

eDRX Support on the MME

This feature describes the Extended Discontinuous Reception (eDRX) support on the MME in the following sections:

- Feature Summary and Revision History, on page 1
- Feature Description, on page 2
- How eDRX Works, on page 3
- Configuring eDRX on the MME, on page 6
- Configuring NB-IoT in UE Context, on page 12
- Monitoring and Troubleshooting eDRX, on page 12

Feature Summary and Revision History

Summary Data

Applicable Products or Functional Area	• C-SGN • MME
Applicable Platforms	• ASR 5500 • UGP • VPC-DI • VPC-SI
Feature Default	Disabled - Configuration Required Enabled - Configuration Required (eDRX GPS time support in 21.4)
Related Changes in This Release	Not applicable

Related Documentation	• *Command Line Interface Reference* • *Statistics and Counters Reference* • *MME Administration Guide* • *Ultra IoT C-SGN Administration Guide*

Revision History

Revision Details	Release
MME is enhanced to detach the UE on deletion of the last PDN associated with the NB-IoT.	21.27
Support is added for Delete Subscriber Data Request (DSR) flag bits 28 and 30 Paging Time Window (PTW) subscription withdrawal with eDRX.	21.26
Paging eDRX H-SFN changed to 10 bits counter.	21.11.3
The eDRX feature is enhanced to support H-SFN Start time configuration in GPS format and H-SFN Reference time in GPS and UTC format. The **edrx** command in the MME Service Configuration mode is enhanced in this release. Refer to the *Configuring Hyper SFN Synchronization* section for more information. The feature default for this enhancement is "Enabled - Configuration Required".	21.4
The feature is tested and qualified on the ASR 5500 platform.	21.3
The enhancements in the N5.1 release include: • MME supports configuration of the T3415 paging timeout value. MME uses the T3415 timer for eDRX UEs. • The **edrx** CLI command is enhanced to support DL Buffering Suggested Packet Count in DDN ACK when unable to page UE. • Support of the DL-Buffering-Suggested-Packet-Count AVP	N5.1 (21.1.V0)
First introduced.	21.0

Feature Description

The Extended Discontinuous Reception (eDRX) feature allows IoT devices to remain inactive for longer periods. This feature allows the device to connect to a network on a need basis – the device can remain inactive or in sleep mode for minutes, hours, or even days, thus increasing the battery life of the device.

Extended DRX cycles provide UEs longer inactive periods between reading, paging, or controlling channels.



Important The Extended DRX feature is license controlled. Contact your Cisco Account or Support representative for information on how to obtain a license.

Important With release 21.11.3 Paging eDRX H-SFN changed to 10 bits counter to allow values between 0 to 1023 as per 3GPP TS 36.331 V13.13.0.

The primary advantage is that without eDRX support, the MME will page the UE unconditionally. When eDRX is enabled, the MME pages the UE only at valid paging occasions and the MME sends the eDRX paging parameters to eNodeB during paging.

DSR flag and PTW Subscription Withdrawal on eDRX

The MME is enhanced to support Delete Subscriber Data Request (DSR) flags bits 28 and 30, and Paging Time Window (PTW) subscription withdrawal with eDRX. This feature supports on the eDRX related Radio Access Technology (RAT) AVP in the DSDR message. This feature is beneficial to the Session Manager (SessMgr) running the MME application stack.

Enforcing Detach on Last PDN Deactivation

MME is enhanced to detach the UE on deletion of the last PDN associated with the NB-IoT access type. The enhancement supports a deviation from the 3GPP standards in this respect.

This scenario is applicable only when Attach without PDN Connectivity is enabled for the user.

How eDRX Works

In order to use the eDRX feature, the UE requests the eDRX parameters during ATTACH and TAU procedures. Based on the configuration, the MME may accept or reject the UE's request to enable the eDRX feature. If the MME accepts the eDRX request, different values of the eDRX parameters are provided based on operator policies, apart from the parameters requested by the UE.

The operator can configure the eDRX parameters Paging Time Window (PTW) and eDRX cycle length duration in the Call Control Profile Configuration mode. The UE requested values of PTW and eDRX cycle is received in the Attach or TAU request. The H-SFN start time and H-SFN reference time for leap second adjustment can also be configured. MME calculates the paging occasion for the UE using the values of H-SFN start time, H-SFN reference time, PTW, and eDRX cycle length. The UE is paged only at the paging occasion until the PTW expires. The MME rejects all other paging requirements which occur in between the paging occasion.

The downlink buffer duration in DDN ACK can be configured when the MME cannot page the UE. This is an optional configuration. For Downlink Data Notifications (DDN), if the UE is not in a paging occasion, the MME does not page the UE. The MME sends a Downlink Data Notification Reject message to the S-GW along with the DL buffering duration and DL suggested packet count IEs as per the operator configuration. The packet count in DDN ACK can be configured to configure the packet count value. The MME starts a timer to page at the next paging occasion. If downlink buffer duration is not configured, the MME rejects the DDN without these IEs. If the packet count value is not configured locally, the subscription provided value is used. The subscription value can be "0" in which case the packet count IE will not be sent for that subscriber even if it is configured locally.

