

CE Mode-B Device Support

This chapter describes the CE Mode-B support for eMTC devices on the MME in the following topics:

- Feature Summary and Revision History, on page 1
- Feature Description, on page 2
- How it Works, on page 2
- Configuring CE Mode-B Devices, on page 4
- Monitoring and Troubleshooting, on page 9

Feature Summary and Revision History

Summary Data

Applicable Product(s) or Functional Area	MME
Applicable Platform(s)	• ASR 5500 • VPC-DI • VPC-SI
Feature Default	Disabled - Configuration Required
Related Changes in This Release	Not applicable
Related Documentation	• *Command Line Interface Reference* • *MME Administration Guide* • *Statistics and Counters Reference*

Revision History

Revision Details	Release
First introduced.	21.6

Feature Description

The CE Mode-B Device support in MME supports the extended time required for CE Mode-B devices and NarrowBand IoT (NB-IoT) RAT type. The Coverage Enhancement (CE) mode sets the mode for the eMTC channel.

The support for CE Mode-B by a UE is indicated to the MME by lower layers. When an MME supporting WB-S1 mode performs NAS signaling with a UE that also supports CE Mode-B and operates in WB-S1 mode in either CE Mode-A or CE Mode-B, the MME calculates the value of the applicable NAS timer for WB-S1/CE mode as specified in 3GPP TS 24.301 (tables 10.2.2 and 10.3.2).

This feature supports the following functionality:

- Updation of CE Mode-B capability in MME for UE.
- EMM and ESM timer support for CE Mode-B and NB-IoT devices.
- Associate and attach timers along with precedence, device type, and RAT type.
- Session setup timeout to support the extended timers during Attach.
- CE Mode-B capability recovery after session recovery.

How it Works

As part of the CE Mode-B Device Support feature, the operator is given the flexibility to configure different timeout values for applicable ESM and EMM timers which vary due to CE Mode-B capability and/or NB-IoT RAT type. To facilitate this, two new CLI commands **access-policy** and **access-profile** are introduced. The access-profile contains the set of timeout values for four EMM timers, four ESM timers, and session-setup timeout value which the operator can configure. The access-policy contains the precedence of which access-profile to select for a particular combination of RAT type and device type. The access-policy can be associated under the mme-service and will be applicable for all sessions or can be associated under the desired call-control-profile to limit it to a selected set of subscribers.

The following sections describe the selection of access-profile and timer selection from access-profile.

Selection of Access-Profile

This section describes the selection of access-profile.

- Access-policy, if associated under matching call-control-profile, will be selected with highest priority. If no access-policy is associated under call-control-profile, then access-policy associated under mme-service will be selected. Else the default timer values will be chosen.
- Access-profile is configured in access-policy along with precedence, RAT type, and device type.
- Access-profile with lower precedence is selected. When the precedence is lower, the priority is higher.
- The appropriate access-profile is selected based on UE’s RAT type or device type.
- Access-profile will be selected when the Initial-UE-Message is received (Initial-Attach, TAU-Request).

  The CE Mode-B indicator is received in the S1 message while the low-power indication parameters (eDRX/PSM) are received in NAS message (Attach-Request).

- Access-profile is updated whenever there is a change in device type.
  - The network accepts the request to use the eDRX by providing the eDRX parameters IE while accepting the Attach/TAU procedure. The access-profile must be updated if eDRX/PSM flags are received in Initial-Attach but not received in TAU-Request.
  - If ce-mode-b indication is not received in the S1 message for Initial-Attach but received in the S1 message for TAU-Request, the access-profile key in UE context must be updated when TAU-Request is received.
- The EMM and ESM timers can be configured using the **timeout emm** and **timeout esm** commands. The session setup timeout must also be configured accordingly to avoid session setup timer expiry before EMM/ESM timer expiry.

Timer Selection from Access-Profile

This section describes the EMM or ESM timer selection from access-profile.

- When the EMM or ESM timer needs to start, UE will fetch the access-profile using the saved precedence as described in Selection of Access-Profile, on page 2.
- UE will check if the corresponding timer is configured in access-profile.

  If the timer is configured, then UE uses the value from access-profile.
- If the timer is not configured, then
  - UE uses the system defaults of NB-IoT timer if NB-IoT is configured.
  - UE uses the system defaults of CE Mode-B timer if CE Mode-B is configured.

