# UE Overload Protection



## Feature Summary and Revision History

### Summary Data

| | |
|---|---|
| Applicable Product(s) or Functional Area | P-GW |
| Applicable Platform(s) | ASR 5500 |
| Default Setting | Disabled - Configuration Required |
| Related Changes in This Release | Not Applicable |
| Related Documentation | • *Command Line Interface Reference*<br>• *P-GW Administration Guide* |

### Revision History

| Revision Details | Release |
|---|---|
| First introduced. | 21.22 |

# Feature Description

The UE Overload Protection feature provides a mechanism to monitor resource utilization of system bandwidth, channel drop rate, SM CPU, SM memory and VPP CPU. When resources exceed configured threshold, certain identified UEs shall be impacted. For example, when system bandwidth resource, which is global, exceeds the configured threshold, the UEs across the system enabled for this feature shall be impacted. Remaining resources are considered as local to CPU complex.

Currently, P-GW supports managing or throttling of traffics and includes the following functions as part of the UE Overload protection functionality:

- Identification of subscriber impact to a P-GW
- Setting thresholds or conditions on the impact of subscriber to a P-GW
- Sending responses to these thresholds by throttling one or more subscribers who exceeded the threshold.

The UE Overload protection feature works only with VPP-enabled ASR 5500 with DPC2 card and other platforms. Threshold handling is applicable only for DPC2 cards (maximum of 6DPC2 cards) that does not include any Demux card. Now you can configure this feature through CLI globally: The following functions are supported:

- Configuration of UE Overload control profiles.
- Managed through PCRF– Enables or disables *ue overload protection* feature for each subscriber and based on the AVP received during the session establishment.
- Allows you to specify configuration actions when thresholds are met. You can adjust the APN-AMBR-DL and APN-AMBR-UL temporarily until the overload condition persists. UE Overload APN AMBR UL/DL values applied to the UEs are reverted to their original values in case of Session Manager restarts, Card migration, and ICSR.

**Note** If an UE session is under throttling, then APN-AMBR values get modified immediately if the new APN_AMBR values are lesser than the currently applied values. Otherwise, the values are not programmed in the fast path, instead, it gets applied once the threshold is relaxed.

- Allows you to receive periodic load condition (including VPP load) from Resource manager and provision to set up overload condition in Session Manager.
- **show status**: To optimize the system load the **show status** command is organized to show the recent status for up to 18 records and along with system-wide criteria. When the system criteria is met as a lower priority criteria, complex wide higher priority can still override for every complex level based on the complex level threshold crossing. You can view the following results through **show status**:
  - All "met" parameters, when a CPU complex is in throttled state due to one threshold parameter and if other threshold parameters meet on that same CPU complex.

    All threshold parameters, if multiple threshold parameters are met within a given configured criteria.

    The system bandwidth threshold, if met, is displayed as a separate row (last row) in the **show status**. The **Activation Time** for system bandwidth can be any one of the CPU complex activation times.

# How it Works

In StarOS, all sessions are distributed across multiple Session Managers. Demux Manager acts as a central element of resource utilization collection at the CPU complex level. When the network traffic speed increases in conjunction with the deployment of 5G, P-GW allows subscribers to manage the performance of the network, such as high-speed downloads, User Equipment (UE) overload detection or recovery scenarios with the help of Demux Manager.

The UE Overload protection feature works on a detection algorithm, which is designed to work and targeted for the DPC2 card-based architecture. However, this algorithm works across different line cards. Following table explains the Overload detection algorithm steps.