If the UE is not in a paging occasion, the MME rejects the paging request for dedicated bearer creation request and sends bearer reject to the S-GW with the cause "UE is temporarily not reachable due to power saving". The MME starts a timer to page at the next paging occasion. If the UE is not in a paging occasion during MME-initiated detach where the MME needs to page the UE to send a detach request, the MME does not page the UE and performs an implicit detach.

The following new flags are introduced as part of this feature. These flags are supported in GTPCv2 Indication IE:

- Pending Network Initiated PDN Connection Signaling Indication (PNSI): The source MME supports sending of PNSI flag in GTPCv2 Indication IE of Context response.
- UE Available for Signaling Indication (UASI): The MME supports sending of the UASI flag in GTPCv2 Indication IE of Create Session Request and Modify Bearer Request to indicate to the P-GW that the UE is available for end-to-end signaling.
- Delay Tolerant Connection Indication (DTCI): The MME supports receiving the DTCI flag in Create Session Response from the S-GW. The MME supports receiving of the DTCI flag in Context Response and Forward Relocation Request from peer MME or S4-SGSN.

The MME rejects CBR/UBR when PPF is False. The cause "UE is temporarily not reachable due to power saving" is sent in the response by the MME if the corresponding PDN was marked "Delay tolerant" by P-GW.

DSR flag and PTW Subscription Withdrawal on eDRX

If MME receives the eDRX-Related-RAT AVP (1705) with the DSR flag set for eDRX withdrawal, the MME compares the RAT type of the subscriber session with the received RAT type in eDRX-Related-RAT AVP. If it matches, then the MME resets the eDRX information to the values negotiated in the Attach Request.

Table 1: Procedure

Step	Message Type	Description
1	Create Session Request	The MME includes Origination Time Stamp and Maximum Wait time on S11 interface. When present, the Origination Time Stamp contain the Universal Time Code (UTC) time when the originating entity initiated the request, and the Maximum Wait Time will contain the duration (number of milliseconds since the Origination Time Stamp) during which the originator of the request waits for a response. If S-GW receives IEs from the MME, then the S-GW includes these IEs on the S5 or S8 interface.
2	Credit Control Request-Initial Request	The IEs received in P-GW sends messages to PCRF through Gx interface. This gets included only in the initial request of CCR.
3	Authentication Authorization Request	The IEs received in P-GW sends messages AAA through s6b interface.

eDRX Parameters

A Hyper-SFN (H-SFN) frame structure is defined for regular idle mode DRX. Each H-SFN value corresponds to a legacy SFN cycle comprised of 1024 radio frames (10.24 seconds). For WB-E-UTRAN, the extended idle mode DRX value range consists of values starting from 5.12seconds (for example, 5.12, 10.24, 20.48 seconds and so on) up to a maximum of 2621.44 seconds (almost 44 minutes). For NB-IoT, the extended idle mode DRX value range starts from 20.48seconds (for example, 20.48, 40.96, 81.92 seconds and so on) up to

a maximum of 10485.76 seconds (almost 3 hours). When eDRX is enabled for a UE, the UE is reachable for paging in specific Paging Hyperframes (PH), which is a specific set of H-SFN values. The PH computation is a formula that is function of the eDRX cycle, and a UE specific identifier. This value can be computed at all UEs and MMEs without need for signalling. The MME includes the extended idle mode DRX cycle length in paging message to assist the eNodeB in paging the UE.

The MME also assigns a Paging Time Window length, and provides this value to the UE during attach/TAU procedures together with the extended idle mode DRX cycle length. The UE first paging occasion is within the Paging Hyperframe. The UE is assumed reachable for paging for an additional Paging Time Window length after first paging occasion. After the Paging Time Window length, the MME considers the UE unreachable for paging until the next Paging Hyperframe.

Loose Hyper SFN Synchronization

In order for the UE to be paged at the same time, the H-SFN of all eNodeBs and MMEs must be loosely synchronized. Each eNodeB and MME synchronizes the H-SFN counter so that the start of H-SFN=0 coincides with a pre-configured time. It is assumed that eNodeBs and MMEs are able to use the same H-SFN value with accuracy in the order of legacy DRX cycle lengths, for example 1 to 2 seconds. Synchronization is not required at SFN level and signaling between network nodes is not required to achieve loose H-SFN synchronization.

Paging and Paging Retransmission Strategy

When the MME receives trigger for paging and the UE is reachable for paging, the MME sends the paging request. If the UE is not reachable for paging, then the MME pages the UE just before the next paging occasion. The MME determines the Paging Time Window length based on paging retransmission strategy, and uses it to execute the retransmission scheme.

The MME uses the T3413 timer for non-eDRX UEs to re-transmit paging. For eDRX UEs the MME uses the T3415 timer and on expiry of T3415 timer, the network aborts the paging procedure.

If a session recovery occurs then the eDRX timer re-starts only for the remaining time of the total time configured before session recovery. This is to ensure that the UE and MME are in sync with respect to the paging occasion.

