ERICSSON

# Quality of Service Configuration

## OPERATION DIRECTIONS

7/1543-AXB 250 10/4-V3 Uen DC

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# Contents

# 1 Introduction

This document provides instructions for configuration of Quality of Service (QoS) on the Evolved Packet Gateway (EPG).

## 1.1 Supported Nodes

The functionalities described in this document are supported by the following nodes:

- Standalone SGW
- Standalone GGSN/PGW
- Combined SGW and PGW

For detailed information about which QoS configurations are supported for different nodes, see Table 1.

## 1.2 Scope

This document covers the configuration of QoS mappings, policing bandwidth, SGSN class mappings, QoS control, service aware bandwidth management profiles, QoS classes, and Allocation/Retention Priority (ARP) mappings.

## 1.3 Target Groups

This document is intended for personnel performing QoS configuration on the EPG. It assumes a basic knowledge of data communication and telecommunication.

# 2 Overview

Table 1 lists QoS configurations supported for different node types.

*Table 1 QoS Configurations Supported for Different Node Types*

| QoS Configurations | | Standalone SGW | Standalone GGSN/PGW | Combined SGW and PGW |
|---|---|---|---|---|
| Configuring QoS Mappings | Disabling Uplink DSCP Remapping | - | × | ×(1) |
| | Configuring QCI to DSCP Mapping | × | × | x |
| Configuring Policing of PDP Contexts, EPS Bearers, or PMIPv6 PDN Connection Bandwidth | | - | × | ×(1) |
| Configuring SGSN Class Mapping for an APN | | - | × | ×(1) |
| Configuring QoS Control | | - | × | ×(1) |
| Configuring Service Aware Bandwidth Management | | - | × | ×(1) |
| Configuring the QoS Class for GTP-C Traffic | | × | × | × |
| Configuring the QoS Class for GTP Prime Traffic | | - | × | ×(1) |
| Configuring the QoS Class for PMIPv6 Traffic | | - | x | x(1) |
| Configuring ARP Mapping | | - | × | ×(1) |
| Disabling the Support for Evolved Allocation/Retention Priority | | - | × | ×(1) |

*(1) The configuration is supported only on the PGW.*

# 3 Prerequisites

Before configuring QoS, ensure that the following prerequisites are met:

- Optional licensed features, such as Service Aware Bandwidth Management, are turned off by default. To employ these features, licenses must be purchased from Ericsson. For information on how to purchase licenses

and enable licensed features, refer to *Software License Management* or contact your local Ericsson support.

- An APN must be configured. Refer to *APN Configuration* for more information.
- The user category and the rule space must be configured. Refer to *SACC Configuration* for more information.

# 4 Configuring QoS to DSCP Mapping

The EPG marks the payload traffic passing through the node with a DSCP value based on the negotiated QoS of the bearer used for payload transport.

For information on how to configure QoS to DSCP mapping for the SGW, see Section 4.1 on page 3. For information on how to configure QoS to DSCP mapping for the GGSN and PGW, see Section 4.2 on page 4.

## 4.1 Configuring QoS to DSCP Mapping for the SGW

The SGW performs QoS to DSCP mapping based on QCI. For more information, refer to *Quality of Service on the SGW*.

To configure a QCI to DSCP map for the SGW, do the following:

1. (Mandatory) Configure a QCI to DSCP map, see Section 4.1.1 on page 3.
2. (Optional) Associate a QCI to DSCP map with an interface for uplink traffic, see Section 4.1.2 on page 4.
3. (Optional) Associate a QCI to DSCP map with an interface for downlink traffic, see Section 4.1.3 on page 4.

### 4.1.1 Configuring a QCI to DSCP Map

The QCI to DSCP map is configured with the following statement:

```
(config) ManagedElement=1,Epg=1,Node=1,QosControl=1,DscpMap=dscpMap
   dscp=(af11 | af12 | af13 | af21 | af22 | af23 | af31 | af32 | af
```

The name of a QCI to DSCP map can be up to 64 characters long. QCI values must be in the range 1–254. For QCI values that are not explicitly configured in the map, the corresponding DSCP value from the default QCI to DSCP map is

used. For information on the default mapping between QCI and DSCP, refer to *Quality of Service on the SGW*.

It is possible to configure up to 300 different QCI to DSCP maps that can be used by different interfaces and APNs.

### 4.1.2 Associating Uplink QoS Mappings on the SGW

It is possible to associate a QCI to DSCP map with the following uplink interfaces: S5/S8-U, combined, or S5-U and S8-U separately.

Associate a QCI to DSCP map with the S5/S8-U combined interface using the following statement:

```
(config) ManagedElement=1,Epg=1,Sgw=1,Interface=1,S5s8U=1
   dscpMap=dscpMapName
```

Associate a QCI to DSCP map with the S5-U interface using the following statement:

```
(config) ManagedElement=1,Epg=1,Sgw=1,Interface=1,S5U=1
   dscpMap=dscpMapName
```

Associate a QCI to DSCP map with the S8-U interface using the following statement:

```
(config) ManagedElement=1,Epg=1,Sgw=1,Interface=1,S8U=1
   dscpMap=dscpMapName
```

### 4.1.3 Associating Downlink QoS Mappings on the SGW

It is possible to associate a QCI to DSCP map with the following uplink interfaces: S1-U, S4-U, and S12-U. These interfaces share configuration.

Associate a QCI to DSCP map with the S1-U, S4-U, and S12-U interfaces using the following statement:

```
(config) ManagedElement=1,Epg=1,Sgw=1,Interface=1,S1s4s12U=1
   dscpMap=dscpMapName
```

## 4.2 Configuring QoS to DSCP Mapping for the GGSN and PGW

The GGSN and PGW support mapping of QoS to DSCP. The method is based on QCI, the QoS concept used in EPS networks, see Section 4.2.1 on page 5.

If the QCI to DSCP mapping method is not configured, the QCI to DSCP mapping method is used with a default mapping of QCI to DSCP values. For

details about the default QCI to DSCP mapping, refer to *Quality of Service on the GGSN and PGW*.

It is also possible to disable QoS to DSCP mapping for uplink traffic, see Section 4.2.2 on page 6.

