LTE-M RAT Type Support

Revision History

Revision Details	Release
First introduced.	21.27

Feature Description

LTE-M (LTE-MTC low-power-wide area (LPWA)) is a cellular radio access technology that is specified by 3GPP that addresses low power-wide area connectivity solutions. It specifically refers to a category of LTE UEs that are suitable for IoT LTE-M, which supports IoT through lower device complexity and provides extended coverage, while allowing the reuse of the LTE installed base.

The RAT Type Information Element (IE) is present in various call flows across many interfaces. When a Create Session Request is received with an unknown RAT Type, as the RAT Type is a mandatory IE in this message, S-GW or P-GW may reject a Create Session Request. With this feature, LTE-M RAT (Radio Access Technology) Type for CUPS is supported.

The RAT Type is present either as an IE (for example, in GTPv2-C, GTPP), AVP (on Diameter-based interfaces), or as an attribute (for example in EDRs) across many interfaces.

The LTE-M solution for CUPS supports the following new LTE-M RAT Type attribute value in the following interface protocols and dictionaries:

- Gx Interface: Diameter Protocol
- Gy Interface: Diameter Protocol
- Gz/Rf Interface: GTPP/Diameter/RADIUS
- S6b Interface: Diameter Protocol

- S11/ S5/S8 Interface: GTPv2-C
- RADIUS AVPs and dictionaries
- Rf interface for CDR generation
- Attributes in EDRs

Enhancements to the Existing Features

The following existing features are enhanced to support the LTE-M RAT Type:

- **Virtual APN Selection Based on RAT Type**: Virtual APNs allow differentiated services within a single APN. The Virtual APN feature allows a carrier to use a single APN to configure differentiated services. The APN that is supplied by the MME is evaluated by the P-GW with multiple configurable parameters. Then, the P-GW selects an APN configuration based on the supplied APN and those configurable parameters. APN configuration dictates all aspects of a session at the P-GW, where different policies imply different APNs.

  You can select the virtual APN by configuring directly under the base APN. This APN selection is done based on RAT Types. In this release, support is added through CLI to select the virtual APN for the LTE-M RAT type.

- **QCI and QoS Mapping**: P-GW supports QCI and QoS mapping association with APN based on RAT type LTE-M. The QCI and QoS mapping allows you to perform quick actions on the QoS Class Index (QCI) to QoS Mapping Configuration Mode, which is used to map QoS Class Indexes to enforceable QoS parameters. Mapping can occur in S-GW, and/or the P-GW in an LTE network.

- **PCRF-based Handling**: P-GW informs the RAT type changes to PCRF through Credit Control Request -Initial and Updated (CCR-I and CCR-U) messages, and PCRF provides a new PCC rule. It allows you to create a bearer by enforcing a new Policy and Charging Control (PCC) rule from the Policy and Charging Rules Function (PCRF).

How it Works

As part of this feature, the RAT Type across many interfaces has been modified to include an additional value that signifies LTE-M RAT Type. Only Standard and customer-specific dictionaries are modified.

The following table specifies the field and its value for various interfaces with support of LTE-M RAT type.

Table 1:

Interface	Field	AVP Attribute	Messages
P-GW			
Gx	RAT-Type (1032) Diameter	LTE-M (1007)	• Credit Control Request-Initial • Credit Control Request-Updated

Interface	Field	AVP Attribute	Messages
Gy	3GPP RAT-Type (21) Diameter	LTE-M (9)	• Credit Control Request-Initial • Credit Control Request-Updated
RADIUS	3GPP RAT-Type (21)	LTE-M (9)	• Accounting Request-Start • Accounting Request-Stop • Account request-Interim
Rf	3GPP RAT-Type (21) Diameter	LTE-M (9)	• Accounting Request-Start • Accounting Request-Stop • Account request-Interim
S6b	3GPP RAT-Type (1032) Diameter	LTE-M (9)	• Authentication • Authorisation • Request
EDRs	RAT-Type	LTE-M (9)	—
PGWCDRs	RAT-Type (30) GTPP	LTE-M (9)	• GTPP Data Record • Transfer Request
S-GW			
SGWCDRs	RAT-Type (30)	LTE-M (9)	• GTPP Data Record • Transfer Request

Limitations

The LTE-M related changes are not implemented for the following functionality:

- Rule matching at ECS
- Ruledef matching at Local-Policy

Supported Standards

Cisco's implementation of the LTE RAT type complies with the following standards:

- 3GPP 23.401 Release 15.4.0 – 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access
- 3GPP 29.274 Release 15.4.0 – 3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; 3GPP Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunnelling Protocol for Control plane (GTPv2-C); Stage 3
- 3GPP 32.299 Release 15.4.0 – 3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Policy and Charging Control (PCC).
- 3GPP 29.060 – 3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; General Packet Radio Service (GPRS); GPRS Tunnelling Protocol (GTP) across the Gn and Gp interface.
- 3GPP 29.061 – 3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Interworking between the Public Land Mobile Network (PLMN) supporting packet based services and Packet Data Networks (PDN)
- 3GPP 32.298 – 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Telecommunication management; Charging management; Charging Data Record (CDR) parameter description
- 3GPP 29.212 Release 15.4.0 – 3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Policy and Charging Control (PCC).

Configuring LTE-M RAT-Type

Configuring Virtual APN Selection based on LTE-M RAT Type

Use the following configuration to select the Virtual-APN that is based on LTE-M RAT Type.

```
configure
  context context_name
    apn apn_name
      virtual-apn preference value apn  apn_name rat-type lte-m
      end
```

NOTES:

- **rat-type lte-m**: Enables LTE-M as a RAT Type for Virtual APN.

