MIoT Field and Lab Test Cases
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Table of Contents

1 Introduction

1.1 Overview

This document contains a set of guidelines for the tests that should be performed in the course of Field Test and Lab Test carried out on LPWA (Low Power Wide Area) Mobile IoT modules and devices.

Field Tests are tests undertaken during later phases of the terminal development against a real live deployed network (i.e. in the field) to prove of a feature or technology.

Lab Tests are tests undertaken during later phases of the terminal development against laboratory based network components, representative of a real deployed network, to prove a feature or technology.

Field Tests are required to ensure confidence in the performance of Mobile IoT modules and devices in the operational network environment. Lab Tests usually complement Field Tests for scenarios which cannot be easily executed in a live network.

It is assumed that Field Tests shall be performed without direct support from the network operator. However TSG and its operator delegates do offer their assistance, if required by any Manufacturer in terms of drafting Field and/or Lab Tests, providing network specific information, etc.

The Field and/or Lab Tests in this document may be performed in any order that is convenient. Only the features supported by the DUT shall be tested.

It is recommended to use a logging tool, if available, to take log files when running the tests. The log files and their indication of network conditions/behaviour during the tests will help to remove any ambiguity that may come out of the test results.

Also more specifically about the performances tests, it is recommended to run the tests with the terminal to be certified and with a reference terminal such as, a competitive terminal available on the market. The behaviour of the reference platform will help to remove any ambiguity about the test results.

In order to provide visibility on the applicability, extent and the result of Field and/or Lab Tests conducted on Mobile IoT modules and devices, Annex A has been included in this document.

1.2 Scope

This document defines all test cases for PTCRB and GCF Certification of LPWA MIoT modules and devices that are to be deployed on mobile networks that support LPWA modules and devices.

These test cases shall be executed against the requirements document as identified within the MIoT Test Requirements document TS.39 reflects the specifications as identified in the 3GPP Release 13 Specifications published in June 2016. Requirements reflecting upcoming 3GPP releases (Rel-14 onwards) are explicitly mentioned.

This document does not replicate any test cases that are currently defined within the GSMA Device Connection Efficiency Test Book TS.35 [9]. Any test cases in this respect will be agreed between the respective MNO's and their Vendors and is outside the scope of this document.

It should be noted that the test cases listed within this document are those that are deemed as a priority by the MNOs for accreditation of MIoT devices onto their networks.

1.3 Classification of Individual Test Scenarios

Every individual test scenario is classified in Field Test, Lab Test or both. This classification should adhere to the following criteria:

Field Test only:

- Confidence is only given that this feature works correctly when it has been tested in the field on real live commercial networks.
- It is possible to execute this test in the field (assuming there are live commercial network deployments).
- The only exception to this rule is when a vendor wishes to test a feature for which there are no commercial network deployments. In this case the feature MAY be lab tested for the purpose of gaining some basic confidence in the feature. If this option is used by the vendor then only a 'provisional pass' of the test can be achieved and this must clearly be marked in the vendors test report.

Lab Test only:

- Technically, it is only practical for this test to be executed in a lab.
- Executing this test in the lab MAY not give the same level of confidence that the feature will work correctly on real live networks, however it may provide some basic confidence in the feature.
- For the identification of absolute performance of the handset, it is better to perform this test in a controlled (Lab-) environment, where resources are allocated only for the handset.

Both, Field Test and Lab Test:

- If there are severe practical difficulties in executing this test in the field then this test MAY be executed in a lab.
- There is equal confidence in the proper function of this feature regardless of whether it is tested in the Field or Lab environment. Passing the test in the lab is therefore equally valid as passing the test in the field.

The individual classification of a test scenario is listed in Annex A.

1.4 Definitions

The key words "SHALL", "SHOULD" and "MAY", within this document are to be interpreted as described in RFC 2119 [19], an abstract of which is included within the table below.