Limitations and Restrictions

The following are the limitations for eDRX Support for the MME feature:

- eDRX feature is compatible only with IoT devices. It is not available for all Mobile Stations (MS). For example, only those MSs and their respective Base Service Stations (BSS) that have the extended coverage parameters are supported by the SGSN.
- 'eDRX withdrawal through HSS' feature to withdraw HSS provided eDRX parameters through Delete Subscriber Data Request (DSR) flag bits 28 (Paging Time Window Subscription Withdrawal) and 30 (eDRX-Cycle-Length Withdrawal) <3GPP rel 15 TS 29.272> is currently supported for NB-IoT subscribers.
- The **show mme-service session** CLI command is enhanced to print the current EDRX parameters PTW and EDRX-Cycle-Length values for only NB-IoT subscribers.
- As part of HSFN synchronization, if eNodeBs and MMEs use different epochs, (for example, due to the use of different time references), the GPS time should be set as the baseline. This is currently not supported.

- If the network starts timer T3415, the network shall set timer T3415 to a value smaller than the value of timer T3-RESPONSE. This is currently not supported.

Standards Compliance

The eDRX feature complies with the following standards:

- 3GPP TS 23.682 version 13.4.0, Architecture enhancements to facilitate communications with packet data networks and applications (Release 13)
- 3GPP TS 24.302 version 13.5.0, Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3 (Release 13)
- 3GPP TS 23.401 version 13.5.0, General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access.
- 3GPP TS 29.274 version 13.5.0, 3GPP Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunneling Protocol for Control plane (GTPv2-C); Stage 3
- 3GPP TS 36.304 version 13.3.0, Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode
- 3GPP TS 36.300 version 13.2.0, Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2
- 3GPP TS 36.413 version 13.1.0, Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP)
- 3GPP TS 24.008 version 13.5.0, Mobile radio interface Layer 3 specification; Core network protocols; Stage 3

Configuring eDRX on the MME

Enabling eDRX on MME

Use the following configuration to enable the eDRX feature on the MME in the Call Control Profile Configuration mode. The configuration provides options to configure:

- Accept eDRX parameters: Paging Time Window (PTW) and eDRX cycle length value, from the UE
- PTW and eDRX cycle length value
- Downlink buffer duration in DDN ACK when unable to page UE
- "DL Buffering Suggested Packet Count" in DDN ACK when unable to page UE

```
configure
   call-control-profile profile_name
      edrx { ptw ptw_value edrx-cycle cycle_length_value | ue-requested } [
dl-buf-duration [ packet-count packet_count_value ] ]
      remove { edrx | nb-iot edrx }
      end
```

Notes:

- The **remove** keyword disables the eDRX configuration on the MME.
- The **edrx** keyword configures extended discontinuous reception parameters.
- The **ue-requested** keyword specifies the accepted UE requested values of the of the Paging Time Window (PTW) and the eDRX cycle length received from the UE in the Attach Request/TAU Request message be accepted.
- The **ptw** *ptw_value* keyword configures the PTW value.

  In releases prior to 21.2: *ptw_value* is an integer ranging from 0 to 20.

  In 21.2 and later releases: *ptw_value* is an integer ranging from 0 to 15. The values 0 to 15 are mapped to 2.56, 5.12, 7.68, 10.24, 12.80, 15.36, 17.92, 20.48, 23.04, 25.60, 28.16, 30.72, 33.28, 35.84, 38.40 and 40.96 seconds.
- The **edrx-cycle** keyword configures the eDRX cycle length. The *cycle_length_value* is an integer value in seconds from 5.12 to 2621.44. It is a multiple of 2 starting from 5.12 up to 2621.44 seconds (for example: 5.12, 10.24, 20.48, and so on).
- The **dl-buf-duration** keyword sends Downlink Buffer Duration data in the DDN ACK message when MME is unable to page the UE.
- The **packet-count** keyword sends "DL Buffering Suggested Packet Count" in DDN ACK when the UE cannot be paged. The *packet_count_value* is an integer from 0 to 65535. If the *packet_count_value* is not configured locally, the subscription provided value for the *packet_count_value* is used. The subscription value can be 0 in which case the packet count IE will not be sent for that subscriber even if it is configured locally.
- This command is disabled by default.

Verifying eDRX on the MME

Execute the following command to verify the configured values.

show call-control-profile full name *profile_name*

```
Extended DRX:
    Paging Time Window                                : 10 Seconds
    eDRX Cycle Length                                 : 512 Seconds
    Downlink Buffer Duration in DDN Ack               : Enabled
    DL Buffering Suggested Packet count in DDN Ack    : 10
```

Configuring Hyper SFN Synchronization

This section describes the Hyper-SFN Synchronization start time and reference time configuration.

Configuring Hyper-SFN Synchronization Start Time

Use the following configuration to configure the Hyper-SFN Synchronization start time in GPS or UTC format.

```
configure
  context context_name
    mme-service service_name
```

```
edrx hsfn-start start_time [ gps | utc ]
no edrx hsfn-start
end
```

Notes:

- The **no** option disables the H-SFN synchronization time configuration.
- *start_time*: Specifies the time at which H-SFN=0 starts, entered in GPS or UTC time format. The UTC time format is **YYYY:MM:DD:hh:mm:ss**.
- **gps | utc**:
  - **gps**: Specifies the time at which H-SFN=0 starts in GPS format. GPS time starts from 1980:01:06:00:00:00.