### 4.2.1 Configuring QCI to DSCP Mapping for the GGSN and PGW

It is possible to use a configured QCI to DSCP map on any APN or interface. To configure QCI to DSCP mapping, do the following:

1. (Mandatory) Configure a QCI to DSCP map, see Section 4.2.1.1 on page 5.
2. (Optional) Associate a QCI to DSCP map with an APN for uplink traffic, see Section 4.2.1.2 on page 5.
3. (Optional) Associate a QCI to DSCP map with an interface for downlink traffic, see Section 4.2.1.3 on page 5.

#### 4.2.1.1 Configuring a QCI to DSCP Map

The QCI to DSCP map is configured as described in Section 4.1.1 on page 3.

#### 4.2.1.2 Associating Uplink QoS Mappings on the GGSN and PGW

A QCI to DSCP map is associated with an APN using the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,Apn=name
   uplinkDscpMap=dscpMap
```

**Note:** Before associating a QCI to DSCP map with an APN, the QCI to DSCP map must be configured on node level, see Section 4.2.1.1 on page 5.

It is not possible to associate a QCI to DSCP map with an APN if any of the following applies:

- Legacy QoS to DSCP remapping is configured for the APN
- Uplink DSCP remapping is disabled for the APN

#### 4.2.1.3 Associating Downlink QoS Mappings on the GGSN and PGW

It is possible to associate a QCI to DSCP map with the following interfaces: Gn-U, S5/S8-U, and S2a-PMIP.

Associate a QCI to DSCP map with the Gn-U interface using the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,Interface=1,GnU=1
   dscpMap=dscpMap
```

**Note:** Associating a QCI to DSCP map with the Gn-U interface is not supported for IPv6 configuration.

Associate a QCI to DSCP map with the S5/S8-U interface using the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,Interface=1,S5s8U=1
   dscpMap=dscpMap
```

**Note:** The QoS to DSCP mapping on the GTP-based S2a/S2b-U interfaces uses the same configuration as the S5/S8-U interface.

Associate a QCI to DSCP map with the S2a-PMIP-U interface using the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,Interface=1,S2aPmip=1
   dscpMap=dscpMap
```

**Note:** Before associating a QCI to DSCP map with a downlink interface, the QCI to DSCP map must be configured on node level, see Section 4.2.1.1 on page 5.

It is not possible to associate a QCI to DSCP map with an interface if legacy QoS to DSCP remapping for downlink traffic is configured.

### 4.2.2 Disabling Uplink DSCP Remapping

To disable uplink DSCP remapping for an APN, use the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,Apn=apnName
   disableUplinkDscpRemapping
```

**Note:** It is not possible to configure disable uplink DSCP mapping for an APN if either QCI to DSCP or legacy QoS to DSCP remapping is configured for the APN.

## 4.3 Runtime Configuration

The EPG supports runtime configuration of QoS to DSCP mapping. The new mapping will take effect for a user the next time the bearer is updated.

# 5 Configuring QCIs

Information on how to configure QCIs is described in the following sections.

## 5.1 Configuring Operator-Specific QCIs

To configure an operator-specific QCI for GBR, enter the following statement:

```
(config)ManagedElement=1,Epg=1,Pgw=1,QosControl=1,OperatorSpecificQ
   gbrQci=qci
```

The value range of `qci` is 128–254.

### 5.1.1 Runtime Configuration

The PGW does not support runtime configuration of operator-specific QCIs for GBR if there are active subscribers using that QCI.

# 6 Configuring Bit Rate Enforcement

Bit rate enforcement allows an operator to limit the throughput of bearers and user sessions to a negotiated value. Bit rate enforcement is performed either by bit rate policing or by traffic shaping using a token bucket algorithm with the parameters described in Section 6.1 on page 7.

By default, the EPG uses bit rate policing for negotiated bit rate enforcement.

For more information on bit rate policing and traffic shaping, refer to *Quality of Service on the GGSN and PGW*.

**Note:** Traffic shaping is only available for bit rate enforcement on the user session level.

## 6.1 Negotiated Bit Rate Enforcement Parameters

The size of the token bucket used for bit rate enforcement is limited by the burst size. The burst size for a specific bearer, user session, or PMIPv6 PDN connection (for PMIPv6-based S2a access) is calculated by multiplying the burst time with the maximum bandwidth downlink for the bearer, user session, or service.

**Note:** Small burst sizes have a negative impact on the performance of TCP.

For traffic shaping, the burst size parameters are not configurable and the traffic shaper uses a fixed burst time of 2 ms. If the resulting burst size falls below the maximum packet size supported by the EPG, the burst size is set to the maximum packet size. There is no maximum burst size for traffic shaping.

For bit rate policing, the burst time can be configured using the `burstTime` statement. If the resulting burst size exceeds the value specified by the `maximumBurstValue` statement, it is set to the `maximumBurstValue`. If the resulting burst size falls below the value specified by the `minimumBurstValue` statement, it is set to the `minimumBurstValue`.

To configure bit rate policing parameters on node level, use the following configuration statements:

```
(config) ManagedElement=1,Epg=1,Pgw=1,PdpContext=1,Policing=1
   burstTime=milliseconds
   maximumBurstValue=value
   minimumBurstValue=value
```

To configure bit rate policing parameters on APN level, use the following statements:

```
(config) ManagedElement=1,Epg=1,Pgw=1,Apn=apnNam
e,PdpContext=1,Policing=1
   burstTime=milliseconds
   maximumBurstValue=value
   minimumBurstValue=value
```

Modifications to bit rate policing parameters do not affect existing bearers or user sessions, or already started services. Any change by configuration is applied to subsequent bearers, user sessions, and services.

*Table 2 Bit Rate Policing Parameters and Values*

| Configuration Parameter | Value Range | Default Value |
|---|---|---|
| `burstTime` | 100–5,000 ms | 3,000 ms |
| `maximumBurstValue` | 128–6,000 KB | 2,000 KB |
| `minimumBurstValue` | 4,000–64,000 B | 16,000 B |

## 6.2 Enabling Traffic Shaping

Traffic shaping can be enabled on both the node level and the APN level, with the following conditions:

- If traffic shaping is enabled on the node level, traffic shaping is performed for all user sessions on all APNs, even if it is not enabled for specific APNs.
- If traffic shaping is disabled on the node level, traffic shaping is only performed for user sessions on APNs for which traffic shaping is enabled by configuration.

By default, traffic shaping is disabled on the node level and on the APN level.

To enable traffic shaping on the node level, include the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,PdpContext=1,Policing=1
   trafficShaping
```

