



## Paging Enhancements on MME

This chapter describes the optimizations introduced in release 13 version of 3GPP specification to page for the availability of UE by eNB. The paging enhancements are introduced to support IoT requirements.

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## Feature Summary and Revision History

### Summary Data

Applicable Product(s) or Functional Area	<ul style="list-style-type: none"><li>• C-SGN</li><li>• MME</li></ul>
Applicable Platform(s)	<ul style="list-style-type: none"><li>• UGP</li><li>• VPC-DI</li><li>• VPC-SI</li></ul>
Feature Default	Disabled
Related Changes in This Release	Not applicable
Related Documentation	<ul style="list-style-type: none"><li>• <i>Command Line Interface Reference</i></li><li>• <i>Statistics and Counters Reference</i></li></ul>

### Revision History

Revision Details	Release
The feature is tested and qualified on the ASR 5500 platform.	21.3

Revision Details	Release
First introduced.	N5.1 (21.1.V0)

## Feature Description

MME supports encoding or decoding of these additional Information Elements (IEs) in S1AP layer as part of paging optimizations introduced in Release 13 version of 3GPP TS 36.413 standard.

The IEs supported for S1AP Paging are:

- **UE Radio Capability for Paging:** This IE contains paging specific UE Radio Capability information. This IE is sent in UE-CAPABILITY-INFO-INDICATION message over S1AP.
- **Information on Recommended Cells and eNodeBs (eNBs) for Paging:** This IE provides information on recommended cells and eNBs for paging. This IE is included in UE-CONTEXT-RELEASE-COMPLETE message.
- **Cell Identifier and Coverage Enhancement Level:** This IE provides information for paging CE capable UEs. This IE is included in UE-CONTEXT-RELEASE-COMPLETE message.
- **Assistance Data for Paging:** This IE provides assistance information for paging optimization. This IE is sent in PAGING request message to page a UE in one or several tracking areas.

The eNodeB sends paging assistance IEs as part of UE Context Release procedure. MME stores these decoded IEs and sends back this information during paging procedure to eNB in order for the EPC and the E-UTRAN to optimize usage of network resources.

The MME supports UE Radio Capability for Paging Information as per TS 23.401 standard. This is required for Cat-0/Cat-M1/NB-IoT devices to provide extended coverage.



### Important

This feature is license controlled. Contact your Cisco account representative for information on how to obtain a license.

## How it Works

MME initiates paging procedure to page a UE by sending PAGING message to the eNB. MME includes "UE Radio Capability for Paging" and "Assistance Data for Paging" IEs if available for the UE. If the "UE Radio Capability for Paging" IE is included in the PAGING message, the eNB uses it to apply specific paging schemes. If the "Assistance Data for Recommended Cells" and "Assistance Data for CE Capable UEs" IEs are included in the Assistance Data for Paging IE, it is used along with the Paging Attempt Information IE if present. If the "Next Paging Area Scope" information is included in the Paging Attempt Information IE, it is used for paging the UE.

The eNB controlling a UE-associated logical S1 connection initiates the procedure by sending a UE-CAPABILITY-INFO-INDICATION message to the MME. This message includes UE Radio Capability for Paging IE containing paging specific UE capability information. This information replaces any previously stored information in the MME for the UE. This information is transparent to MME, which stores the received information as is and sends back the same to eNB in S1-Paging message.

Upon successful operation of MME initiated UE-CONTEXT-RELEASE, the eNB, if supported, reports the following information "Information on Recommended Cells and eNBs for Paging" IE & "Cell Identifier and Coverage Enhancement Level" IE in UE-CONTEXT-RELEASE-COMPLETE message. The MME stores this information and sends back the same in subsequent Paging message initiated from MME. This information replaces any previously stored information in the MME for the UE. This information is transparent to MME, which stores the received information as is and sends back the same to eNB.

During Attach without PDN / Attach with CP Optimization enabled / TAU Attach with Attach without PDN enabled cases, MME sends the Connection Establishment Indication message without UE Radio Capability IE to eNB if it does not have the information after Attach Accept/TAU Accept. If eNB receives this message without UE Radio Capability IE, it fetches the data and sends it in the UE-CAPABILITY-INFO-INDICATION message.

## Limitations

The following are the list of limitations with respect to the configuration of this feature:

- MME does not store the "UE Radio Capability for Paging" IE with a length exceeding 1024 bytes. This IE information is stored only when the maximum length of the IE is within 1024 bytes.
- MME recovers the stored "UE Radio Capability for Paging" information as part of session recovery, but does not recover the following information "Information on Recommended Cells and eNBs for Paging" and "Cell Identifier and Coverage Enhancement Level".

## Monitoring and Troubleshooting the Paging Enhancements

This feature does not have any functional impact in the field if MME fails to decode the new S1AP IE(s);

- It continues to process the "UE-CONTEXT-RELEASE-COMPLETE" and release the resources if any exists for the S1 connection.
- It continues to send the S1-Paging as it is sending currently without the optional parameters.

If the feature is not working as expected, the following information needs to be collected to help debug the issue further:

- Output of **show mme-service session full imsi** <imsi> command will help to identify if MME is able to decode and store the "UE Radio Capability for Paging" IE as part of UE context.
- Output of **monitor subscriber ...** or **monitor protocol** command along with S1-AP protocol enabled for the affected subscriber where the dissected protocol information is available for all S1AP messages with the new IE(s).



### Important

MME does not store the received UE Radio Capability for Paging information if it exceeds the maximum allowed limit and it prints the following log, "2016-Aug-18+05:40:14.307 [mme-app 147072 debug] [2/0/14972 <sessmgr:1> access\_s1.c:1461] [software internal user syslog] Error processing NAS msg. Length of UE Radio Capability for Paging IE is more than expected."

## Paging Enhancements Show Command(s) and/or Outputs

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

The show commands in this section are available in support of the Paging Enhancement feature.

### mme Schema

A new bulk statistic "slap-transdata-connestind" is added in this schema to count the total number of times MME has sent Connection Establishment Indication message over S1AP interface to eNodeB.

### show mme-service session full imsi

A new field "Radio Capability for Paging" has been added to the output of this show command. This field displays the value in hexadecimal format if the UE received "UE Radio Capability for Paging" IE in S1 "UE-CAPABILITY-INFO-INDICATION" message from eNB. Otherwise, this field displays N/A.

### show mme-service statistics

A new field "Connection Est Ind" is added to this command under Transmitted S1AP Statistics to display the total number of times MME has sent Connection Establishment Indication message over S1AP interface to eNodeB.

### monitor protocol

This command is used for monitoring and troubleshooting a particular UE. When S1-AP protocol is enabled for the UE, this command displays the dissected protocol information for the associated IE(s).