Intelligent RAT Paging for ISR on the S-GW

This chapter provides detailed feature information for the Intelligent RAT Paging for Idle Mode Signaling Reduction (ISR) feature on the S-GW.

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Feature Description

This section describes the Intelligent RAT Paging for ISR feature on the S-GW.

When Idle Mode Signaling Reduction (ISR) is active, and a UE is in idle mode with control plane connections to both the MME and the S4-SGSN, and the S-GW receives downlink data for that UE, it sends Downlink-Data-Notification-Requests (requests to page UEs) to both the S4-SGSN and MME in parallel. This scenario causes the following problems:

- Both the MME and S4-SGSN perform paging in parallel, thereby resulting in an overuse of radio resources. The UE can be camped on either the MME or S4-SGSN, and respond to the paging of either the MME or S4-SGSN, so the radio resource of one node is not used effectively.
- If the S-GW tries to send DDN messages to both nodes sequentially, there can be a delay in call setup and establishment.

The Intelligent RAT Paging for ISR feature reduces both the radio resource usage due to paging and the internal load on the MME/S4-SGSN nodes.

The S-GW intelligently determines when to perform sequential paging as opposed to parallel paging by identifying the APN and its configuration (in the apn-profile configuration) for the downlink packet for which paging is originated. This provides the following benefits:

- More efficient utilization of radio resources used for paging when the incoming packet is not delay sensitive.
- Reduction in the delay of call establishment due to parallel paging when the incoming packet is delay sensitive.

This feature is useful for ISR enabled Networks to reduce the radio resource usage due to paging.

Relationships to Other Features

Before configuring the Intelligent RAT Paging for ISR feature on the S-GW, be aware of the following requirements and relationships to other features:

- This feature is useful if the peer MME and S4-SGSN also support ISR.
- If operators want to have the ISR paging method recovered for a given PDN, the Session Recovery feature must be configured on the S-GW.

How it Works

Intelligent RAT Paging for ISR on the S-GW

Depending on the situation, the S-GW uses one of two methods to perform Intelligent RAT Paging for ISR:

- **Sequential Paging** (pages both nodes one after the other). This method optimizes radio resource utilization. If quick call setup time is not indicated, the S-GW will perform sequential paging and it will page the S4-SGSN and MME one after the other. It first will page to the node of the last known RAT type of the UE.
- **Parallel Paging** (pages both the nodes in parallel). This method results in quick paging response time and faster call setup time. If the DDN is initiated for an APN that requires the quick call setup time (for example, VoLTE APN) then the S-GW performs parallel paging.

For intelligent paging, the S-GW has to determine whether to perform radio resource optimization or to use a quick call establishment procedure. The S-GW makes the decision to determine whether to perform sequential paging or parallel paging based on the configuration of the APN (through apn-profile applied for the APN).

The S-GW finds the APN of the particular bearer, and it checks to see if it received the downlink data. If isr-sequential-paging is configured for this APN on the S-GW, the S-GW initiates a DDN message to one node (MME or S4-SGSN) and waits for the service request procedure from that node within a configured time. If the S-GW does not receive the service request procedure within configured time, it initiates the DDN message towards the other node.

The node which was last sent the Modify Bearer Request to the S-GW (that is, the last known RAT type) is selected first to send the DDN messages.

Intelligent RAT Paging for ISR requires manual configuration through the Command Line Interface (CLI).

Licenses

Intelligent RAT Paging for ISR is a licensed-controlled Cisco feature. A separate feature license may be required. Contact your Cisco account representative for detailed information on specific licensing requirements. For information on installing and verifying licenses, refer to the *Managing License Keys* section of the *Software Management Operations* chapter in the *System Administration Guide*.

Limitations

The Intelligent RAT Paging for ISR feature has the following restrictions and limitations:

1. The S-GW performs sequential paging (if configured) only for Downlink data triggered Downlink Data Notification (DDN) messages. All control event triggered DDN messages are treated as high priority

DDN messages and the S-GW always performs parallel paging for control event triggered DDN messages. No DDN-Throttling and DDN-Delay shall be applicable only to Downlink data triggered DDN messages.

2. S-GW Intelligent RAT Paging for ISR is supported on the S-GW only. It is not supported on the SAE-GW.

Flows

This section provides descriptive call flows for the Intelligent RAT Paging for ISR feature. It includes call flows for both sequential and parallel paging procedures.