Configuring QCI - QoS Mapping

Use the following configuration to configure QCI-QOS mapping for an APN.

```
configure
   qci-qos-mapping mapping_name
   end
```

Associating QCI - QoS Mapping with LTE-M RAT Type

Use the following configuration to select the LTE-M RAT Type for QCI - QoS Mapping during session setup.

```
configure
   context context_name
      apn apn_name
         associate qci-qos-mapping mapping_name rat-type lte-m
         end
```

Verifying the QCI - QoS Mapping with LTE-M RAT Type Configuration

Check the output of the following show CLI commands to verify if QCI - QoS Mapping configuration is associated with LTE-M RAT Type:

- **show configuration**
- **show apn name** *apn_name*
- **show apn name** *apn_name* **all**

Monitoring and Troubleshooting

This section provides information regarding commands available to monitor and troubleshoot the LTE-M RAT Type support on the SAEGW, P-GW and S-GW Services.

Show Commands and Output

This section provides information on show commands and their corresponding outputs for the LTE-M RAT type feature.

show apn statistics { all | name }

The output of the **show apn statistics { all | name }** CLI command has been enhanced to display the "LTE-M" field under "Initiated Sessions per RAT Type" and "Active Sessions per RAT Type" section.

show subscribers { full | full all | call-id <call_id> }

The output of these show CLI commands are used for monitoring the subscriber call. The output of these commands are enhanced to include "(R) - LTE-M" under "Access Tech" as part of this feature.

show subs { pgw-only | sgw-only | saegw-only }{ full | full all }

The output of these show CLI commands is enhanced to display the Access Technology of the call as LTE-M:

- Access Tech: LTE-M

show session subsystem [full | verbose]

These CLIs are used for monitoring session-related statistics. The output of these commands are enhanced, as part of this feature, to display the following fields under "User Data Statistics":

- LTE Data Statistics
  - packets to User
  - octets to User
  - packets from User
  - octets from User
- LTE-M Connection Statistics
  - Total Sessions
  - Total calls arrived
  - Total calls connected
  - Total calls disconnected

show session summary

The output of this show CLI command is enhanced to display the following field: LTE-M

show subscribers { subscription full | activity all }

The output of these show CLI commands is enhanced to display the "LTE-M" field as the RAT Type of the call.

show { pgw-service | sgw-service | saegw-service } statistics { all | name }

The output of the following show CLI commands is enhanced to include "LTE-M" field as the RAT Type:

show pgw-service statistics { all | name }

This CLI is used to display the statistics per P-GW service. The output of this CLI is enhanced to display the number of "Initiated PDNs By RAT-Type" and "Current PDNs By RAT-Type" with LTE-M RAT Type per P-GW Service.

show sgw-service statistics { all | name }

This CLI is used to display the statistics per S-GW service. The output of this CLI is enhanced to display the number of "Current Subscribers By RAT-Type" and "Current PDNs By RAT-Type" with LTE-M RAT Type per S-GW Service.

show saegw-service statistics { all | name }

This CLI is used to display the statistics per SAEGW service. The output of this CLI is enhanced to display the number of "Colocated PDNs", "PGW-Anchor PDNs", "SGW-Anchor PDNs", and "GGSN-Anchor PDNs" with LTE-M RAT Type.

Bulk Statistics

The following statistics are added in support of the LTE-M RAT type feature

APN Schema

The following LTE-M RAT Type feature-related bulk statistics are available in the APN schema.

Bulk Statistics	Description
active-lte-m-sessions	The total number of active LTE-M sessions per APN (with LTE-M as RAT Type).
initiated-lte-m-sessions	The total number of initiated LTE-M sessions.

P-GW Schema

The following LTE-M RAT Type feature-related bulk statistics are available in the P-GW schema.

Bulk Statistics	Description
sesstat-pdn-rat-lte-m	The total number of PDN Type session statistics for LTE-M.
sessstat-rat-init-lte-m	The total number of initiated LTE-M PDNs (with LTE-M as RAT Type).

S-GW Schema

The following LTE-M RAT type feature-related bulk statistics are available in the S-GW schema.

Bulk Statistics	Description
sessstat-totcur-ue-lte-m	The total number of active UEs with LTE-M as the RAT Type.
sessstat-totcur-pdn-lte-m	The total number of active PDNs with LTE-M as the RAT Type.

SAEGW Schema

The following LTE-M RAT type feature-related bulk statistics are available in the SAEGW schema.

Bulk Statistics	Description
sgw-sessstat-totcur-ue-lte-m	The total number of active UEs with LTE-M as the RAT type.
sgw-sessstat-totcur-pdn-lte-m	The total number of LTE-M PDNs (P-GW anchored/Collapsed PDN) with RAT Type as LTE-M.
pgw-sesstat-pdn-rat-lte-m	The total number of LTE-M PDNs (P-GW anchored/Collapsed PDN) with RAT Type as LTE-M.
pgw-sessstat-pdn-rat-init-lte-m	The total number of initiated LTE-M PDNs.

Bulk Statistics	Description
saegw-sgw-anchor-pdn-rat-lte-m	The total number of LTE-M PDNs (S-GW anchored) with RAT Type as LTE-M.
saegw-pgw-anchor-pdn-rat-lte-sm	The total number of LTE-M PDNs (P-GW anchored) with RAT Type as LTE-M.
saegw-collapsed-pdn-rat-lte-m	The total number of LTE-M PDNs (SAEGW Collapsed PDN) with RAT Type as LTE-M.