To enable traffic shaping on the APN level, include the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,Apn=apnNam
e,PdpContext=1,Policing=1
   trafficShaping
```

## 6.3 Configuring the Traffic Shaping Queue Size

If the maximum bandwidth is exceeded on a user session, the traffic shaper buffers incoming packets in a queue. The queue size is set dynamically by the traffic shaper to the bandwidth divided by 2,000, with a maximum queue size of 1,024 packets. For example, a bandwidth of 2 Mbps gives a queue size of 1,000 packets. It is also possible to configure a fixed queue size for all user sessions on the node level and the APN level. It is not recommended to configure a large queue for a low bandwidth as it can cause delays in packet transfer.

To configure the traffic shaping queue size on the node level, use the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,PdpContext=1,Policing=1
   trafficShapingQueueSize=queueSize
```

To configure the traffic shaping queue size on the APN level, use the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,Apn=apnNam
e,PdpContext=1,Policing=1
   trafficShapingQueueSize=queueSize
```

The supported range of values for traffic shaping queue size is 1–1,024 packets.

The APN level queue size configuration is used for user sessions on APNs with traffic shaping enabled. For other user sessions, the node level queue size configuration is used.

## 6.4 Disabling Negotiated Bit Rate Enforcement

Enforcement of negotiated bit rate is enabled by default and can be optionally disabled on both node level and APN level. Disabling negotiated bit rate enforcement on node and APN level is handled as follows:

- If negotiated bit rate enforcement is disabled on APN level, negotiated bit rate is not enforced for user sessions on the specific disabled APN.

- If negotiated bit rate enforcement is disabled on node level, the negotiated bit rate is not enforced for any user sessions.

**Note:** Even if negotiated bit rate enforcement is disabled, the licensed bit rate and service MBR are, if applicable, always enforced.

To disable negotiated bit rate enforcement on node level, include the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,PdpContext=1,Policing=1
   noPolicing
```

To disable negotiated bit rate enforcement on APN level, include the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,Apn=apnNam
e,PdpContext=1,Policing=1
   noPolicing
```

# 7 Rounding off Bit Rate

When receiving MBR, GBR, or APN-AMBR over the Gx and S6b interfaces, bit rates are specified in bits per second (bps), but on other interfaces they are specified in kilobits per second (kbps). During the conversion from bps to kbps, the bit rate values for MBR, GBR, and APN-AMBR can be either rounded up or down. By default, the values are rounded down.

To round up the bit rate values, use the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,QosControl=1
   bitrateRounding=up
```

To round down the bit rate values, use the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,QosControl=1
   bitrateRounding=down
```

The configuration takes effect immediately on the current session. The GGSN or PGW rounds off the bit rates accordingly when receiving them next time.

# 8 Configuring SGSN Class Mappings for an APN

It is possible to map SGSN IP address and optionally RAT type to SGSN class identifiers. Up to 24 unique SGSN classes can be configured per APN, with identifiers in the range 1–24.

To configure the SGSN class mappings, include the following statement.

```
(config) ManagedElement=1,Epg=1,Pgw=1,Apn=apnName,Sgsn=
1,SgsnClass=sgsnClassId,SgsnAddress=address
   ratTypes=(unknown | geran | utran | eutran | wlan | gan | hspa)
```

The `SgsnAddress` can be the SGSN IP address or the SGW IP address. The specified SGSN or SGW IP address can be either a full IP address or a network.

# 9 Configuring Maximum Bit Rate for Individual Services or a Group of Services

The EPG can be configured to enforce an MBR for a service or group of services, with separate maximum bit rates for uplink and downlink traffic specified in a QoS profile. The bit rate configured in the QoS profile must be lower than the bit rate negotiated for the bearer or user session to have an effect. A QoS profile can be associated, per rule space, to individual services or to a group of services. Services are represented by ACRs. Associating a QoS profile to an individual service ensures the bit rate of the service does not exceed the bit rate configured in the QoS profile. Associating a QoS profile to a group of services ensures that the services aggregated bit rate does not exceed the bit rate configured in the QoS profile. The service-level bit rate enforcer uses the same burst time value as the bearer-level bit rate enforcer as described in Section 6.1 on page 7.

For information on ACRs, refer to *SACC Overview*. For information on bit rate enforcement, refer to *Quality of Service on the GGSN and PGW*.

To configure a maximum bit rate for individual services or a group of services, do the following:

1. Configure a service QoS profile, as described in Section 9.1 on page 12.

2. Associate a QoS profile for individual services with ACRs, as described in Section 9.2 on page 12 . Or associate a QoS profile for a group of services with ACRs as described in Section 9.3 on page 12.

A configuration example is shown in Section 9.4 on page 13.

## 9.1 Configuring Service QoS Profiles

To configure a QoS profile for a service, use the following command:

```
(config) ManagedElement=1,Epg=1,Pgw=1,QosControl=
1,ServiceProfile=profileName
   maximumBitRateDownlink=mbrDL
   maximumBitRateUplink=mbrUL
```

The EPG supports a maximum of 64 service QoS profiles. The maximum supported length for the name of a service QoS profile is 63 characters. The `maximumBitRateDownlink`, and `maximumBitRateUplink` values range from 0–4,000,000 kbps, but the maximum supported value is 1,000,000 kbps.

**Note:** Only maximumBitRateDownlink and maximumBitRateUplink are enforced for individual services or a group of services.

If a QoS profile is added, removed, or modified during runtime, the change takes effect immediately.

## 9.2 Associating a QoS Profile for Individual Services with ACRs

To associate a QoS profile for individual services with ACRs a QoS profile for a service must first be configured, as described in Section 9.1 on page 12. The configured profile is then mapped, based on the profile name, to the ACRs. To associate a QoS profile for individual services with ACRs, use the following command:

```
(config) ManagedElement=1,Epg=1,Pgw=1,RuleSpace=ruleSpaceN
ame,AccessControlRule=ruleId[-ruleId],ServiceQos=1
   profile=profileName
```

**Note:** An ACR can only be associated with one profile.

## 9.3 Associating a QoS Profile for a Group of Services with ACRs

To associate a QoS profile for a group of services with ACRs, use the following command:

```
(config) ManagedElement=1,Epg=1,Pgw=1,RuleSpace=ruleSpaceN
ame,AccessControlRule=ruleId[-ruleId],SharedServiceQos=1
   profile=profileName
```

**Note:** An ACR can only be associated with one profile.

## 9.4 Configuration Examples for Maximum Bit Rate for Individual Services or a Group of Services

A configuration of service QoS profiles and the mapping between the profiles and ACRs are shown in Example 1 and Example 2.

First, two service QoS profiles are created as shown in Example 1.