***Table 1: Workflow***

| Step | Description |
|---|---|
| 1 | Collects resource information at CPU complex level. |
| 2 | CLI defines the threshold of the resource utilization. |
| 3 | A programmable timer (time provided through CLI) runs the detection algorithm on its expiry and checks against the upper threshold for any of the resource utilizations has crossed the upper threshold limit:<br>• If crossed, then scans for the offending users part of the instance of VPP thread or Session Manager and applies the temporary **APN-AMBR-DL** and **APN-AMBR-UL** threshold values.<br>• Else, waits for the next cycle. |
| 4 | Checks recovery algorithm loop (with checks for resource utilization have gone below lower threshold value, which is configured through CLI.<br>If the condition is crossed, then scans for the **APN-AMBR-DL** and **APN-AMBR-UL** instances and replaces with the original **APN-AMBR-DL** and **APN-AMBR-UL** values. |
| 5 | Records incidents in the counters to update statistics. |
| 6 | Applies timestamp when a criterion is met and used for checking the dampening expiry. |

# Limitations

The limitations are:

- Works only with VPP-enabled ASR 5500 whereby the load monitoring is performed on the DPC2 card.
- As the intent of this feature is to bring down the system load by throttling the user traffic through AMBR parameters, the operator should take care of enabling the sessions to be throttled.

- The operator must enter the actual name of the APNs at the time of entering the APN names in the list. This is because there is no validation on this list with respect to the APN names used in the system. For APN name, which is not available in the system, the error is not displayed during configuration.You can view the error through the **show config errors** command.

# Configuring ue-overload-control-profile

UE Overload feature is applicable only to the new UE sessions that come up after the UE Overload configuration. When you enable the UE Overload configuration for a valid virtual APN(s) or base APN(s), you cannot modify any existing UE sessions to apply the feature.

Use the following commands to configure the ue- overload control profile settings on ASR5500:

```
configure
    context context_name
     ue-overload-control-profile name
        end
```

Notes:

- **ue-overload-control-profile**: Creates a new UE Overload Control Profile without prompting for confirmation.

**Note** Deletion of an UE Overload profile or an applied/active criteria or applied/active action profile or parameters results in relaxing of applied threshold(s) on a Card/CPU complex immediately.

Any modification of configuration takes effect only in the next *check-interval*.

# Configuring ue-overload Criteria

Use the following commands to configure ue-overload criteria.

```
configure
   context context_name
    ue-overload-control-profile overload-criteria  value prioritypriority_value

        system
           bandwidth-thresholdvalue
           drop-rate-thresholdvalue
       exit
        sessmgr
           cpu-thresholdvalue
           memory-thresholdvalue
        exit
        vpp
           cpu-thresholdvalue
        exit
```

```
overload action name
exit
apn name
    overload-actionname
    downlink-ambrvalue
    uplink-ambrvalue
check-intervalseconds
dampen-intervalseconds
exit
```

**Notes**:

- **overload-criteria**: Configures Overload criteria thresholds for system, sessmgr, vpp parameters along with criteria priority.

  **overload-action**: Configures overload action associated with this overload criteria.

- **sessmgr** : Configures Session Manager threshold for various overload criteria parameters.
- **system** : Configures System threshold for various overload criteria parameters.
- **vpp**: Configures VPP threshold for various overload criteria parameters.
- **apn**: Includes APN names to apply for this UE Overload control profile. APN is added in the UE Overload configuration in the following two ways:
  - enable-by-default – UE Overload feature is applicable to the UE sessions if the **UEOVERLOAD** field is enabled in the Service-Feature AVP or if **UEOVERLOAD** field or Service-Feature AVP is altogether missing.
  - enable-by-gx – UE Overload feature is applicable to the UE sessions only if the **UEOVERLOAD** field is enabled in the Service-Feature AVP.

  *check-interval*: Configures UE Overload parameters monitoring interval (in seconds). The default value is 30 seconds.

- **dampen-interval** : Configures minimum time defined for the system to be in the Overloaded State or Normal State (in seconds). The default value is 300 seconds.
- **default** : Restores default value assigned for following options.
  - **do** : Spawns an exec mode command which displays information to the administrator.
  - **end**: Exits configuration mode and returns to Exec Mode.
  - **exit**: Exits current configuration mode, returns to previous mode.
  - **no**: Enables or disables the following option:
    - **overload-criteria**: Configures Overload criteria thresholds for system, session manager, and VPP parameters along with criteria priority.