    For example: **edrx hsfn-start 2000:03:01:12:34:56 gps**
  - **utc**: Specifies the time at which H-SFN=0 starts in UTC format. UTC time starts from 1972:06:30:00:00:00.

    For example: **edrx hsfn-start 2000:03:01:12:34:56 utc**
- The **gps** and **utc** keywords are optional. If not explicitly provided, then H-SFN=0 starts in UTC format.
- After the HSFN-start configuration, the HSFN-reference can be configured to adjust the leap seconds.

Configuring Hyper-SFN Synchronization Reference Time

Use the following configuration to configure the Hyper-SFN Synchronization reference time for leap second adjustment.

```
configure
  context context_name
    mme-service service_name
      edrx hsfn-reference ref_time adjust leap_seconds
      no edrx hsfn-reference
      end
```

Notes:

- *ref_time*: Specifies the reference time in UTC format as **YYYY:MM:DD:hh:mm:ss**.
- **adjust** *leap_seconds*: Specifies the number of leap seconds that need to be adjusted. *leap_seconds* must be an integer from 0 to 100.
  - A maximum of **2** H-SFN reference time configuration is allowed. The first configuration will be the latest leap-second adjustment UTC time and the second configuration will be the next or declared leap-second adjustment UTC time.

    For example:

    Consider the following H-SFN reference time configuration:

    ```
    edrx hsfn-reference 2017:01:01:00:00:00 adjust 5
    ```

    When the next leap second adjustment is announced with new time **2018:01:01:00:00:00**, MME can be configured any time before 2018:01:01 with the following configuration.

    ```
    edrx hsfn-reference 2018:01:01:00:00:00 adjust 6
    ```

When another leap second adjustment is announced with another new time **2018:06:30:00:00:00**, MME can be configured any time before 2018:06:30 with the following configuration, and deletes the oldest time reference (2017:01:01) configuration.

```
no edrx hsfn-reference 2017:01:01:00:00:00
edrx hsfn-reference 2018:06:30:00:00:00 adjust 7
```

- For HSFN-Start in GPS format, the number of leap seconds must be provided from 1980:1:06. For example: at 2017:01:01:00:00:00, the number of leap seconds from 1980:1:06 are 18.
- For HSFN-Start in UTC format, the number of leap seconds must be provided from the HSFN-Start time. For example: at 2000:03:01:12:34:5, the number of leap seconds from 2000:03:01:12 are 5.

- The **no** option disables the H-SFN reference time configuration.
- The **edrx hsfn-reference** command is disabled by default.

Understanding Lead Seconds Adjustments

A second (leap second) is added to our clocks to synchronize them with the Earth's slowing rotation.

The International Earth Rotation and Reference Systems Service (IERS) is responsible for monitoring the Earth's rotation and deciding when to insert a leap second.

Leap seconds are added from time to time to ensure that our clocks reflect the Earth's rotation speed as accurately as possible. The speed at which our planet rotates around its axis fluctuates daily and it slows down slightly when measured over a long period (although for shorter periods it may speed up).

By adding an extra second to the time count allows clocks to stop for that second to give Earth the opportunity to catch up.

How it Works

The Coordinated Universal Time (UTC) is the world's time standard, and each time zone is defined by some hours or minutes ahead or behind UTC.

At its core, UTC follows International Atomic Time (TAI). This time scale combines the output of some 200 highly precise atomic clocks that are maintained in laboratories around the world.

UTC was already 10 seconds behind TAI before the first leap second was added in 1972. Since then, the Earth has slowed down an extra 27 seconds, and a total of 27 leap seconds have been added. This means that UTC is currently 37 seconds behind TAI. For more information see, the *Past Leap Seconds* table.

Table 2: Past Leap seconds

UTC Date	UTC Time	Difference TAI vs. UTC
30/06/1972	23:59:60	11 secs
31/12/1972	23:59:60	12 secs
31/12/1973	23:59:60	13 secs
31/12/1974	23:59:60	14 secs
31/12/1975	23:59:60	15 secs

UTC Date	UTC Time	Difference TAI vs. UTC
31/12/1976	23:59:60	16 secs
31/12/1977	23:59:60	17 secs
31/12/1978	23:59:60	18 secs
31/12/1979	23:59:60	19 secs
30/06/1981	23:59:60	20 secs
30/06/1982	23:59:60	21 secs
30/06/1983	23:59:60	22 secs
30/06/1985	23:59:60	23 secs
31/12/1987	23:59:60	24 secs
31/12/1989	23:59:60	25 secs
31/12/1990	23:59:60	26 secs
30/06/1992	23:59:60	27 secs
30/06/1993	23:59:60	28 secs
30/06/1994	23:59:60	29 secs
31/12/1995	23:59:60	30 secs
30/06/1997	23:59:60	31 secs
31/12/1998	23:59:60	32 secs
31/12/2005	23:59:60	33 secs
31/12/2008	23:59:60	34 secs
30/06/2012	23:59:60	35 secs
30/06/2015	23:59:60	36 secs
31/12/2016	23:59:60	37 secs
**Further leap seconds not yet announced.*		

Calculating Leap Seconds

Use the *Past Leap Seconds* table to count the number of leap seconds that are added in between the start time and the reference time chosen.