  Else check if the timer is configured in the MME-service and use the defaults.
- Any change to the access-profile name / deletion of access-profile / changing precedence in access-policy before the start of a procedure may cause the access-profile lookup to fail as the UE context will have the old access-profile key stored during Initial-Attach/TAU-Attach/Handoff. However, changes in the timer configuration in access-profile will be immediately applied to the same UE.

Default EMM/ESM Timer Values

This section describes the default timer values in seconds for CE Mode-B and NB-IoT.

Table 1: Default Timer Values

EMM / ESM Timer	WB-S1/CE Mode-B (sec)	NB-IoT (sec)
T3422	24	6 + 240
T3450	18	6 + 240
T3460	24	6 + 240
T3470	24	6 + 240
T3485	16	8 + 180

EMM / ESM Timer	WB-S1/CE Mode-B (sec)	NB-IoT (sec)
T3486	16	8 + 180
T3489	12	4 + 180
T3495	16	8 + 180

Standards Compliance

The CE Mode-B feature complies with the following standards:

- 3GPP TS 24.301 v13.10.0, Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3
- 3GPP TS 36.413, Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP)

Configuring CE Mode-B Devices

This section describes the various CLI commands to configure the CE Mode-B Device Support feature.

Creating an Access Policy

Use the following configuration to create a new access-policy in the Global Configuration Mode:

```
configure
   [ no ] access-policy policy_name [ -noconfirm ]
   end
```

Notes:

- Entering the command results in the following prompt and changes to the Access Policy Configuration Mode:

  `[local]host_name(access-policy-policy_name)#`

- **access-policy** *policy_name*: Specifies the name of the access-policy. *policy_name* must be an alphanumeric string of 1 through 64 characters.
- **no**: Deletes the configured access-policy.
- A maximum of four access-policies can be configured.
- One access-policy can contain upto 16 entries of precedence pointing to 16 different access-profiles.

Verifying the Configuration

Use the following command to verify the number of access-policies configured.

```
show access-policy all
```

Use the following command to verify the configuration for all configured access-policies.

show access-policy full all

Use the following command to verify the configuration for the specified access-policy.

show access-policy name *policy_name*

Creating an Access Profile

Use the following configuration to create a new profile "access-profile" in the Global Configuration Mode:

```
configure
   [ no ] access-profile profile_name [ -noconfirm ]
   end
```

Notes:

- Entering the command results in the following prompt and changes to the Access Profile Configuration Mode:

  `[local]host_name(access-profile-profile_name)#`

- **access-profile** *profile_name*: Specifies the name of the access-profile. *profile_name* must be an alphanumeric string of 1 through 64 characters.
- **no**: Deletes the configured access-profile.
- A maximum number of 16 access-profiles can be configured in the system.
- To use the access-profiles, the access-policies must be created under the Global Configuration mode and associated under mme-service or call-control-profile.
- One access-policy can contain upto 16 entries of precedence along with access-profile, device type, and RAT type. When the precedence is lower, the priority is higher.

Verifying the Configuration

Use the following command to verify the configured access-profile name:

show access-profile full name *profile_name*

Associating Access-Policy to Call Control Profile

Use the following configuration to associate an access-policy to the call-control-profile:

```
configure
   call-control-profile cc_profile_name
      associate access-policy policy_name
      remove associate access-policy
      end
```

Notes:

- **call-control-profile** *cc_profile_name*: Specifies the name of the call-control-profile. *cc_profile_name* is an alphanumeric string of 1 through 64 characters.

- **associate access-policy** *policy_name*: Specifies the access-policy to be associated with the call-control-profile. *policy_name* specifies the name of the access-policy, entered as an alphanumeric string of 1 through 64 characters.
- **remove**: Removes the access-policy associated with the call-control-profile. After removing the configuration from call-control-profile, the access-policy associated with the mme-service will be used.

Verifying the Configuration

Use the following command to verify if the access-policy is associated with call-control-profile:

```
show call-control-profile full name profile_name
```

Associating Access-Policy to MME Service

Use the following configuration to associate an access-policy to the MME service:

```
configure
  context context_name
    mme-service service_name
      associate access-policy policy_name
      remove associate access-policy
      end
```

Notes:

- **mme-service** *service_name*: Specifies the name of the MME service as an alphanumeric string of 1 through 63 characters.
- **associate access-policy** *policy_name*: Specifies the access-policy to be associated with the MME service. *policy_name* specifies the name of the access-policy, entered as an alphanumeric string of 1 through 64 characters.
- **remove**: Removes the access-policy associated with the MME service.

