

Support for EPC QoS Attributes on SGSN

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Feature Description

The Gn-Gp SGSN now supports EPC QoS parameters during PDP Activation/Modification procedures. Support is added for Evolved-ARP, APN-AMBR and UE-AMBR QoS parameters. The purpose of adding this support is to achieve end to end synchronization of QoS parameters during IRAT (3G/4G) mobility procedures. In previous releases it was observed that there is no synchronization between QoS parameters during TAU/RAU mobility from a 4G scenario to a 3G scenario or vice versa.

Overview

The EPC QoS attributes now supported Gn SGSN can be briefly described as below:

Evolved-ARP (E-ARP): Evolved allocation or retention priority specifies the relative importance of a Radio Access Bearers as compared to other Radio Access Bearers for allocation or retention of the Radio access bearer. The EPC uses Evolved ARP, which has priority level ranging from "1" up to "15". Additionally, evolved ARP comprises of pre-emption capability and pre-emption vulnerability. The preemption capability information defines whether a bearer with a lower priority level should be dropped to free up the required resources. The pre-emption vulnerability information indicates whether a bearer is applicable for such dropping by a preemption capable bearer with a higher priority value.

APN-AMBR (per APN Aggregate Maximum Bit Rate): The APN-AMBR limits the aggregate bit rate that can be provided across all Non- GBR PDP contexts of the same APN (for example, excess traffic may get discarded by a rate shaping function). Each of those Non-GBR PDP contexts can potentially utilize the entire APN AMBR (for example, when the other Non- GBR PDP contexts do not carry any traffic). The PGW enforces the APN AMBR in downlink. Enforcement of APN AMBR in uplink may be done in the UE and additionally in the PGW.

UE-AMBR: The UE AMBR limits the aggregate bit rate that can be provided across all Non-GBR PDP contexts of a UE (for example, excess traffic may get discarded by a rate shaping function). Each of the Non-GBR PDP contexts can potentially use the entire UE AMBR (for example, when the other Non-GBR

PDP contexts do not carry any traffic). The GBR (real-time) PDP contexts are outside the scope of UE AMBR. The RAN enforces the UE AMBR in uplink and downlink.

With this feature enhancement the SGSN now supports the following functionalities:

1. EPC QoS parameters for Gn/Gp interface activated PDPs are supported.
2. The Gn-Gp SGSN reads the EPC QoS parameters from the HLR/HSS and the user.
3. The Gn-Gp SGSN now performs capping of the QoS parameters and sends the negotiated values towards the GGSN and RAN.

How It Works

During PDP context activation/modification, Inbound ISRAU/SRNS and Standalone ISDs the SGSN sends negotiated E-ARP and APN-AMBR values to the GGSN. The SGSN reads the Subscribed QoS values from the HSS/HLR and from the user (configured through the CLI commands), based on the QOS capping configured the SGSN caps the QoS values.

The QoS profile configuration mode is used to configure the APN-AMBR values; this mode is now enhanced to configure E-ARP values. The QoS-profile is associated to APN profile which is selected based on the APN name, the QoS profile now contains locally configured E-ARP and APN-AMBR values. The command **prefer-as-cap** is configured to instruct either to take values from HLR/HSS or local configuration or the minimum of these two.

If the APN profile is not configured, E-ARP and APN-AMBR values are same as the subscribed values provided by the HSS/HLR. If E-ARP and APN-AMBR values are locally configured in the QoS profile, subscribed E-ARP and APN-AMBR values are overridden with locally configured values. This enforcement is done for all contexts which are activated in the SGSN for the first time or during Inter SGSN RAU when the user shifts from other SGSNs to our SGSN or during context activation when a user switches from 2G to 3G or vice versa.

The SGSN calculates the authorized UE-AMBR equal to the sum of all the APN-AMBRs. If the calculated UE-AMBR is greater than subscribed value it is capped to subscribed value.

The SGSN sends the negotiated E-ARP and APN-AMBR values in the following GTPV1 messages to the GGSN during PDP activation/modification or when subscription is received with new values of E-ARP and APN-AMBR:

- Create PDP Context Request.
- Update PDP Context Request
- Update PDP Context Response

The SGSN receives the E-ARP and APN-AMBR in the following GTPV1 messages from the GGSN during PDP activation/modification:

- Create PDP Context Response.
- Update PDP Context Response
- Update PDP Context Request

If the GGSN replies with changed values of E-ARP and APN-AMBR then the downgraded values will be accepted immediately, but upgraded values are accepted only if the allow upgrade option is configured through the CLI.

The following CLI under the Call Control Profile is configured to allow upgrade of E-ARP:

override-arp-with-ggsn-arp

If the GGSN replies with changed values of APN-AMBR then the upgrade and downgrade values are accepted unconditionally.