Example 1: For HSFN-Start in GPS format, provide the number of leap seconds from 1980:01:06:00:00:00. For example, if start time is configured at 1980:01:06:00:00:00 and reference time is configured at 2017:01:01:00:00:00, then the number of leap seconds that is added in between these start and reference times are 18. Hence, leap seconds adjustment becomes 18.

Example 2: For HSFN-Start in UTC format, provide the number of leap seconds from the HSFN-Start time. For example, if start time is configured at 2000:03:01:12:34:05 and reference time is configured at

2017:01:01:00:00:00, then the number of leap seconds that is added in between these start and reference times are 5. Hence, leap seconds adjustment becomes 5.

Verifying H-SFN Synchronization

Use the following command to verify the H-SFN configuration:

show mme-service full *service_name*

```
Extended DRX:
     H-SFN Start            : 2016:03:01:12:34:56 GPS | UTC
     H-SFN UTC Reference    : 1982:209.165.200.224
     Adjusted time          : 1
```

Configuring the T3415 eDRX Timer

This section describes how to configure the T3415 eDRX timer. This timer is used to configure the eDRX paging timeout. The **t3415-timeout** keyword is added as part of the **emm** command in the MME Service Configuration mode. The **emm** command is used to configure evolved mobility management timer parameters such as timeout durations for timers and retransmission counts and for Non-Access Stratum (NAS) message retransmission in MME service.

```
configure
  mme-service service_name
     emm { implicit-detach-timeout detach_dur | mobile-reachable-timeout
mob_reach_dur | t3346-timeout t3346_dur | t3412-extended-timeout t3412_ext_dur
| t3412-timeout t3412_dur | t3413-timeout t3413_dur | t3415-timeout t3415_dur
 | t3422-timeout t3422_dur | t3423-timeout t3423_dur | t3450-timeout t3450_dur
 | t3460-timeout t3460_dur | t3470-timeout t3470_dur }
     default emm { implicit-detach-timeout | mobile-reachable-timeout |
t3346-timeout | t3412-extended-timeout | t3412-timeout | t3413-timeout |
 t3415-timeout | t3422-timeout | t3423-timeout | t3450-timeout |
t3460-timeout | t3470-timeout }
```

Notes:

- The keyword **t3415-timeout** *t3415_dur* is used to configure the T3415 paging timeout value. The *t3415_dur* is an integer value in the range 1 up to 20 seconds. The default value is 6 seconds.

Verifying the T3415 eDRX Timer

Execute the **show mme-service full** *service_name* command to verify the configured value of the T3415 timer.

For example: The **T3415 Timeout** parameter displays the configured value of T3415 timer as 3 seconds.

show mme-service full *service_name*

```
T3415 Timeout  :  3s
```

Configuring the T3415 eDRX Timer in LTE Paging Profile Configuration Mode

This section describes how to configure the T3415 eDRX timer in the LTE Paging Profile Configuration mode. This timer is used to configure the eDRX paging timeout. The **t3415-timeout** keyword is added as part of the **paging-stage** command under the LTE Paging Profile Configuration mode. The **paging-stage**

command enables the operator to configure different stages of paging in the order of desired execution with parameters that control the pace, volume, and behavior of a given paging stage.

```
configure
   lte-policy policy_name
      paging-profile profile_name
         [ no ] paging-stage level match-criteria { ue-contact-time seconds |
 all } action { last-n-enb-last-tai max-n-enb value | all-enb-last-tai |
all-enb-all-tai } t3413-timeout seconds max-paging-attempts attempts [
t3415-timeout t3415_dur ]
        end
```

Notes:

- The **t3415-timeout** *t3415_dur* keyword is used to configure the T3415 paging timeout value. The *t3415_dur* is an integer ranging from 1 to 20 seconds.
- The **no** keyword disables the configuration.
- There are no re-tries in a paging stage.
- This command is disabled by default.

Configuring NB-IoT in UE Context

Use the following configuration to detach the UE on the deletion of the last PDN for NB-IoT access type even if the UE did an attach with Attach Without PDN Connectivity enabled:

```
configure
          call-control-profile profile_name
                    [ remove ] nb-iot ignore-attach-without-pdn
            end
```

NOTES:

- **nb-iot ignore-attach-without-pdn**: Allows detach of Attach-Without-PDN UE after last PDN disconnect.
- **remove**: Disables the existing configuration.

Monitoring and Troubleshooting eDRX

eDRX Show Command(s) and /or Outputs

This section provides information regarding the show commands and their outputs for the eDRX feature.

show mme-service statistics

The following fields are added to the output of this command.

- EDRX Subscribers - Displays information about the eDRX subscribers.
- Attached Cells - Displays the number of attached subscribers for which eDRX is enabled.

- DDN Rejects - Displays the number of DDNs rejected when eDRX subscribers cannot be paged (UE is out of the paging window).

show egtpc statistics verbose

The following fields are added to the output of this command.