Verifying the Configuration

Use the following command to verify the access-policy configured in MME service:

```
show mme-service name mme_svc_name
```

Configuring EMM Timer Configuration in Access Profile

The EMM timer configuration in access-profile is used for NAS signaling timer changes at MME for NB-S1 mode and WB-S1 mode with CE mode support. The configured timer values can also be used for NBIoT RAT.

Use the following configuration to configure EMM timers in access-profile:

```
configure
  access-profile profile_name
    timeout emm { t3422 | t3450 | t3460 | t3470 } timeout_value
    remove timeout emm
    end
```

Notes:

- **timeout emm { t3422 | t3450 | t3460 | t3470 }**: Configures the EMM timers.
  - **t3422**: Timer for Retransmission of Detach Request.
  - **t3450**: Timer for Retransmission of Attach Accept/TAU Accept.
  - **t3460**: Timer for Retransmission of Auth Request/Security Mode.
  - **t3470**: Timer for Retransmission of Identity Request.
- *timeout_value*: Specifies the timeout value in seconds as an integer from 1 to 270.
- **remove**: Removes the configured EMM timers from access-profile.

  After removing the configuration from access-profile, the timeout value configured in mme-service will be used.
- The EMM timer configuration in access-profile will have higher precedence over the same timer configuration in mme-service.
- The device type and RAT type are not known while configuring the timer values. Hence, the valid range for these timers is defined such that it covers the maximum value for E-UTRAN and NB-IoT RAT as specified in 3GPP TS 24.301 Release 13.
- The new configuration for a given timer will override the previous configuration. For example:

  emm t3450-timeout 90

  emm t3450-timeout 200

  The final value for T3450 timeout that will be applied is 200 seconds.

Verifying the Configuration

Use the following command to verify the EMM timer configuration:

```
show access-profile full name profile_name
```

Configuring ESM Timer Configuration in Access Profile

The ESM timer configuration in access-profile is used for NAS signaling timer changes at MME for NB-S1 mode and WB-S1 mode with CE mode support. The configured timer values can also be used for NBIoT RAT.

Use the following configuration to configure ESM timers in access-profile:

```
configure
  access-profile profile_name
    timeout esm { t3485 | t3486 | t3489 | t3495 } timeout_value
    remove timeout esm
    end
```

Notes:

- **timeout esm { t3485 | t3486 | t3489 | t3495 }**: Configures the ESM timers.
  - **t3485**: Timer for Retransmission of Activate Default/Dedicated Bearer Request.

- **t3486**: Timer for Retransmission of Modify EPS Bearer Context Request.
- **t3489**: Timer for Retransmission of ESM Information Request.
- **t3495**: Timer for Retransmission of Deactivate EPS Bearer Request.

- *timeout_value*: Specifies the timeout value in seconds, as an integer from 1 to 270.
- **remove**: Removes the configured ESM timers from access-profile.

  After removing the configuration from access-profile, the timeout value configured in mme-service will be used.
- The ESM timer configuration in access-profile will have higher precedence over the same timer configuration in mme-service.
- The device type and RAT type are not known while configuring the timer values. Hence, the valid range for these timers is defined such that it covers the maximum value for E-UTRAN and NB-IoT RAT as specified in 3GPP TS 24.301 Release 13.
- The new configuration for a given timer will override the previous configuration. For example:

  emm t3495-timeout 95

  emm t3495-timeout 250

  The final value for T3495 timeout that will be applied is 250 seconds.

Verifying the Configuration

Use the following command to verify the ESM timer configuration:

```
show access-profile full name profile_name
```

Configuring Session Setup Timer in Access Profile

Use the following configuration to configure the session setup timer in access-profile:

```
configure
  access-profile profile_name
    timeout session-setup setup_timer
    remove timeout session-setup
    end
```

Notes:

- **timeout session-setup** *setup_timer*: Configures the session setup timeout in seconds. *setup_timer* is an integer from 1 to 10000.
- **remove**: Removes the configured session setup timer from access-profile.
- The device type and RAT type are not known while configuring the timer values. Hence, the valid range for these timers is defined such that it covers the maximum value for E-UTRAN and NB-IoT RAT.
- The session setup timer configuration in access-profile will have higher precdence over the same timer configuration in mme-service.
- The new configuration for a given timer will override the previous configuration. For example:

```
timeout session-setup 500
timeout session-setup 700
```

The final session setup timeout value that will be applied is 700 seconds.