# Monitoring and Troubleshooting

## Show Commands and Outputs

This section provides information regarding show commands and their outputs for this feature.

### show ue-overload-control-profile

The output of this command includes the following fields:

| Field | Description |
|---|---|
| all | Displays all UE Overload Control Profiles. |
| full | Displays UE Overload Control profile in detail. |
| **name**-Displays UE Overload Control Profile names. | |
| Status | Displays the current status of an UE Overload Control profile. |
| APN List | Displays APN list that are configured under UE Overload Control profile. |

### show ue-overload-action

The output of this command includes the following fields:

| Field | Description |
|---|---|
| ue-overload-action | Displays all UE overlaoad action information or criteria and its statistics.. |
| Statistics | Displays total collected information about criteria applied on UEs since its activation. |

### show ue-overload-control-profile name

The output of this command includes the following fields:

| Field | Description |
|---|---|
| **UE Overload Control Profile** | |
| Profile Name | Displays name of the ue-overload control profile. |
| Status | Displays the current status of the ue-overload control profile. |

### show ue-overload-profile full all

The output of this command includes the following fields:

| Field | Description |
|---|---|
| **UE Overload Control Profiles** | |
| UE Overload Control Profile Name | Displays name of the ue-overload control profile. |
| **Overload-Criteria (s)** | |
| Name | Displays name of the overload criteria. |
| Priority | Displays the priority of the ue-overload profile. |
| System | Displays System threshold for various overload criteria parameters. |
| Sessmgr | Displays Session Manager threshold for various overload criteria parameters. The percentage must be an integer between 0 to100. |
| vpp | Displays a VPP CPU utilization threshold in percentage. |
| Bandwidth threshold | Displays a System bandwidth threshold in percentage. |
| drop-rate threshold | Displays System drop-rate in pps. |
| cpu threshold | Displays Session Manager CPU threshold in percentage. |
| memory threshold | Displays Session Manager memory threshold in percentage. |
| overload-action | Displays the associated UE Overload action profile. |
| **APN (s)** | |
| enable-by-default | Displays all the APNs enabled by default. |
| enable-by-gx | Displays all APNs enabled by Gx interface. |
| **Check-interval**: Displays check interval in seconds. **check-interval** must be an integer ranging from 15 through 300 seconds. | |
| **Dampen-interval**: Displays dampen interval in seconds. The **dampen-interval** must be an integer ranging from 30 through 3000 seconds. | |

## show ue-overload-action statistics full

To optimize the system load, the statistics entries are limited to seven records (six for the complex level and one for the system wide). System-Wide statistics entry is always shown as the last row.

The output of this command includes the following fields.

| Field | Description |
|---|---|
| **Profile-name**: Displays name of the UE overload profile.<br>**Note** If an UE Overload profile is deleted or if association is removed from SAEGW service, then any statistics collected gets erased. | |

| Field | Description |
|---|---|
| Criteria Name (Priority) | Displays Overload criteria name and priority.<br>**Note** In a given criteria, if multiple thresholds are met along with System Bandwidth, then post relaxing the threshold, statistics are collected as part of the System Bandwidth entry. |
| Activation Time | The activation time of the overload criteria.<br>**Note** For statistics collected post EGTPMGR recovery, the **Activation Time** is displayed as blank. |
| Activation Duration | The duration up to which the overload criteria was active.<br>**Note** For statistics collected post EGTPMGR recovery, the **Activation Duration** is displayed as blank. |
| No.of Impacted UEs | Displays the number of UEs for which the temporary UL-AMBR values are applied. |
| Total UEs | Displays the total number of UEs on the Card/CPU complex<br>**Note** If the **Total UEs** entries are less than the **No.of Impacted UEs**, some UE sessions might go down as the statistics are collected at the Card/CPU-complex when it comes out of threshold. |
| Card/CPU | The Card/CPU complex for which the particluar criteria was active. If there is a sytem-wide overload action criteria, then it will display as **SYSTEM**.<br>If no UE sessions were throttled on a Card/CPU-complex, then UE session entries are not shown in the statistics even though the Card/CPU complex exceeds any of the configured threshold parameters. |