- UE not reachable due to PSM
- Create Bearer Denied
- Create Bearer Denied TX
- Update Bearer Denied
- Update Bearer Denied TX

The Create Bearer Request (CBR) and Update Bearer Request (UBR) are rejected when the UE is in Power Saving Mode. The MME sends the cause "EGTP_CAUSE_UE_TEMP_NOT_REACHABLE_DUE_TO_POWER_SAVING" in the reject message if that PDN is marked "Delay Tolerant" by PGW (DTCI flag enabled in PDN Connection Indication IE of Create Session Response). Otherwise the MME sends the cause "EGTP_CAUSE_UNABLE_TO_PAGE_UE" to S-GW in CBR/UBR Reject.

show lte-policy paging-profile name *profile_name*

The following fields are added to the output of this command.

- Paging Stage
- Paging Action
- Match Criteria
- T3413-Timeout
- Max Paging Attempts
- T3415-Timeout

Troubleshooting

The following troubleshooting steps can be used to verify the eDRX configuration:

- If eDRX is not enabled, verify if the eDRX parameters are configured in the call control profile and the eDRX H-SFN start time is configured for the MME service.
- If paging failures occur, verify the eDRX parameters.

Show Commands and Outputs

This section provides information about the show commands and outputs to displays the current Paging eDRX information of a subscriber.

show mme-service session full all | grep Paging

Table 3: show mme-service session full all | grep Paging Command Output Descriptions

Field	Description
SessMgr Instance	The Session Manager instance managing this session.
Paging eDRX	The following are the paging eDRX parameters: • eDRX cycle length • PTW
MSID	The UE identity (MS Identity) of a connected subscriber to an MME service, and whether the subscriber is unauthenticated (such as during emergency attach).
Callid	The call identity in 8 digit hex number of connected calls to an MME service.
MME Service	The name of the serving MME service of which information is displayed.
MME HSS Service	The name of the serving MME-HSS service which is used for AAA for this subscriber with HSS on S6a interface.
EGTP S11 Service	The name of the serving eGTP service which is used for connectivity between MME and S-GW on S11 interface.
MME S1 Address	The IP address of MME used for connecting with eNodeB on S1-MME interface.
EGTP S11 Address	The IP address assigned to eGTP service which is used for connectivity between MME and S-GW on S11 interface.
ME Identity	The mobile equipment identity of connected UE.
GUTI	The Globally Unique Temporary Identifier (GUTI) used for this subscriber session. GUTI is constructed with following identifiers: • PLMN (MMC and MNC) • MME Group ID (MMEGI) • MME Code (MMEC) • MME TMSI (M-TMSI)
MSISDN	The Mobile Station International ISDN Number (MSISDN) of connected EPS subscriber to an MME service.
EMM State	The status of EPS Mobility Management (EMM) session of connected subscriber. Possible status are: • Registered • Connected

Field	Description
ECM State	The status of EPS Connection Management (ECM) session of connected subscriber. Possible status are: • Registered • Connected • Idle
Attach type	Indicates the type of UE attachment of active subscriber to MME service, for example: Emergency or Initial EPS.
Active SGW S11 Addr	The IP address of S-GW connected to MME on S11 interface.
SGW Control TEID	Displays the TEID of the S-GW currently serving the UE.
UE Offloading	Displays the UE offload state for load rebalancing. Possible values are None, Marked, In-Progress and Done.
UE Reachability Timer	The configured value of the mobile reachability timer set for tracking UE in EMM session.
Remaining Time	The remaining time in seconds out of the configured value of the mobile reachability timer in the EMM session.
Paging Proceed Flag (PPF)	The current state of the Paging Proceed Flag indicating whether or not the UE is sending periodic TAUs within the span of the mobile reachability timer. If the UE fails to send a TAU within the timer value, this flag is set to "Paging Disabled" indicating that the MME is no longer paging the UE.
ISR Status	Displays if the session is using Idle mode Signaling Reduction (ISR). Possible configurations are Activated or Not activated.
Low Access Priority Indication	Displays whether this session has LAPI indicator in any of attach/extended service/TAU/bearer resource allocation/bearer resource modification/PDN connectivity requests.
Initial UE establishment cause	Displays the establishment cause as set in the Initial UE message: Delay Tolerant Access / High Priority Access / Emergency / MT-Access / Unknown
Peer SGSN	Displays the IP address of the SGSN which has a context for this UE in support of Idle mode Signaling Reduction (ISR). A Peer SGSN address is only shown when ISR is activated for this session.
UE Capability Information	This group shows the UE Capability information for connected UE received by an MME service.
Radio Capability	The radio capability information received by an MME service for connected UE in UE capability exchange message.
Radio Capability for Paging	The radio capability information received by an MME service for paging the UE. This field displays the value in hexadecimal format if the UE receives "UE Radio Capability for Paging" IE in S1 "UE-CAPABILITY-INFO-INDICATION" message from eNB. Otherwise, this field displays N/A.

