1–100. The **value** is associated with the system load stage that you have configured using **congestion-control-threshold**.

Configuration Example

The following is an example configuration:

```
config
   amf-global congestion-control-threshold critical
      action-profile sample_profile value 15
      end
```

Configuration Verification

To verify the configuration:

```
show running-config amf-global congestion-control-threshold
```

Sample Output

```
amf-global
 congestion-control-threshold critical value 95 action-profile critcal_profile
```

```
 congestion-control-threshold major value  90 action-profile major_profile
 congestion-control-threshold minor value 85 action-profile minor_profile
exit
```

Configuring Congestion Action Profile

To configure this feature, use the following configuration:

```
config
   congestion-action-profile action-profile action_profile_name
      n2-overload
         report-overload {
permit-emergency-sessions-and-mobile-terminated-services-only |
permit-high-priority-sessions-and-mobile-terminated-services-only |
reject-new-sessions | reject-non-emergency-sessions }
         traffic-load-reduction load_reduction_percentage
      nas-congestion-enabled
      end
```

NOTES:

- **congestion-action-profile**—Enter the congestion action configuration mode.
- **action-profile** *action_profile_name*—Specify the action profile name that is mapped to the system load stage.
- **n2-overload**—Configure parameters that must be applied when N2 is overloaded.
- **report-overload** —Configure the overload response message that AMF sends to gNB.

  The **report-overload** includes the following options:

  - **permit-emergency-sessions-and-mobile-terminated-services-only**—Configure to permit only emergency sessions and mobile-terminated services to access AMF during the overload situation.
  - **permit-high-priority-sessions-and-mobile-terminated-services-only**—Configure to permit only high priority or emergency sessions and mobile-terminated services that AMF sends to the gNBs.
  - **reject-new-sessions**—Configure to reject all new connection requests except emergency requests sent to the AMF during the overload situation.
  - **reject-non-emergency-sessions**—Configure to reject all nonemergency or nonhigh priority Sessions Creation Requests during the overload situation.

- **traffic-load-reduction** *load_reduction_percentage*—Specify the percentage of traffic load to be reduced at gNB. *load_reduction_percentage* must be an integer in the range 1–99.
- **nas-congestion-enabled**—Enable the congestion control feature for NAS. **nas-congestion-enabled** is disabled by default.

Configuration Example

The following is an example configuration:

```
config
   congestion-action-profile action-profile sample_profile
      n2-overload
```

```
        report-overload { permit-emergency-sessions-and-mobile-terminated-services-only |
 permit-high-priority-sessions-and-mobile-terminated-services-only | reject-new-sessions |
 reject-non-emergency-sessions }
        traffic-load-reduction 20
     nas-congestion-enabled
     end
```

Configuration Verification

To verify the configuration:

show running-config congestion-action-profile

Sample Output

```
congestion-action-profile critcal_profile
 n2-overload traffic-load-reduction 98
 n2-overload report-overload reject-new-sessions
 nas-congestion-enabled
exit
```

OAM Support

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

Bulk Statistics Support

The following statistics are supported for the Overload Control for N2 and NAS feature:

amf_overload_status

Description: The counter indicates the overload status as:

- Minor
- Major
- Critical

Example:

```
amf_overload_status{app_name="AMF",cluster="clu1",data_center="dc1",instance_id="2",service_name="amf-protocol-ep"}
 2
```