Verifying the Configuration

Use the following command to verify the session setup timer configuration:

```
show access-profile full name profile_name
```

Configuring the Device Type and RAT Type

Use the following configuration to associate the access-profile, device type, and RAT type to the precedence in access-policy:

```
configure
  access-policy policy_name
    precedence precedence_value access-profile profile_name { device-type {
low-power | mode-b } | rat-type { eutran | nbiot } }
    no precedence precedence_value
    end
```

Notes:

- **access-policy** *policy_name*: Configures the access-policy. *policy_name* must be an alphanumeric string of of 1 through 64 characters.
- **precedence** *precedence_value*: Configures the order of access-profile precedence. *precedence_value* must be an integer from 1 to 16, where 1 has the highest precedence.
- **access-profile** *profile_name*: Configures the access-profile to associate with the access-policy. *profile_name* must be the name of an access-profile as an alphanumeric string of 1 through 64 characters.
- **device-type { low-power | mode-b }**: Configures the IoT device type — Low power or CE Mode-B.
- **rat-type { eutran | nbiot }**: Configures the RAT type — Evolved UTRAN or NB-IOT.
- **no**: Removes the configured precedence value.
- One access-policy can have upto 16 entries of precedence along with access-profile, device type, and RAT type. If the precedence is lower, then the priority is higher.

Monitoring and Troubleshooting

This section provides information on the show commands and bulk statistics available for the CE Mode-B Device Support feature.

Show Commands and/or Outputs

This section provides information regarding show commands and/or their outputs for the CE Mode-B Device Support feature.

show access-policy full all

The **Access Policy Name** field added to the output of this command displays the configured access-policy name.

show access-profile full name <profile_name>

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

- Access Profile Name — Displays the configured access-profile name.
- T3422 Timeout — Displays the configured time for T3422 timeout in seconds. Displays "Not Configured" if the timer value is not configured in access-profile.
- T3450 Timeout — Displays the configured time for T3450 timeout in seconds. Displays "Not Configured" if the timer value is not configured in access-profile.
- T3460 Timeout — Displays the configured time for T3460 timeout in seconds. Displays "Not Configured" if the timer value is not configured in access-profile.
- T3470 Timeout — Displays the configured time for T3470 timeout in seconds. Displays "Not Configured" if the timer value is not configured in access-profile.
- T3485 Timeout — Displays the configured time for T3485 timeout in seconds. Displays "Not Configured" if the timer value is not configured in access-profile.
- T3486 Timeout — Displays the configured time for T3486 timeout in seconds. Displays "Not Configured" if the timer value is not configured in access-profile.
- T3489 Timeout — Displays the configured time for T3489 timeout in seconds. Displays "Not Configured" if the timer value is not configured in access-profile.
- T3495 Timeout — Displays the configured time for T3495 timeout in seconds. Displays "Not Configured" if the timer value is not configured in access-profile.
- Session Setup Timeout — Displays the configured session setup timeout in seconds. Displays "Not Configured" if the session timeout value is not configured in access-profile.

show call-control-profile full name <profile_name>

The **Access Policy** field added to the output of this command displays the configured access-policy name.

If access-policy is not associated with call-control profile, the Access Policy field displays "Not Defined".

show mme-service name <mme_svc_name>

The **Access Policy** field added to the output of this command displays the configured access-policy name.

show mme-service session full all

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

- 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.

show mme-service statistics

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

- CE-mode-B Capable Subscribers:
  - Attached Calls — Displays the number of attached calls by CE Mode-B subscribers.
  - Connected Calls — Displays the number of connected calls by CE Mode-B subscribers.
  - Idle Calls — Displays the number of idle calls by CE Mode-B subscribers.

Bulk Statistics

The following bulk statistics are added in the MME Schema in support of the CE Mode-B Device Support feature.

- attached-ce-mode-b-subscriber — The current total number of attached subscribers which are capable of operating in CE Mode-B.
- connected-ce-mode-b-subscriber — The current total number of attached subscribers which are capable of operating in CE Mode-B and in connected state.
- idle-ce-mode-b-subscriber — The current total number of attached subscribers which are capable of operating in CE Mode-B and in idle state.