Field	Description
Supported Codec List	The Supported Codec List information received by an MME service for connected UE in UE capability exchange message.
Mobile Station Classmark 2	The Mobile Station Classmark 2 information received by an MME service for connected UE in UE capability exchange message.
Mobile Station Classmark 3	The Mobile Station Classmark 3 information received by an MME service for connected UE in UE capability exchange message.
Security Mode Information	This group shows the status of NAS integrity check and NAS ciphering along with applicable algorithm as security mode information. It contains following information: • NAS Integrity Check • NAS Integrity Check Algorithm • NAS Ciphering • NAS Ciphering Algorithm
Active ENodeB information	This group shows the information of active eNodeB serving to this session.
Global ENodeB ID	The global identifier of active eNodeB serving to this session.
S1AP End Point	The IP address used by eNodeB on S1AP interface to connect with MME service.
Crypto-map Name	The name of the crypto map supporting this EnodeB association.
MME UE S1AP ID	Indicates the session identifier between MME and UE on S1AP interface serving to this session.
ENodeB UE S1AP ID	Indicates the session identifier between eNodeB and UE on S1AP interface serving to this session.
MME UE S1AP ID (stack):	Indicates up to three MME UE S1AP session identifiers present in this S1AP stack.
ENodeB UE S1AP ID (stack):	Indicates up to three eNodeB UE S1AP session identifiers present in this S1AP stack.
Total S1AP ID (stack)	Indicates the total count of S1AP session identifiers present in the stack.
Idle Mode Information Data	This group shows the information for the sessions in ECM idle mode.
Last TAI	Tracking Area Identity of the last Tracking Area visited by UE.
Last ECGI	E-UTRAN Cell Global Identifier of the last Cell visited by UE.
Last Connected ENodeB	Displays information about the ENodeB to which the session was last connected. • **Global ENodeB ID:** Global ENodeB Identifier of the ENodeB to which the UE last connected. • **S1AP End Point:** End Point IP Address of the ENodeB to which the UE last connected.

Field	Description
UE Subscription Data	This group shows the subscribed aggregate maximum bit rate applicable for connected UE in this session.
UE-UL-AMBR	The subscribed aggregate maximum bit rate in bits per second in upload traffic for connected UE in this session.
UE-DL-AMBR	The subscribed aggregate maximum bit rate in bits per second in download traffic for connected UE in this session.
Enforced UE-UL-AMBR at eNodeB	The enforced aggregate maximum bit rate in bits per second in upload traffic for connected UE at eNodeB in this session.
Enforced UE-DL-AMBR at eNodeB	The enforced aggregate maximum bit rate in bits per second in download traffic for connected UE at eNodeB in this session.
PDN Information	This group shows the information of PDNs connected for this session.
APN Name	The APN name which is serving for this PDN in this session.
UE Requested APN	Displays the UE requested APN with non-standard characters in hexadecimal format and standard characters in normal string format.
APN Restriction	The total number of APN restriction applied to this PDN.
PDN Type	The type of PDN (IPv4 and/or IPv6) which is serving in this session for PDN.
PGW Address	The IP address of the P-GW which is serving this session for connected PDN.
PGW control TEID	The control tunnel end identifier at P-GW on S5/S8 interface for control messaging serving to this session.
UE IPv4 Address	The IP address allocated to UE while connected to PDN in this session.
APN-UL-AMBR	The applicable aggregate maximum bit rate in bits per second in upload traffic for APN serving this PDN.
APN-DL-AMBR	The applicable aggregate maximum bit rate in bits per second in download traffic for APN serving this PDN.
Bearer Suspension State	The current suspension state of the bearer.
CSG Cell Change Notification	Displays CSG Information Reporting as specified by the PGW. If enabled, the MME sends notification when the UE enters or leaves a closed CSG cell.
CSG Subscribed Hybrid Cell Change Notification	Displays CSG Information Reporting as specified by the PGW. If enabled, the MME sends notification when the UE enters or leaves a hybrid cell as a subscribed member of the CSG in question.
CSG Unsubscribed Hybrid Cell Change Notification	Displays CSG Information Reporting as specified by the PGW. If enabled, the MME sends notification when the UE enters or leaves a hybrid cell with unsubscribed (non-member) status of the CSG in question
Marked for Deletion	Displays whether the PDN has marked for deletion flag set.