Figure 1: Intelligent RAT Paging for ISR: Sequential Paging Procedure

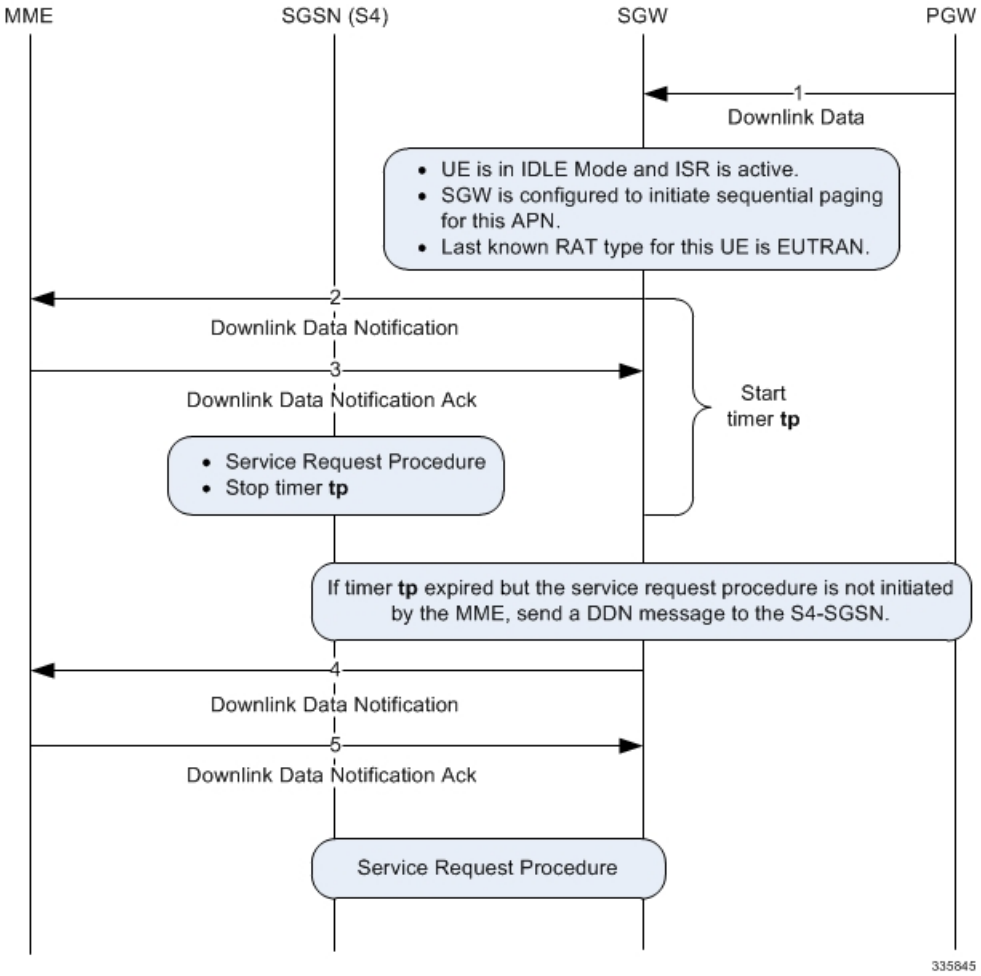

Table 1: Intelligent RAT Paging for ISR: Sequential Paging Procedure Description

Step	Description
1	The S-GW receives the downlink data packet for an idle UE which has ISR active and the S-GW is configured to initiate sequential paging for this APN. The Last known RAT Type for this UE is E-UTRAN.
2	The S-GW initiates Downlink Data Notification towards the MME and starts the timer **tp**.

Step	Description
3	The MME replies with a Downlink Data Notification Ack message. If the MME initiates the service request procedure for this UE within time **tp**, then the S-GW will stop the timer **tp** and process the service request procedure. The S-GW will not initiate the Downlink Data Notification towards S4-SGSN (in a different RAT). Therefore, the system saves the paging attempt and the radio resource of the S4-SGSN.
4	If the MME does not initiates the service request procedure for this UE within time **tp** then upon expiry of timer **tp**, the S-GW will initiate the Downlink Data Notification towards the S4-SGSN.
5	The S4-SGSN replies with a Downlink Data Notification Ack message. The S4-SGSN attempts to page the UE. The S-GW will receive the service request procedure from S4-SGSN.

