

# Smart Paging

## TECHNICAL PRODUCT DESCRIPTION

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# 1 Introduction

This document describes support for smart paging in the EPG over the S4 and S11 interfaces for GSM, WCDMA, and LTE networks.

## 1.1 Scope

This document provides an overview of smart paging, including serviceID-aware smart paging and DSCP-aware smart paging.

For information on configuring serviceID-aware smart paging or DSCP-aware smart paging in the SGW, refer to [Paging Configuration](#).

## 1.2 Target Groups

This document is intended as an introduction to smart paging for network operators, network and service planners, as well as system engineers and administrators. It can be used as a basis for training and assumes a basic knowledge of data communication and telecommunication.





## 2 Overview

As part of the network-triggered request procedure, when the SGW receives downlink user packets for a UE device in ECM-IDLE state, the SGW starts buffering the user packets and notifies the SGSN or MME of the event by sending a Downlink Data Notification message. The SGW includes the EPS Bearer ID (EBI) of the bearer on which the downlink user packets was received in the Downlink Data Notification message to the SGSN or MME. With this information, the SGSN or MME can identify which UE device required the paging procedure and consequently can apply differentiated paging strategies for different end-user services.

Smart paging is an optional feature that enables the SGW to include EBI information in the Private Extension IE in a Downlink Data Notification message.

Smart paging includes serviceID-aware smart paging and DSCP-aware smart paging. Both of them are service-aware smart paging. ServiceID-aware smart paging helps the SGSN and MME to avoid Downlink Data Notification messages for low priority services, DSCP-aware smart paging helps the SGSN and MME to avoid aggressive default paging strategies, which both would otherwise load the radio network unnecessarily.

**Note:** To support DSCP-aware smart paging on the SGW, the Configurable and Adaptive Paging feature in the Ericsson SGSN-MME is required.





## 3 Service-Aware Smart Paging

This section describes serviceID-aware smart paging, DSCP-aware smart paging, and the interaction between them if both are enabled.

### 3.1 ServiceID-Aware Smart Paging

If serviceID-aware smart paging is enabled on the SGW, upon receiving downlink user packets for an idle UE, Downlink Data Notification messages sending to the SGSN or MME and packets sending to the eNodeB are based on service priorities defined in serviceID-aware smart paging profiles. When the SGSN or MME restores the path with successful paging, the SGW forwards the packets with High service priority first.

**Note:** The fragmented IP packets are classified as Normal priority service.

When serviceID-aware smart paging is enabled on the SGW, the SGW performs header packet inspection on each downlink user packet that is received for an idle UE to extract basic information.

A header rule defines the service identifier for a service and the classification criteria for the service including network address, network port, protocol, and TCP flags. A header rule set defines a list of header rules which represent the list of services serviceID-aware smart paging is to detect.

The SGW classifies the inspected packets into different services based on a header rule that is included in the header rule set. Each service is identified by a configured service identifier. For more information about header packet inspection configuration, refer to [Paging Configuration](#).

A serviceID-aware smart paging profile defines service priority for one or several service identifiers. The SGW sends Downlink Data Notification message and packets based on service priorities, as described in Table 1:

Table 1 ServiceID-Aware Smart Paging

Service Priority	Behavior
High	<p>A Downlink Data Notification message is triggered immediately regardless of Downlink Data Notification throttling and Downlink Data Notification interval. In a configured interval, Downlink Data Notification message for high priority service is only sent once.</p> <p>The SGW buffers the received packet.</p>



Service Priority	Behavior
Buffering	NoDownlink Data Notification message is triggered. The SGW buffers the received packet.
Drop	NoDownlink Data Notification message is triggered. The SGW drops the received packet.
Normal	A Downlink Data Notification message is triggered. The SGW buffers the received packet.

If downlink user packet is not matched with any serviceID-aware smart paging profile, the packet is treated as normal service priority.

When the SGSN or MME restores the path with successful paging, the SGW forwards the packets based on service priority, the packets with High service priority are sent first.

For more information about serviceID-aware smart paging profile configuration, refer to [Paging Configuration](#).

## 3.2 DSCP-Aware Smart Paging

With DSCP-aware smart paging enabled, the SGW, upon receiving downlink user packets for an idle UE, sends a Downlink Data Notification message to the SGSN or MME with a modified ARP, which overrides the bearer ARP. The SGW can also, optionally, be configured to exclude EBI information from the Downlink Data Notification message to the SGSN or MME.

The SGW identifies the bearer, to which an idle UE device is connected, using a combination of the QoS Class Identifier (QCI) and the ARP values. For all downlink user packets received from the PGW on that identified bearer, the SGW inspects the inner IP headers for the DSCP values. The SGW inspects the DSCP field for IPv4 packets and the Traffic Class field for IPv6 packets. For information on IP headers, refer to [User Packet Handling](#).

**Note:** The SGW does not support DSCP inspection of fragmented IP packets.

The QCI, ARP values, message priority, DSCP, and EBI exclusion option are defined in paging profiles configured on the SGW. For more information, refer to [Quality of Service on the SGW](#).

If the inspected DSCP, QCI, and ARP values of the downlink packet correspond to the configured values in a matching paging profile, the SGW replaces the bearer ARP with the configured ARP value in the Allocation/Retention Priority IE of the Downlink Data Notification message to be sent to the SGSN or



MME. Optionally, the SGW may exclude the EBI from the EPS Bearer ID and Private Extension IEs in the Downlink Data Notification message. When message priority is enabled for S4 interface or S11 interface, the SGW generates the MP-flag and Message Priority fields in the Downlink Data Notification message if message priority value is configured in this paging profile. For more information about the message priority in the Downlink Data Notification message, refer to Quality of Service on the SGW.