Field	Description
APN Restoration Priority	Displays the priority for reactivating impacted PDNs following a P-GW Restart Notification (PRN) where 1 is highest priority, 16 is lowest.
Low Access Priority Indication	Displays whether this PDN has LAPI indicator set as received in PDN connectivity requests.
Bearer Id	The identifier used for bearer between eNodeB and S-GW while connected to PDN in this session.
QCI	The quality class identifier applicable for this MME session.
AMBR	The applicable aggregate maximum bit rate in bits per second in download/upload direction for APN serving this PDN.
S1U ENodeB TEID	Indicates the tunnel end identifier at eNodeB on S1-U interface serving to this session.
S1U SGW TEID	Indicates the tunnel end identifier at S-GW on S1-U interface serving to this session.
S5S8 PGW TEID	Indicates the tunnel end identifier at P-GW on S5/S8 interface serving to this session.
S1U ENodeB IPv4 Addr	Indicates the IPv4 address used at eNodeB while connecting to S-GW on S1-U interface serving to this session.
S1U ENodeB IPv6 Addr	Indicates the IPv6 address used at eNodeB while connecting to S-GW on S1-U interface serving to this session.
S1U SGW IPv4 Addr	Indicates the IPv4 address used at S-GW while connecting to eNodeB on S1-U interface serving to this session.
S1U SGW IPv6 Addr	Indicates the IPv6 address used at S-GW while connecting to eNodeB on S1-U interface serving to this session.
S5S8 PGW Addr	Indicates the IP address used at P-GW while connecting to S-GW on S5/S8 interface serving to this session.
ESM State	The EPS session Management status serving to this session.
Bearer Type	The type of bearer used for this session. Possible values are: • Default • Dedicated
ARP	The Allocation Retention Priority value assigned to the bearer. The HSS assigns the value for default bearers and the P-GW assigns it for dedicated bearers.
PCI	Specifies the ARP Pre-emption Capability Indicator, either Enabled or Disabled.
PVI	Specifies the ARP Pre-emption Vulnerability Indicator, either Enabled or Disabled.
PGW-C+SMF Selected	Specifies that Combined PGW-C/SMF selection indicator, either Yes or No.
Marked for Deletion	Displays whether the bearer has marked for deletion flag set.
Total PDNs	The total number of PDNs connected through this session for a subscriber.

Field	Description
Total Bearers	The total number of bearers created for UE to use in this session.
Max APN Restrictions	The maximum number of APN restrictions applied to this PDN.
Tracking Area Information	This group displays the tracking area information available for this session.
TAI of last TAU	The tracking area identifier used in last Tracking Area Update (TAU) message received for TAU procedure in this session.
Current Tracking Area List	The tracking area list used for TAU procedure in this session.
CSG Information	This group displays Closed Subscriber Group information relating to this session.
CSG ID at Last Connection	Displays the CSG ID for this session. This is a unique identifier within the scope of PLMN which identifies a Closed Subscriber Group (CSG) in the PLMN.
CSG Cell Type	Displays the Closed Subscriber Group cell access mode (type) for this session, either Closed or Hybrid.
CSG Membership Status	Displays if the session is a member of the cell's CSG. Possible values are Member or Non-Member.
Operator Policy Association	The operator policy associated with this PDN.
CSFB Information	This group displays the Circuit-Switched Fall Back configuration associated with the session.
SGS Assoc State	The state of the SGs association with the VLR for the UE as determined by the MME. Possible states are: • SGs-NULL: Specifies that there is no SGs association with the VLR for the UE. In this state, no fields in this group will display information. • LA_UPDATE_REQUESTED: Specifies that the MME has requested an update location from the VLR before sending a response to the UE • SGs-ASSOCIATED: Specifies that the MME has stored an SGs association for the UE.
SGS Service	The name of the configured SGs service associated with the session.
VLR	The name of the VLR, as configured in the SGs service, associated with the session.
LAI	The Location Area Identifier to which the UE is mapped.
Pool Area	The name of the configured Location Area Code (LAC) pool area associated with the SGs service and the session.
P-TMSI	The Packet-Temporary Mobile Subscriber Identifier allocated by the MSC for the UE.

Field	Description
Flags	The current active variables associated with the UE. Possible states are: • SMS-Only: Specifies that the UE is combined attached for SMS services only. • MME Reset Indicator: Specifies that the MME has restarted after a failure. • VLR Reliable Indicator: Specifies that the MME has received a reset indication from the VLR. • VLR Offload: Specifies that the UE is set to offload state. • Non-EPS Alert: Specifies that the VLR is requesting from the MME an indication when any signaling activity from the UE is detected.
CIoT Optimisation Information	Displays the CIoT optimization information.
NB-IoT RAT	Displays if the RAT type NB-IoT is either enabled or disabled.
Attach Without PDN Support	Displays if attach without PDN support is either enabled or disabled.
UE capable of operating in CE-mode-B	Displays "TRUE" or "FALSE" to indicate if UE is operating in CE Mode-B.
Access Profile Association	Displays the configured access-profile name.
DECOR Information:	
UE Usage type	Displays the configured UE usage types.
DCN Id	Displays the configured DCN identifier.
UE DC-NR Information:	
DC-NR capable UE	Indicates whether the UE is DCNR capable.
DC-NR operation allowed	Indicates whether the DCNR operation is allowed by MME for the DCNR capable UE.
UE N1-Mode Information	
N1-mode capable UE	Indicates whether the UE N1 mode information is allowed by MME for the N1-mode capable UE.

Bulk Statistics

The following bulk statistics are added in the MME Schema in support of the eDRX feature.

- attached-edrx-subscriber - The current number of attached subscribers in eDRX mode.
- ddn-rejects-edrx - The total number of DDN rejects due to eDRX ever since the chassis was up.

Diameter Attributes

Diameter Attribute Value Pairs (AVPs) carry specific authentication, accounting, authorization, routing and security information as well as configuration details for the request and reply. The following Diameter attributes are added in support of this feature:

DL-Buffering-Suggested-Packet-Count

This AVP indicates the DL buffering suggested packet count.

Vendor ID 10415

VSA Type 1674

AVP Type Integer32

AVP Flag V-bit is set to true, M-bit is set to false.