The SGSN sends negotiated E-ARP, UE-AMBR , APN-AMBR in the following GTPV1 messages to the peer SGSN/MME during Inter- SGSN RAU and SRNS procedures:

- SGSN Context Response.
- Forward Relocation Request

The SGSN sends E-ARP and UE-AMBR in the following RANAP messages to RNC during RABs establishment and modification procedures:

- RAB assignment Request.
- RAB Modification Request

Standards Compliance

This feature complies with the following 3GPP standards:

- 3GPP TS 29.060 (version 12.0.0)
- 3GPP TS 25.413 (version 12.0.0)

Configuring EPC QoS Support on SGSN

The following commands are used to configure EPC QoS Support on Gn SGSN:

Configuring QoS Profile to Support EPS QoS Parameters in GTPv1 messages

The following new command has been introduced in the QoS Profile configuration mode to enable or disable the SGSN to send EPC QoS parameters to GGSN:

```
config
  quality-of-service-profile profile_name
    [remove] epc-qos-params-in-gtpv1 { eps-subscription | gprs-subscription
 }
    exit
```

Notes:

- This command is disabled by default.
- On enabling this command E-ARP and APN-AMBR parameters are included in the GTPV1 SM messages towards the GGSN
- If the keyword **eps-subscription** is configured, the EPC QoS parameters from EPS subscription are sent to the GGSN. (Note: This option is not supported in this release)
- If the keyword **gprs-subscription** is configured, E-ARP and APN-AMBR from the GPRS subscription are sent. The UE-AMBR value is read from the user (local capping).

Configure E-ARP values in the Quality of Service Profile

A new keyword is introduced in the **class** command under the QoS profile configuration mode to configure the E-ARP values.

```
config
  [remove] class { background | conversational | interactive | streaming
 } evolved-arp { preemption-capability capability_value |
preemption-vulnerability vulnerability_value | priority-level level_value  }
  exit
```

Notes:

- This command is disabled by default.
- Use the keyword **preemption-capability** to configure the preemption capability value. The value is configured as "0" or "1".
- Use the keyword **preemption-vulnerability** to configure the preemption capability value. The value is configured as "0" or "1".
- Use the keyword **priority-level** to configure the priority level of the E-ARP. The priority can be configured as any value in the range "1" up to "15".

Configure Local Capping in the Quality of Service Profile

The existing command **prefer-as-cap** is used to instruct the SGSN to use either the local or subscription or both-subscription-and-local (lower of either the locally configured QoS bit rate or the subscription received from HLR/HSS) QoS configuration value as the capping value for the QoS parameters.

```
config
 quality-of-service-profile profile_name
  prefer-as-cap [ both-subscription-and-local | subscription | local ]
  exit
```

Configure Override of E-ARP Values Provided by GGSN

The existing command **[remove] override-arp-with-ggsn-arp** under the Call Control Profile is used to enable or disable the ability of the SGSN to override an Allocation/Retention Priority (ARP) value with one received from a GGSN. If there is no authorized Evolved ARP received from the GGSN, by default the SGSN continues to use the legacy ARP included in the Quality of Service (QoS) Profile IE.

```
config
 call-control-profile profile_name
  [remove] override-arp-with-ggsn-arp
  exit
```

Verifying the Configuration

The configuration can be verified by executing the show command **show quality-of-service-profile full all**. The following parameter is displayed if **gprs-subscription** is selected in the **epc-qos-params-in-gtpv1** command:

Sending of epc-qos-params to GGSN : Enabled with GPRS Subs

Monitoring and Troubleshooting EPC QoS Support on SGSN

This section provides information on the show commands available to support this feature.

Show Command(s) and/or Outputs

Listed below are the show outputs and new statistics added for EPC QoS support on SGSN:

show subscriber sgsn-only full all

The following new statistics are added in the **show subscriber sgsn-only full all** command:

- Evolved Allocation/Retention Priority
- Priority level
- Pre-emption Vulnerability
- Pre-emption Capability
- AMBR
- Negotiated APN-AMBR UL
- Negotiated APN-AMBR DL
- Max-Requested-Bandwidth-UL
- Max-Requested-Bandwidth-DL
- Applied UE-AMBR DL

Troubleshooting EPC QoS Support on SGSN

This section provides troubleshooting information for some common scenarios which might occur when EPC QoS parameter support is enabled on the SGSN.

If EPC QoS parameters are not being sent to the GGSN, execute the following troubleshooting procedure:

- Ensure that E-ARP and APN-AMBR values are received in subscription from HLR/HSS.
- Verify if **epc-qos-params-in-gtpv1** command is configured in the QoS profile. Execute the command **show quality-of-service-profile full all** to verify the configuration.The following statistic is displayed based on the configuration:
  - **Sending of epc-qos-params to GGSN : Enabled with GPRS Subs**

If UE-AMBR is not being sent to the RNC, execute the following troubleshooting procedure:

- Ensure that the UE-AMBR is received in subscription from HLR/HSS.
- Verify if sending of UE-AMBR is configured for the RNC. Execute the show command **show iups-service all** to verify the configuration. The following statistic is displayed based on the configuration:
  - **UE Aggregate Maximum Bit Rate : IE included in message**