## show configuration bulkstats

The following example shows the Bulk Statistics Server Configuration:

```
config
  bulkstats collection
  bulkstats historical collection
  bulkstats mode
    sample-interval 1
    transfer-interval 2
    file 1
      remotefile format data/bulkstats/%host%-%date%-%time%.csv
     receiver 10.105.84.124 primary mechanism ftp login root encrypted password +B3qmvomy0b
 fenh0p6bitcxn3lfs19 febnhcv66ry0uocxu3s2zrze0zompd le3gc7d2bjdm 199d61ny1360gwn1 zr8332rg
 vnjsjvanb4
    #exit
    file 2
      header format UE-AMBR-drop-stats
      remotefile format data/bulkstats/%host%-%date%-%time%.csv
      receiver 10.105.84.124 primary mechanism ftp login root encrypted password +B0nu
axjhro0b lg2lspsbf12eupo2cxv6ljisgtxb01ap 2239iddb925p69epd in6cc05jm1v96b59uz0moxiz1gsk9qx
 3ijqpsossxi89
```

```
    #exit
    file 3
      header format UE-Overload-drop-stats
      remotefile format data/bulkstats/%host%-%date%-%time%.csv
      receiver 10.105.84.124 primary mechanism ftp lo gin root encrypted password
+B3iw43muh3b2j62d9ib6t2jo50232r3dt9ih97iq1ga70qh7r0cbq2a0z j68wpxki22fn9b2t
9i69td06rq782uc83vs2xlfi96h64bi3
      saegw schema ueoverload-stats format
Server1,pgw-apnambrratelimit-ulpktdrop:%pgw-apnambrratelimit-ulpktdrop%,pgw-apnambrratelimit-dlpktdrop:
 %pgw-apnambrratelimit-dlpktdrop%, pgw-apnambrratelimit-ulbytedrop:%pgw-apnambr
ratelimit-ulbytedrop%,
       pgw-apn ambrratelimit-dlbytedrop:%pgw-apn ambrratelimit-
dlbytedrop%,pgw-ueoverload-apnambrratelimit-ulpktdrop:%pgw-ueoverload-apnambrratelimit-ulpktdrop%,
 pgw-ueoverload-apnambrratelimit-dlpktdrop: %pgw-ueoverload-apnambr ratelimit-dlpktdrop%,
       pgw-ueov erload-apnamb rratelimit-ulbytedrop:% pgw-ueoverload-
apnambrratelimit-ulbytedrop%,pgw- ueoverload-apnambrratelimit-dlbytedrop:
%pgw-ueoverload-apnambrratelimit-dlbytedrop%
    #exit
  #exit
end
```

Bulkstats Output on server

```
UE-Overload-drop-stats
Server1,pgw-apnambr ratelimit-ulpktdrop:11060, pgw-apnambrr
atelimit-dlpktdrop:14231,pgw-apnambrra telimit-ulbytedrop:888455,
pgw-apnambrratelimit-dlbytedrop:14965964,
pgw-ueoverload-apnamb rratelimit-ulpktdrop:11060,pgw-ueov erload-apnam br
ratelimit-dlpktdrop:14231,pgw-ueover load-apnambrratelimit-ulbytedrop:888455,
pgw-ueoverload-apnambrratelimit-dl bytedrop:14965964
```

## show saegw-service all

The following example shows the results on UE Overload Contol Profile for SAEGW service.

```
Service name                     : SAEGW21
  Service-Id                     : 12
  Context                        : EPC2
  Status                         : STARTED
  sgw-service                    : SGW21
  pgw-service                    : PGW21
  sx-service                     : Not defined
  User Plane Tunnel GTPU Service : Not defined
  Ue Overload Control Profile    : prof-1
  Newcall policy                 : n/a
  downlink-dscp-per-call-type    : n/a
  CUPS Enabled                   : No
```