```
ManagedElement=1,Epg=1,Pgw=1,QosControl=1
   ServiceProfile=voip
      maximumBitRateDownlink=64
      maximumBitRateUplink=64
      up
   ServiceProfile=streaming
      maximumBitRateDownlink=512
      maximumBitRateUplink=64
      up
   up
```

*Example 1 Configuring a Service QoS Profile*

Next, the previously configured service QoS profiles are mapped to ACRs as shown in Example 2. The VoIP profile is associated with individual services in the `ServiceQos` section; each service can use 64 kbps uplink and 64 kbps downlink. The streaming profile is associated with a group of services in the `SharedServiceQos` section, and the services share the configured bit rate of 512 kbps downlink and 64 kbps uplink.

```
ManagedElement=1,Epg=1,Pgw=1,RuleSpace=1
   AccessControlRule=105-110
      ServiceQos=1
         profile=voip
         up
      up
   AccessControlRule=206-208
      SharedServiceQos=1
         profile=streaming
         up
      up
   up
```

*Example 2 Mapping a QoS Profile for Individual Services and a Group of Services*

# 10 Configuring QoS Control Based on Service Detection

**Note:** To utilize default bearer QoS Control based on service detection functionality, the Service-Aware Charging and Control (SACC) business solution must be enabled. Local Policy Table (LPT) or PCC must also be configured.

The GGSN and PGW can be configured to control the QoS of the default bearer, or to create dedicated bearers based on service detection.

To configure bearer QoS control for default bearers, see Section 10.2 on page 14.

To configure bearer QoS control for dedicated bearers, see Section 10.3 on page 17.

## 10.1 Activating QoS Control Based on Service Detection

To activate QoS Control Based on Service Detection, issue the following command:

```
(config) ManagedElement=1,Epg=1,Pgw=1,FeatureActivation=1
   qosBasedOnServiceDetection
```

**Note:** If this configuration is updated at runtime, the new configuration takes effect at the next service start detection.

## 10.2 Configuring Default Bearer QoS Control Based on Service Detection

**Note:** Default bearer QoS control based on service detection is not supported when enforcement of PCRF-provided QoS is enabled using the `noOverrideAuthorizedQos` CLI command.

To configure default bearer QoS control based on Service Detection, do the following:

1. Activate the feature, as described in Section 10.1 on page 14.
2. Configure a default bearer QoS control profile, see Section 10.2.1 on page 15.
3. Associate a default bearer QoS control profile with an ACR, see Section 10.2.2 on page 15.

A configuration example is shown in Section 10.2.3 on page 16.

### 10.2.1 Configuring Default Bearer QoS Profiles

To configure default bearer QoS control based on service detection on the GGSN or PGW, a default bearer QoS profile must be configured. To configure a default bearer QoS profile, include the following statements:

```
(config) ManagedElement=1,Epg=1,Pgw=1,QosControl=1
,DefaultBearerProfile=profileName
   aggregatedMbrDownlink=apnAmbrDl
   aggregatedMbrUplink=apnAmbrUl
   qosClassIdentifier=qci
   AllocationRetentionPriority=1
      priorityLevel=level
      preEmptionCapability=(enable | disable)
      preEmptionVulnerability=(enable | disable)
```

A maximum of 64 default bearer profiles can be configured. The name of a default bearer QoS profile can be maximum 63 characters long. The `aggregatedMbrUplink` and `aggregatedMbrDownlink` values can be configured in the range of 1–4,000,000 kbps, but the maximum supported value is 1,000,000 kbps. The `qosClassIdentifier` value ranges 5–64 and 67–127 for all bearers and 128–254 for non-GBR bearers. The ARP `priorityLevel` value ranges 1–15.

**Note:** None of these QoS configuration parameters are mandatory. However, at least one QoS parameter must be specified in the profile.

If the QoS profile is modified at runtime, the new QoS profile takes effect after the next service start. If the service is active when the QoS profile is changed, the service must first be stopped and then started again before the new QoS is applied.

### 10.2.2 Associating a QoS Profile for the Default Bearer with an ACR

To configure default bearer QoS control based on service detection, a QoS profile must have been previously configured, as described in Section 10.2.1 on page 15. The configured profile is then mapped, based on the profile name, to an ACR with a priority:

```
(config) ManagedElement=1,Epg=1,Pgw=1,RuleSpace=ruleSpaceN
ame,AccessControlRule=ruleId[-ruleId],DefaultBearerQos=1
   profile=profileName
   priority=level
```

The `priority` level ranges from 1–$2^{32}$-1, where 1 is the highest priority level.

**Note:** If a QoS profile is added or updated at runtime, the new QoS profile is used after the next service start. If the service is active when the QoS profile is changed, the service must first be stopped and then started again before the QoS profile is applied.

### 10.2.3 Configuration Examples for Default QoS Bearer Control Based on Service Detection

A configuration for default bearer QoS profiles based on service detection and the mapping between the profiles and ACRs are shown in Example 3 and Example 4.

First, two default bearer QoS profiles are created as shown in Example 3.