Figure 2: Intelligent RAT Paging for ISR: Parallel Paging Procedure

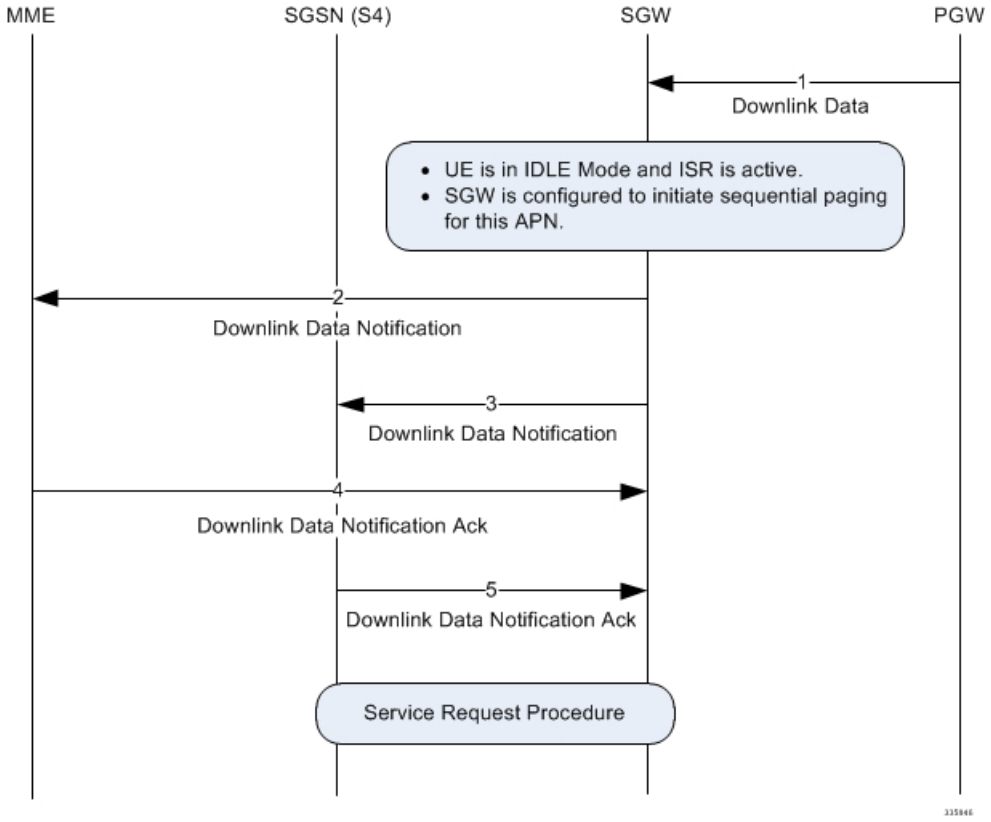

Table 2: Intelligent RAT Paging for ISR: Parallel Paging Procedure 1

Step	Description
1	The S-GW receives the downlink data packet for an ISR active, Idle UE. The S-GW is configured to initiate parallel paging for this APN.
2	The S-GW initiates Downlink Data Notification towards the MME.

Step	Description
3	The S-GW initiates Downlink Data Notification towards the S4-SGSN.
4	The MME replies with a Downlink Data Notification Ack message.
5	The S4-SGSN replies with a Downlink Data Notification Ack message.
6	The MME and S4-SGSN attempt to page the UE. The S-GW will receive the service request procedure from either the MME or S4-SGSN.

Configuring Intelligent RAT Paging for ISR on the S-GW

This section describes how to configure the Intelligent RAT Paging for ISR feature on the S-GW. It also describes how to verify the configuration and to monitor the feature's performance.

Configuring the Intelligent RAT Paging for ISR Feature

Configuration of the Intelligent RAT Paging for ISR feature on the S-GW includes enabling ISR sequential paging in the APN profile context and configuring the DDN ISR sequential paging delay time in the S-GW service context.

Use the example configuration below to configure the Intelligent RAT Paging for ISR feature.

```
config
  apn-profile apn_profile_name
    isr-sequential-paging
    end
```

Notes:

- *apn_profile_name* is the name of the APN profile to be used for Intelligent RAT ISR Paging on this S-GW.
- **isr-sequential-paging** enables Intelligent RAT ISR Paging in this APN profile.
- To disable isr-sequential-paging, enter the **remove isr-sequential-paging** command.

```
config
  context sgw_context_name
    sgw-service sgw-service_name
    ddn isr-sequential-paging delay time  duration_msecs
    end
```

Notes:

- *sgw_context_name* is the name of the context in which the S-GW service is configured.
- *sgw_service_name* is the name of the configured S-GW service.
- **ddn isr-sequential-paging delay time** specifies the time delay between the paging of different RAT types. This value is entered in increments of 100 milliseconds (where 1 = 100 milliseconds). Valid entries are from 1 to 255. The default setting is 10 (1 second).

Verifying the Intelligent RAT Paging for ISR Configuration

This section describes how to verify the Intelligent RAT Paging for ISR configuration settings.

To verify that Intelligent RAT Paging for ISR is enabled in the APN profile for this S-GW, enter the following command from Exec Mode:

```
show apn-profile full name apn_profile_name
...
LIPA-APN                                :Disabled
ISR-SEQUENTIAL-PAGING                  :Enabled
Local Offload                           :Disabled
Overcharging protection                 :Disabled
...
```

To verify that the ISR sequential delay time is configured properly, enter the following command from Exec Mode:

```
show sgw-service name sgw_service_name
...
Service name
...
   GTPU Error Indication Handling:
...
      S4U-Interface: local-purge
      ddn failure-action pkt-drop-time:   300
      ddn isr-sequential-paging delay-time:  1
      Idle timeout                          :n/a
...
```