Figure 1 shows an example of signaling during a network-triggered service request procedure with DSCP-aware smart paging enabled.

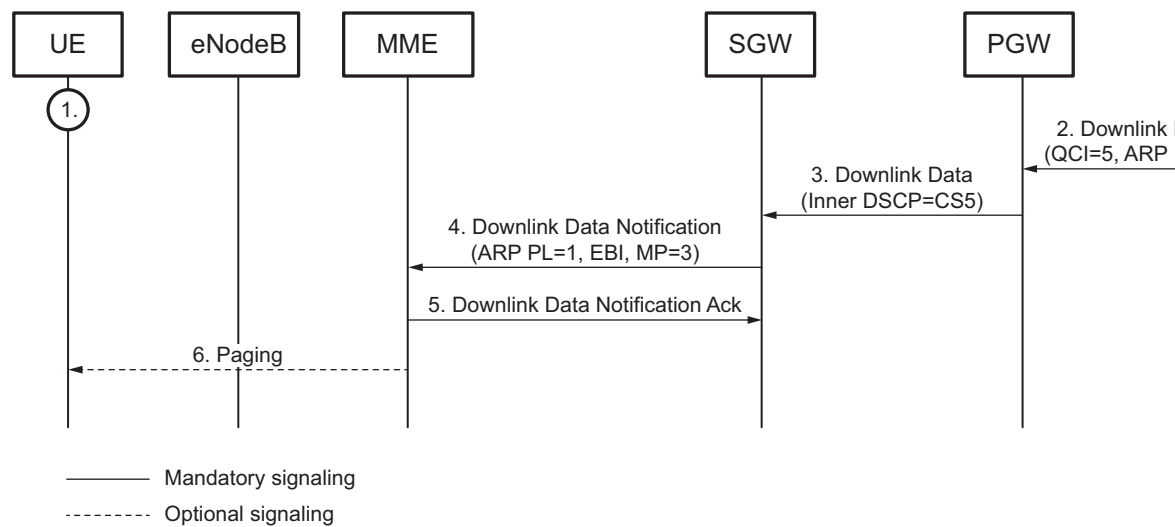


Figure 1 Signaling during a Network-Triggered Service Request Procedure with DSCP-Aware Smart Paging Enabled

Table 2 shows the values and attribute configured in a paging profile for this example.

Table 2 Paging Profile Attributes and Values

Attribute	Value
QCI	5
Bearer ARP	9
DSCP	CS5
ARP to be sent in the Downlink Data Notification message	1
Exclude EBI	No
Message Priority	3

The following steps describe the signaling for the example:



1. The UE device is in an ECM-IDLE state. DSCP-aware smart paging is enabled with the configuration of one paging profile, as shown in Table 2.
2. The PGW receives downlink user packets, which are to be sent to the idle UE.
3. The PGW forwards the downlink user packets to the SGW.
4. The SGW buffers the downlink user packets in the buffer. If the bearer QCI and ARP values match the values specified in a configured paging profile, the SGW inspects the inner IP header of packets on that identified bearer to identify the DSCP value.

If the DSCP value of the inspected packet matches the DSCP value specified in the paging profile, the SGW sends a `Downlink Data Notification` message to the MME serving the UE device with a modified ARP value set to the value configured in the matching paging profile. Based on the configuration, the EBI is included in the `Downlink Data Notification` message.

If no match is made, the SGW applies the default action, that is, sends the `Downlink Data Notification` message with an unchanged ARP value and EBI included.

5. The MME responds with a `Downlink Data Notification Acknowledge` message to the SGW.
6. The MME starts paging the UE device, according to the network-triggered service request procedure. For more information on the network-triggered service request procedure, refer to [Session Management](#).

### 3.3 Interaction between ServiceID-Aware Smart Paging and DSCP-Aware Smart Paging

ServiceID-aware smart paging and DSCP-aware smart paging work independently of each other. If both are enabled, received downlink user packets are handled by both serviceID-aware smart paging and DSCP-aware smart paging, `Downlink Data Notification` message sending decision is made by serviceID-aware smart paging first, then DSCP-aware smart paging.

For example, if DSCP-aware smart paging is enabled only, the SGW sends a `Downlink Data Notification` message for a received downlink user packet. But if both serviceID-aware smart paging and DSCP-aware smart paging are enabled, and the service priority of the received downlink user packet is `Buffering`, no `Downlink Data Notification` message is triggered for this downlink user packet.



## 4 Sending Downlink Data Notification Messages

The SGW cannot send Downlink Data Notification messages for a UE device in ECM-IDLE state more often than at a configurable interval. For information on configuring the interval for sending Downlink Data Notification messages, refer to [Paging Configuration](#).

If the SGW receives downlink user packets for a UE device in idle state with service priority High, the SGW triggers a Downlink Data Notification message to the SGSN or MME immediately. In a configured interval, Downlink Data Notification message for high priority service is only sent once.

If DSCP-aware smart paging is enabled, the SGW also triggers Downlink Data Notification messages immediately to the SGSN or MME if the ARP value to be included in the Downlink Data Notification message is higher than the ARP value sent in the previous Downlink Data Notification message for the same bearer, as described in [Section 3.2](#) on page 6.