```
ManagedElement=1,Epg=1,Pgw=1,QosControl=1
   DefaultBearerProfile=voip
      qosClassIdentifier=6
      aggregatedMbrUplink=1000
      aggregatedMbrDownlink=1000
      AllocationRetentionPriority=1
         priorityLevel=7
         preEmptionCapability=enable
         preEmptionVulnerability=disable
         up
      up
   DefaultBearerProfile=streaming
      qosClassIdentifier=8
      aggregatedMbrUplink=1000
      aggregatedMbrDownlink=16000
      up
   up
```

*Example 3 Configuring a Default Bearer QoS Profile*

Next, the previously configured default bearer QoS profiles are mapped to ACRs as shown in Example 4.

```
ManagedElement=1,Epg=1,Pgw=1,RuleSpace=1
   AccessControlRule=105
      DefaultBearerQos=1
         profile=streaming
         priority=1
         up
      up
   AccessControlRule=106-110
      DefaultBearerQos=1
         profile=streaming
         priority=2
         up
      up
   AccessControlRule=206
      DefaultBearerQos=1
         profile=voip
         priority=5
         up
      up
   up
```

*Example 4 Mapping a QoS Profile for a default bearer*

## 10.3 Configuring Dedicated Bearer Creation Based on Service Detection

To configure dedicated bearer creation based on service detection, do the following:

1. Activate the feature, as described in Section 10.1 on page 14.
2. Configure a QoS profile for a service, as described in Section 10.3.1 on page 17.
3. Associate a QoS profile for a service with an ACR, as described in Section 10.3.2 on page 19.

To configure and associate additional QoS profiles for dedicated bearers, perform Step 2 to Step 3.

A configuration example is shown in Section 10.3.4 on page 19.

### 10.3.1 Configuring Service QoS Profiles

To configure a QoS profile for a service, issue the following command:

```
(config) ManagedElement=1,Epg=1,Pgw=1,QosControl=
1,ServiceProfile=profileName
   guaranteedBitRateDownlink=gbrDL
   guaranteedBitRateUplink=gbrUL
```

```
maximumBitRateDownlink=mbrDL
maximumBitRateUplink=mbrUL
qosClassIdentifier=qci
AllocationRetentionPriority=1
   priorityLevel=level
   preEmptionCapability=(enable | disable)
   preEmptionVulnerability=(enable | disable)

UplinkFilter=1
  precedence=prio
  Filter=id
    remoteAddress
    remotePort
    localPort
    protocolNumber
    dscp
```

A maximum of 64 service QoS profiles can be configured. The name of a service QoS profile can be maximum 63 characters long. The `guaranteedBitRateDownlink`, `guaranteedBitRateUplink`, `maximumBitRateDownlink`, and `maximumBitRateUplink` values range from 0–4,000,000 kbps, but the maximum supported value is 1,000,000 kbps. The `qosClassIdentifier` value ranges 1–254. The ARP `priorityLevel` value ranges 1–15.

**Note:** If the `AllocationRetentionPriority` is configured, the `qosClassIdentifier` value must also be configured.

If the QCI value is in the range 1–4, 65, or 66, both the guaranteed and the maximum bit rates must be configured.

If the QCI is in the range 5–64, or 67–127, the maximum bit rates must be configured.

If the QCI is in the range 128–254, the maximum bit rates must be configured. If the bearer is GBR, the guaranteed bitrate must also be configured.

If the `AllocationRetentionPriority` is not configured, the value is taken from `AllocationRetentionPriority` on the sessions default bearer.

If the maximum bit rate is changed in an existing service QoS profile, then the new bit rate is enforced immediately. However, the QoS of the bearer is only updated after the next service start. If the service is active when the QoS profile is changed, the service must first be stopped and then started again before the QoS of the bearer is updated.

If the `ServiceProfile` has no QCI configured, no dedicated bearer is created.

The UplinkFilter is a predefined filter in the PGW, which is used to fill the TFT IE in the Create Bearer Request message. The UplinkFilter must match the configuration in PISC. Up to 16 uplink filters can be configured.

**Note:** Only the Uplink filters related to the same ACR can be created under one QoS ServiceProfile.

### 10.3.2 Associating a QoS Profile for a Service with an ACR

To associate a QoS profile for a service with an ACR, a QoS profile for a service must first be configured, as described in Section 10.3.1 on page 17. The configured profile is then mapped, based on the profile name, to an ACR. To associate a QoS profile for a service with an ACR, issue the following command:

```
(config) ManagedElement=1,Epg=1,Pgw=1,RuleSpace=ruleSpaceN
ame,AccessControlRule=ruleId[-ruleId],ServiceQos=1
   profile=profileName
```

**Note:** This feature cannot be used together with always allowed ACRs.

If an association between an ACR and a QoS profile is removed, any current dedicated bearer based on this ACR is deleted by the PGW.

### 10.3.3 Configuration for Bearer Creation Retry

To configure the duration of the retry timer, include the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,QosControl=1,BearerCreation=1
   retryDelay=value
```

The value range is 30–900 seconds. The default value is 600 s.

To configure the maximum number of retries, include the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,QosControl=1,BearerCreation=1
   maxRetries=value
```

The value range is 0-16. The default value is 0.

**Note:** The retry timer and the maximum number of retries must be both configured. If the maximum number of retries is 0, the retry function is not enabled, and the retry timer does not take effect.

**Note:** The configuration of retryDelay has no impact on the running retry timer and takes effect to the next started retry timer. The configuration of maxRetries takes effect immediately.

### 10.3.4 Configuration Examples for Dedicated Bearer Creation Based on Service Detection

A configuration of service QoS profiles for dedicated bearer creation based on service detection and the mapping between the profiles and ACRs are shown in Example 5 and Example 6.

First, two service QoS profiles are created as shown in Example 5.

```
ManagedElement=1,Epg=1,Pgw=1,QosControl=1
   ServiceProfile=voip
      guaranteedBitRateDownlink=64
      guaranteedBitRateUplink=64
      maximumBitRateDownlink=64
      maximumBitRateUplink=64
      qosClassIdentifier=4
      AllocationRetentionPriority=1
         priorityLevel=1
         preEmptionCapability=enable
         preEmptionVulnerability=disable
         up
      up
   ServiceProfile=streaming
      maximumBitRateDownlink=512
      maximumBitRateUplink=64
      qosClassIdentified=6
      AllocationRetentionPriority=10
         priorityLevel=1
         preEmptionCapability=disable
         preEmptionVulnerability=enable
         up
      up
   up
```

*Example 5 Configuring a Service QoS Profile*

Next, the previously configured service QoS profiles are mapped to ACRs as shown in Example 6.

