Enhanced MBR and APR-AMBR Enforcement Support

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Feature Summary and Revision History

Summary Data

Applicable Product(s) or Functional Area	• GGSN • P-GW • SAEGW
Applicable Platform(s)	• ASR 5500 • VPC - DI • VPC - SI
Feature Default	Disabled - Configuration Required
Related Changes in This Release	Not Applicable
Related Documentation	• *Command Line Interface Reference* • *ECS Administration Guide* • *Statistics and Counters Reference*

Revision History

Revision Details	Release
First introduced.	21.7

Feature Description

The token replenishment time for maximum bit rate (MBR) is currently hardcoded at 1 ms. This causes the Cisco P-GW to flat out traffic, which causes the RAN to see no burst traffic. Therefore, the RAN scheduler is unable to work efficiently. To improve the efficiency of the RAN scheduler and to cause the RAN scheduler to see burst traffic, it is necessary to increase the token replenishment time. The Enhanced MBR and APR-AMBR Enforcement Support feature addresses this requirement.

How It Works

The new MBR and APR-AMBR enforcement logic is implemented as described in the following sections.

MBR Enforcement Logic

A new token replenishment interval for MBR enforcement is introduced that is configurable at the APN and Global Configuration level. The APN level configuration takes precedence over the Global Configuration level.

The following example describes the change:

```
flow limit-for-bandwidth direction downlink peak-data-rate 4000000 peak-burst-size 500000
violate-action discard
```

The Peak-Data-Rate (MBR) is set at 4 Mbps (4000000/8 = 500 KBps) and Peak-Burst-Size is 500 KBps (500000).

1. Token Replenishment Interval is 1 msec:

   MBR of 4 Mbps means 4000000/1000 = 4000/8 = 500 bytes token is accumulated and allowed every 1 msec. Therefore, 1 packet is passed every 3 ms. Initial burst is 500 KBs (assumption is that each packet size is 1500 bytes).

2. Token Replenishment Interval is 10 msec:

   MBR of 4 Mbps means 4000000/100 = 40000/8 = 5000 bytes token is accumulated and allowed every 10 msecs. Therefore, 3 packets are passed during a 10 ms interval. Initial burst is 500 KBs (assumption is that each packet size is 1500 bytes),

3. Token Replenishment Interval is 100 msec:

   MBR of 4 Mbps means 4000000/10 = 400000/8 = 50000 bytes token is accumulated and allowed every 100 msecs. Therefore, 33 packets are passed during a 100 ms interval. Initial burst is 500 KBs (assumption is that each packet size is 1500 bytes).

4. Token Replenishment Interval is 500 msec:

MBR of 4 Mbps means 4000000/2 = 2000000/8 = 250000 bytes token is accumulated and allowed every 500 msecs. Therefore, 166 packets are passed during a 500 msec interval. Initial burst is 500 KBs (assumption is that each packet size is 1500 bytes).

5. Token Replenishment Interval is 1000 msec (1sec):

   MBR of 4 Mbps means 4000000/1 = 4000000/8 = 500000 bytes token is accumulated and allowed every 1000 msecs. Therefore, 333 packets are passed during a 1 sec interval. Initial burst is 500 KBs (assumption is that each packet size is 1500 bytes).

APN-AMBR Enforcement Logic

A new token replenishment interval for MBR enforcement is introduced that is configurable at the APN Configuration level. For more details, see the "Configuring MBR and APN-AMBR Enforcement" section.

Recommendations

The following is recommended while configuring the token replenishment interval for MBR and APN-AMBR enforcement.

1. To achieve data rate, not more than peak-data-rate at any point of time, it is recommended to configure peak-burst-size equals to peak-data-rate (MBR) in bytes.

   Examples:

   For flow level bandwidth limiting:

   ```
   flow limit-for-bandwidth direction downlink peak-data-rate 4000000 peak-burst-size 500000
    violate-action discard
   ```

   For dynamic rule bandwidth limiting:

   ```
   policy-control burst-size auto-readjust duration 1
   ```

Note Currently, default value of burst-size for dynamic rule bandwidth limiting is 5 times the MBR value.

2. If violate-action is configured as lower-ip-precedence, new MBR enforcement algorithm based on token replenishment interval, forwards packets, with zero ToS marked, if rate is beyond the configured MBR value. This may not improve efficiency of RAN side scheduler. Therefore, it is recommended to use violate-action as discard.

3. The burst size for APN-AMBR should be configured as [ambr (bps) / 8] bytes or if auto-readjust is used, duration should be 1 sec.

   Examples:

   AMBR downlink received from PCRF is 4000000 (4 Mbps)

   ```
   apn-ambr rate-limit direction downlink burst-size 500000 violate-action drop
   ```

   or

   ```
   apn-ambr rate-limit direction downlink burst-size auto-readjust duration 1 violate-action
    drop
   ```

4. For APN-AMBR enforcement, it is recommended to use violate-action as drop.

5. For APN-AMBR violate-action shape, it is recommended to configure token replenishment interval as either 100 ms or 10 ms. No other token replenishment intervals are not supported for APN-AMBR shaping.

Limitations

The following restrictions are applied to the MBR and APN-AMBR enforcement logic:

- After redundancy actions (like inter- and intra-chassis session recovery), new MBR enforcement logic will use token replenishment interval time from the latest configuration during recovery. In other words, if token replenishment interval is changed on the fly, after redundancy action, all existing subscriber session will use the latest configured token replenishment interval.
- If violate-action is configured as lower-ip-precedence, packets are forwarded with zero ToS marked, if the rate is beyond configured MBR value. This may not improve efficiency of RAN side scheduler. Therefore, it is recommended to use violate-action as discard.
- For APN-AMBR violate-action shape, it is recommended to configure token replenishment interval as either 100 ms or 10 ms. No other token replenishment intervals are not supported for APN-AMBR shaping.