```
ManagedElement=1,Epg=1,Pgw=1,RuleSpace=1
   AccessControlRule=105
      ServiceQos=1
         profile=voip
         up
      up
   AccessControlRule=206-210
      ServiceQos=1
         profile=streaming
         up
      up
   up
```

*Example 6 Mapping a QoS Profile for a dedicated bearer*

# 11 Configuring Local Operator QoS Control Using QCTs

Local Operator QoS Control is configured only on the GGSN by using QoS Control Tables (QCTs), over Gx, or over Gx+ PCC. For more information on how to configure Operator QoS Control using QCTs, see the following sections. For information how to configure Operator QoS Control over Gx, according to the 3GPP Release 6 standard, refer to *Gx+ Static Access Control Configuration*. For information on how to configure Operator QoS Control over Gx+ PCC, according to the 3GPP Release 7 and 8 standards, refer to *Gx+ Policy and Charging Control Configuration*.

When Local Operator QoS Control is enabled, it is possible to configure QoS policies and profiles on a detailed level. The configuration defines QCTs in which QoS policies and profiles are pointed out by user category, SGSN class, roaming class, and traffic class (for EPS bearers only `DefaultQualityOfService` can be used). If a PDP context can be matched to a QoS policy and profile, the bandwidth restrictions optionally configured at node level or APN level are overridden.

To configure Operator QoS Control, include the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,Apn=apnName
,QosControl=1,Profile=profileName
   (Default=1 | RoamingClass=roamingClassId | SgsnClass=sgsnClassId
      (QualityOfService=(conversational | streaming | interactive-1
         trafficClass=(conversational | streaming | interactive-1 |
         policy=(must | min-required | max-allowed)
         maximumBitRateUplink=bitRate
```

```
maximumBitRateDownlink=bitRate
guaranteedBitRateUplink=bitRate
guaranteedBitRateDownlink=bitRate
transferDelay=milliseconds
arpPriorityLevel=value
arpPci=(enable | disable)
arpPvi=(enable | disable)
```

## 11.1 Creating QCTs

The QCT to use for a specific PDP context is selected based on user category. The PDP context is then mapped to an SGSN class or roaming class configured in the QCT. Primarily, the PDP context is mapped to an SGSN class and secondarily to a roaming class. A default class to use when there is no match can also be configured in each QCT. Finally, the PDP context is mapped to a traffic class for which the QoS policy and profile is specified. For information on the configuration of SGSN classes and roaming classes for an APN, see Section 8 on page 10, and *APN Configuration*, respectively.

A QCT is created by including the `Profile` statement, which specifies a user category. It is possible to create multiple QCTs by specifying multiple user categories, that is, by including multiple `profile` statements. The maximum number of QCTs per APN is 16.

To configure SGSN classes or roaming classes for a user category, include the `SgsnClass`statement or the `RoamingClass` statement respectively. It is possible to configure multiple SGSN classes or roaming classes for a user category by including multiple `SgsnClass` or `RoamingClass` statements. The default class is configured by including the `Default` statement. The maximum number of SGSN classes per QCT is 24 and the maximum number of roaming classes is 24.

**Note:** The addresses in SGSN class do not match S4-SGSN addresses. For EPS sessions, they instead match the S5/S8 addresses of the SGW.

To configure a traffic class for an SGSN class or roaming class, include the `QualityOfService` statement. The following traffic classes can be configured for each SGSN class or roaming class in a QCT (including the default class):

- `conversational`
- `streaming`
- `interactive-1`
- `interactive-2`
- `interactive-3`
- `background`

- Default

  The default traffic class is applicable when the user requests a traffic class that does not match any other traffic class configured in the QCT.

  **Note:** The default traffic class is configured by including the `DefaultQualityOfService` statement.

  For EPS sessions, only `DefaultQualityOfService` can be used.

Multiple traffic classes can be configured for an SGSN class or roaming class by including multiple `QualityOfService` statements.

### 11.1.1 Configuring QoS Policies and Profiles

To configure the QoS policy for a traffic class, include the `policy` statement. One of the following QoS policies can be configured in a QCT for each traffic class, including the default traffic class:

- `min-required`

  The QoS parameters configured for the SGSN class or the roaming class specifies the required minimum values.

- `max-allowed`

  The QoS parameters configured for the SGSN class or the roaming class specifies the allowed maximum values.

- `must`

  The user must use exactly the QoS parameter values configured for the SGSN class or the roaming class. The GGSN attempts to change the QoS profile received from the SGSN so that it matches exactly what has been configured. The attempted QoS change possibly results in a QoS profile that has some QoS parameters upgraded while other QoS parameters are downgraded. This is the default behavior if QoS policy is not configured.

The following QoS profile parameters can be configured in a QCT for each traffic class, including the default traffic class:

- `guaranteedBitRateDownlink`
- `guaranteedBitRateUplink`
- `maximumBitRateDownlink`
- `maximumBitRateUplink`
- `trafficClass`

- transferDelay
- arpPriorityLevel
- arpPci
- arpPvi

To configure the downlink and uplink Guaranteed Bit Rate (GBR), include the guaranteedBitRateDownlink and the guaranteedBitRateUplink statements respectively. The value range of these statements is 0–256,000 kbps.

**Note:** For the PGW, only the APN-AMBR functions when negotiating with the MBR in the default QoS traffic class of the QCT. However, there are two limitations when the PGW selects QoS in the QCT.

- In the case of UE roaming, the APN-AMBR of the access through the S4-SGSN has the same QoS profile as the MBR of the access through the Gp-SGSN. Since only the default EPS bearer or the primary PDP context is enabled when the PGW uses the QCT, the limitation is small.
- Only the default traffic class is used for QCT negotiation on the PGW and the MBR can be configured on other traffic class which is not used for PGW QCT negotiation. The PGW does not restrict this configuration.