Configuring MBR and APN-AMBR Enforcement

The following section provides the configuration commands to enable or disable the feature.

Configuring APN-AMBR Enforcement (APN level)

Use this command to configure token replenishment interval at APN level for APN-AMBR. This command is configured in the APN Configuration Mode.

```
configure
  context  context_name
    apn  apn_name
      [ default ] apn-ambr rate-limit token-replenishment-interval {
10ms [ multiplication-factor < 2..100 > ] | 100ms }
      end
```

NOTES:

- **default**: Configures default token replenishment interval at APN level for apn-ambr. Default token replenishment interval for apn-ambr is 100 ms.
- **apn-ambr**: Configures apn-ambr attributes for all PDNs of the APN.
- **rate-limit**: Configures rate-limit parameters.
- **token-replenishment-interval**: Configures token-replenishment-interval. The available values range from 10ms to 1000ms (1 sec). Token-replenishment-interval value other than 100 ms or 10 ms is not valid for violate-action shape.
- **multiplication-factor**: Configures multiplication factor of 10 ms as token replenishment interval. Multiplication-factor is configurable only if token replenishment interval is 10 ms.

- The burst size should be configured as [ambr (bps) / 8] bytes or if auto-readjust is used, duration should be 1 sec.
- By default, this CLI is disabled.

Configuring MBR Enforcement (Active Charging Service level)

Use this command to configure token replenishment interval for MBR enforcement at the Active Charging Service level. This command is configured in the ACS Service Configuration Mode.

```
configure
   context  context_name
      apn  apn_name
         [ no ] policy-control token-replenishment-interval { 10ms [
multiplication-factor < 2..100 > ] }
         end
```

NOTES:

- **no**: Disables token replenishment interval at Active Charging Service level.
- **token-replenishment-interval**: Configures token-replenishment-interval. The available values range from 10 ms to 1000 ms (1 sec).
- **multiplication-factor**: Configures multiplication factor of 10 ms as token replenishment interval. Multiplication-factor is configurable only if token replenishment interval is 10 ms.
- By default, this CLI is disabled.

Configuring MBR Enforcement (APN level)

Use this command to configure token replenishment interval for MBR enforcement at the APN level. This command is configured in the APN Configuration Mode.

```
configure
   context  context_name
      apn  apn_name
         [ no ] mbr rate-limit token-replenishment-interval { 10ms [
multiplication-factor < 2..100 > ] }

         end
```

NOTES:

- **no**: Disables token replenishment interval at the APN level.
- **mbr**: Configures MBR attributes for all PDNs of the APN.
- **rate-limit**: Configures rate-limit parameters.
- **token-replenishment-interval**: Configures token-replenishment-interval. The available values range from 10 ms to 1000 ms (1 sec).
- **multiplication-factor**: Configures multiplication factor of 10 ms as token replenishment interval. Multiplication-factor is configurable only if token replenishment interval is 10 ms.

- By default, this CLI is disabled.

Monitoring and Troubleshooting

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

Show Commands and/or Outputs

The output of the following CLI command has been enhanced in support of the feature.

show apn <apn_name>

This show command CLI now includes the value for the following new field when token replenishment interval is configured for the specified APN at the APN level:

token-replenishment-interval

show configuration (Active Charging Service Level)

This show command CLI now includes the values for the following new fields when token replenishment interval is configured at the Active Charging Service (ACS) level:

- token-replenishment-interval
- multiplication-factor

show configuration (APN level)

This show command CLI now includes the values for the following new fields when token replenishment interval is configured at the APN level:

For MBR Enforcement:

- mbr
- rate-limit
- token-replenishment-interval
- multiplication-factor

For APN-AMBR Enforcement:

- apn-ambr
- rate-limit
- token-replenishment-interval
- multiplication-factor

show configuration verbose (Active Charging Service Level)

This show command CLI now includes the value for the following new field when token replenishment interval is configured at the Active Charging Service (ACS) level:

token-replenishment-interval

show apn <apn_name>

This show command CLI now includes the value for the following new field when token replenishment interval is configured for the specified APN at the APN level:

token-replenishment-interval

show configuration (Active Charging Service Level)

This show command CLI now includes the values for the following new fields when token replenishment interval is configured at the Active Charging Service (ACS) level:

- token-replenishment-interval
- multiplication-factor

show configuration (APN level)

This show command CLI now includes the values for the following new fields when token replenishment interval is configured at the APN level:

For MBR Enforcement:

- mbr
- rate-limit
- token-replenishment-interval
- multiplication-factor

For APN-AMBR Enforcement:

- apn-ambr
- rate-limit
- token-replenishment-interval
- multiplication-factor

show configuration verbose (Active Charging Service Level)

This show command CLI now includes the value for the following new field when token replenishment interval is configured at the Active Charging Service (ACS) level:

token-replenishment-interval

show configuration verbose (APN level)

This show command CLI now includes the value for the following new field when token replenishment interval is not configured at the APN level:

For MBR Enforcement:

- mbr
- rate-limit
- token-replenishment-interval

For APN-AMBR Enforcement:

- apn-ambr
- rate-limit
- token-replenishment-interval