To configure the downlink and uplink Maximum Bit Rate (MBR), include the maximumBitRateDownlink and the maximumBitRateUplink statements respectively. The supported value range of these statements is 64–1,000,000 kbps, while the configurable value range is 0–4,000,000 kbps

**Note:** For 2G/3G users, the downlink and uplink MBR is suggested to be configured to a value less than 256,000 kbps.

The guaranteedBitRateDownlink, guaranteedBitRateUplink, maximumBitRateDownlink, and the maximumBitRateUplink statements can be configured to a value supported by GTP. For information on configuring maximum negotiated bit rate, see *Overload Protection Configuration*.

If the values configured for guaranteedBitRateDownlink, guaranteedBitRateUplink, maximumBitRateDownlink, and the maximumBitRateUplink are not supported by GTP, the EPG uses the nearest supported GTP value. Table 3 shows the nearest values used for each QoS policy:

*Table 3 Nearest Values Used per QoS Policy*

| QoS Policy | Nearest Value Used |
|---|---|
| must | The nearest supported GTP value lower than the configured value. (1) |

| QoS Policy | Nearest Value Used |
|---|---|
| min-required | The nearest supported GTP value higher than the configured value. |
| max-allowed | The nearest supported GTP value lower than the configured value. |

*(1) For example, in case of 5,000 kbps, the EPG uses 4,992 kbps.*

To configure an alternative traffic class to use, include the `trafficClass` statement. The same traffic classes can be configured for a traffic class as for an SGSN class or roaming class, except for the default traffic class.

To configure the maximum transfer delay, include the `transferDelay` statement. The value range of this statement is 10–4,000 milliseconds. The `transferDelay` statement can be configured to a value supported by GTP. Thus, configure the value in 10 ms increments within the 10–150 ms range, in 50 ms increments within the 150–1,000 ms range, and configure the value in 100 ms increments within the 1,000–4,000 ms range.

**Note:** A low transfer delay value gives a higher quality of service. Thus, when the value of the transfer delay parameter is decreased, the transfer delay parameter is considered to be upgraded.

To configure ARP, configure the ARP level, and optionally enable or disable the preemption capability information and preemption vulnerability information.

- To configure the ARP priority level, include the `arpPriorityLevel` statement. The value range of *`level`* is 1–15; level 1 indicates the highest priority level, and level 15 indicates the lowest priority level.
- To configure the ARP preemption capability information, include the `arpPci` statement. ARP preemption capability information can be set to `enable` or `disable`.

  If the statement is not included, `arpPci` is considered to be disabled.
- To configure the ARP preemption vulnerability information, include the `arpPvi` statement. ARP preemption vulnerability information can be set to `enable` or `disable`.

  If the statement is not included, `arpPvi` is considered to be enabled.

### 11.1.2 Configuring Limitations

The following limitations apply to the Operator QoS Control configuration:

- When `max-allowed` is the policy configured, it is not possible to set the `trafficClass` statement of a traffic class (the `QualityOfService` statement) to a higher value than that of the traffic class entry itself. This applies except for the interactive subclasses with each other.

- When `min-required` is the policy configured, it is not possible to set the `trafficClass` statement of a traffic class (the `QualityOfService` statement) to a lower value than that of the traffic class entry itself. This applies except for the interactive subclasses with each other.

- The `guaranteedBitRateDownlink`, `guaranteedBitRateUplink`, and the `transferDelay` statements can be configured for all traffic classes including the default traffic class, but they are not used for the traffic classes Interactive-1, Interactive-2, Interactive-3, or Background.

- The `guaranteedBitRateDownlink`, `guaranteedBitRateUplink`, and `transferDelay` statements must be configured when the `trafficClass` statement of the traffic classes Interactive-1, Interactive-2, Interactive-3, or Background is set to Conversational or Streaming. This also applies to the default traffic class.

- The uplink and downlink MBRs must be equal to or higher than the uplink and downlink GBRs for a configured QoS profile.

- When the `arpPriorityLevel` statement is not configured, the configured PCI and the PVI values are not used. Otherwise, the requested ARP priority level and the configured ARP priority level are negotiated against the configured policy. Additionally, the PCI and the PVI value that is configured in the local QoS Control table is used as the negotiated value.

## 11.2 Associating a QoS Control Profile with a User Category

To associate a QoS control profile with the default user category, include the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,Apn=apnNam
e,UserCategory=1,Default=1
   qosControlProfile=profileId
```

To associate a QoS control profile with a specific user category, include the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,Apn=apnName,Use
rCategory=1,Category=userCategoryId
   qosControlProfile=profileId
```

The QoS control profile to be associated with the user category must be configured according to Section 11 on page 21.

The user category must be configured according to the instructions for enabling Packet Inspection and Service Classification (PISC) in *PISC Configuration*.

# 12 Configuring the QoS Class for GTP-C Traffic

The following sections describe the configuration of QoS class for GTP-C traffic.

By default, `af31` is used, which is assured forwarding class 3, low drop precedence, for all GTP-C traffic.

For more information about QoS classes and DSCP values, refer to *Quality of Service on the GGSN and PGW* and *Quality of Service on the SGW*.

## 12.1 Configuring the QoS Class for GTP-C Traffic for the PGW

To configure the QoS class to be used by the GGSN or PGW for all GTP-C traffic between the PGW part in the combined SGW and PGW or standalone GGSN/PGW and the SGSN, include the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,Interface=1
   (GnC=1 | S5s8C=1)
      diffserv=(af11 | af12 | af13 | af21 | af22 | af23 | af31 | af
```

**Note:** The `GnC` and `S5s8C` interfaces must have the same value.

Configuring the QoS class for GTP-C traffic for the Gn-C interface is not supported for IPv6 configuration.

## 12.2 Configuring the QoS Class for GTP-C Traffic for the SGW

The following sections describe the configuration of QoS class for GTP-C traffic for the SGW.

### 12.2.1 Configuring the QoS Class for GTP-C Traffic for the S4 and S11 Interfaces

To configure the QoS class to be used by the SGW for all GTP-C traffic between the SGW and the S4-SGSN and the MME, include the following statement:

```
(config) ManagedElement=1,Epg=1,Sgw=1,Interface=1,S4s11C=1
   diffserv=(af11 | af12 | af13 | af21 | af22 | af23 | af31 | af32
```

### 12.2.2 Configuring the QoS Class for GTP-C Traffic for the S5/S8 Interface

The following sections describe the configuration of QoS class for GTP-C traffic for the S5/S8 interface.

#### 12.2.2.1 Configuring the QoS Class for GTP-C Traffic for the Combined S5/S8 Interface

To configure the QoS class to be used by the SGW for all GTP-C traffic between the SGW and a PGW on the combined S5/S8 interface, include the following statement:

```
(config) ManagedElement=1,Epg=1,Sgw=1,Interface=1,S5s8C=1
   diffserv=(af11 | af12 | af13 | af21 | af22 | af23 | af31 | af32 |
```

#### 12.2.2.2 Configuring the QoS Class for GTP-C Traffic for the Separate S5 and S8 Interfaces

To configure the QoS class to be used by the SGW for all GTP-C traffic between the SGW and a PGW on the separate S5 and S8 interfaces, include the following statement:

```
(config) ManagedElement=1,Epg=1,Sgw=1,Interface=1
   (S5C=1 | S8C=1)
      diffserv=(af11 | af12 | af13 | af21 | af22 | af23 | af31 | af32
```

# 13 Configuring the QoS Class for GTP Prime Traffic

To configure the QoS class to be used by the GGSN and PGW for all GTP Prime traffic between the GGSN or PGW and the charging gateway servers, include the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,Charging=1,GtpPrime=1
   diffserv=(af11 | af12 | af13 | af21 | af22 | af23 | af31 | af32 |
```

By default, the GGSN or PGW uses `af31`, which is assured forwarding class 3, low drop precedence, for all GTP Prime traffic.

For more information about QoS classes and DSCP values, refer to *Quality of Service on the GGSN and PGW*.

# 14 Configuring the QoS Class for PMIPv6 Traffic

To configure the QoS class to be used by the PGW for all PMIPv6 traffic between the PGW and the Mobile Access Gateway (MAG), include the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,Interface=1,S2aPmip=1
   dscp=(af11 | af12 | af13 | af21 | af22 | af23 | af31 | af32 | af
```

By default, the PGW uses `af31`, which is assured forwarding class 3, low drop precedence, for all PMIPv6 traffic.

For more information about QoS classes and DSCP values, refer to *Quality of Service on the GGSN and PGW*.

# 15 Configuring ARP Mapping for the GGSN and PGW

To configure the ARP mapping between the Gn/Gp, S5/S8, and Gx interfaces for the GGSN and PGW, include the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,Interface=1,GnC=1,AllocationR
   highPriority=value
   mediumPriority=value
```

To configure the value of H (high priority), include the `highPriority` statement. The value range for this statement is 1–13, and the default value is 1. To configure the value of M (medium priority), include the `mediumPriority` statement. The value range for this statement is 2–14, and the default value is 2. The M value must be greater than the H value.

**Note:** The configuration for `GnC` and `S5s8C` must have the same value.

Changes made to the H value or the M value is immediately applied to new and existing PDP context, EPS bearer, or PMIPv6 PDN connection (for PMIPv6-based S2a access).

## 15.1 Mapping the ARP Values to Corresponding Message Priority and DRMP Value

To configure the ARP command to map the ARP values into corresponding message priority and DRMP values, include the following statement:

```
(config)ManagedElement=1,Epg=1,Pgw=1,SessionPriority
=1,ArpPriorityLevel=arpPriorityLevelId
```

To configure the ARP command to map the ARP values into corresponding Message Priority values, include the following statement:

```
(config)ManagedElement=1,Epg=1,Pgw=1,SessionPriority=1,Arp
PriorityLevel=arpPriorityLevelId=<arp-priority>, gtp=1
      messagePriority=<message-priority>
```

The following output shows an example to display the ARP Message Priority values:

```
(config) ManagedElement=1,Epg=1,Pgw=1,SessionPriority=1,ArpPriorityLe
erv@epg513-1>show
  Gtp=1
   messagePriority=4
```

The following output shows an example when multiple ARP Priority Levels are configured:

```
(config) ManagedElement=1,Epg=1,Pgw=1,SessionPriority=1
erv@epg513-1>show
SessionPriority=1
   ArpPriorityLevel=1
   ArpPriorityLevel=2
```

**Note:** The mapping is global and applies to all APNs and S5 interfaces. Any change in the ARP message priority and ARP DRMP mapping reflects in the message priority of the subsequent messages of the session.

To configure the ARP command to map the ARP values into corresponding DRMP values, include the following statement:

```
(config)ManagedElement=1,Epg=1,Pgw=1,SessionP
riority=1,arpPriorityLevel=arpPriorityLevelId
,<arp-priority>, diameter=1
    routingMessagePriority=<drmp-val>
```

The following output displays the ARP values into corresponding DRMP values:

```
(config) ManagedElement=1,Epg=1,Pgw=1,SessionPriority=1,ArpPriorityLe
erv@epg513-1>show
   Gtp=1
   routingMessagePriority=5
```

**Note:** ARP Priority level cannot overlap across sessionPriority values. The `arpPriorityLevel=1` cannot exist under any other sessionPriority value. The `sessionPriority=1` is supported.

# 16 Disabling the Support for Evolved Allocation/Retention Priority

By default, support for evolved Allocation/Retention Priority (ARP) in the combined SGW and PGW, or standalone GGSN/PGW, is enabled. To disable support for evolved ARP in the combined SGW and PGW, or standalone GGSN/PGW, include the following statement:

```
(config) ManagedElement=1,Epg=1,Pgw=1,Interface=1,GnC=1
   noEvolvedArp
```

If support for evolved ARP in the combined SGW and PGW, or standalone GGSN/PGW, is disabled, review the configuration and make sure that ARP is not configured in any QCT. The following statements are affected:

- `arpPriorityLevel=`*`level`*
- `arpPci=(enable | disable)`
- `arpPvi=(enable | disable)`

If these statements are present in the configuration, remove them.

If support for evolved ARP in the combined SGW and PGW, or standalone GGSN/PGW, is disabled and ARP is configured as described in any QCT, the configuration is considered invalid and it is not possible to commit.

For more information about QCTs, see Section 11 on page 21.