Term	Description
MUST	This word, or the terms "REQUIRED" or "SHALL", mean that the definition is an absolute requirement of the specification.
SHOULD	This word, or the adjective "RECOMMENDED", mean that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.
MAY	This word, or the adjective "OPTIONAL", mean that an item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because the vendor feels that it enhances the product while another vendor may omit the same item. An implementation which does not include a particular option MUST be prepared to interoperate with another implementation which does include the option, though perhaps with reduced functionality. In the same vein an implementation which does include a particular option MUST be prepared to be interoperate with another implementation which does not include the option (except, of course, for the feature the option provides.)
Actor	Physical entity (person, company or organisation) that can assume a Role in the functional architecture. It is possible for an Actor to assume multiple Roles in the same functional architecture.
CAT-M	Generic device category for eMTC (enhanced Machine Type Communication) devices. CAT-M1 specifies eMTC category according to 3GPP Rel-13, CAT-M2 specifies device category supporting further enhancements to MTC (feMTC) introduced with 3GPP Rel-14.
CAT-NB	Generic device category for NB-IoT (NarrowBand - Internet of Things) devices. CAT-NB1 specifies NB-IoT category according to 3GPP Rel-13, CAT-NB2 specifies device category supporting enhancements to NB-IoT introduced with 3GPP Rel-14.
Client	Any device that is used to help fulfil the field trial requirement. A Client may be a cellular device, software client, a server, a system simulator or other device used to complete a test, if not defined otherwise in Initial Configuration These additional devices are by default identified as Client-1, Client-2, Client-3, … etc.
Connectivity Parameters	A set of data (for example SMSC address) required by the eUICC to open a communication channel (for example SMS, HTTPS) on a dedicated network.
Customer	A paying party, in particular a legally responsible juridical person or entity.
Device	Equipment into which an Embedded UICC and a communication module are inserted during assembly. Examples include Utility meter, car and camera.
Disabled (Profile)	The state of a Profile where all files and applications (for example NAA) present in the Profile are not selectable over the eUICC-Terminal interface.

Term	Description
Embedded UICC (eUICC)	A UICC which is not easily accessible or replaceable, is not intended to be removed or replaced in the Device, and enables the secure changing of Profiles.
Enabled (Profile)	The state of a Profile when its files and/or applications (for example, NAA) are selectable over the UICC-Terminal interface.
eUICC Manufacturer	Supplier of the eUICCs and resident software (for example firmware and operating system).
International Mobile Subscriber Identity	Unique identifier owned and issued by Mobile operators to (U) SIM applications to enable Devices to attach to a network and use services.
MIoT Device	A Mobile IoT (MIoT) Device is a generic term to indicate one of the following 3GPP standard technologies for LPWA: CAT-M, CAT-NB and EC-GSM-IoT.
Mobile Network Operator	An entity providing access capability and communication services to its Customers through a mobile network infrastructure.
3GPP module	A communications module complying with one or more of the 3GPP communication technologies such as 2G, 3G, EC-GSM-IoT, CAT-NB or CAT-M, this includes all necessary eUICC or UICC components. Can also be called User Equipment or UE.
Network Access Application	An application residing on a UICC which provides authorisation to access a network for example a USIM application.
Profile	Combination of a file structure, data and applications to be provisioned onto, or present on, an eUICC and which allows, when enabled, the access to a specific mobile network infrastructure.
Profile Component	A Profile Component is an element of the Profile and may be one of the following: An element of the file system like an MF, EF or DF An Application, including NAA and Security Domain POL1 MNO-SD.

Term	Description
Reference Device	A specific device with similar capabilities as the DUT that has already been successfully field trialed for the test being performed, if not defined otherwise in Initial Configuration. This is used when a performance or behavior comparison is required to confirm the pass criteria of the DUT. These additional devices are by default identified as Reference-1, Reference-2, Reference-3, etc. See also Client.
Roles	Roles are representing a logical grouping of functions.
SIM	Subscriber Identity Module; a physical entity that contains keys and ID required to authenticate a user on a mobile network. “SIM” is commonly used to refer to the physical entity that is technically called the UICC (see UICC definition below).This document generally uses “SIM” to refer to the physical entity
Subscriber	An entity (associated with one or more users) that is engaged in a Subscription with a Telecommunication Service Provider. The Subscriber is allowed to subscribe and unsubscribe to services, to register a user or a list of users authorised to use those services, and also to set the limits relative to the use that associated users make of those services.
Subscription	Describes the commercial relationship between the Subscriber and the Telecommunication Service Provider.
Subscription Manager Data Preparation	Role that prepares the Profiles and manages the secure download and installation of these Profiles onto the eUICC.
Subscription Manager Secure Routing	Role that securely performs functions of Platform Management commands and the transport of Profile Management commands.
Telecommunication Service Provider	The organization through which the Subscriber obtains PLMN telecommunication services. This is usually the network operator or possibly a separate body.
Test Route	A route preferably provided by the operator and contains ideally all mobility scenarios supported by the operator’s network. In case no Test Route is or can be provided by the operator a test route will follow the limited set below. In both cases the test route should not exceed 50 km in length or can be completed in approximately 30 min. during off-peak hours and normal road traffic conditions.
UICC	Universal Integrated Circuit Card; the physical entity that contains as a minimum the SIM/USIM application
USIM	An application that runs on the UICC and provides authentication functions similar to those provided by the SIM in pre-3G systems

1.5 Abbreviations

Term	Description
3GPP	3rd Generation Partnership Project
BGA	Ball Grid Array
CAT-NB	Category Narrow Band (not 3GPP release specific)
CAT-NB1	Category Narrow Band 1 (3GPP Rel-13 onwards)
CAT-NB2	Category Narrow Band 2 (3GPP Rel-14 onwards)
CAT-M	Category M (not 3GPP release specific)
CAT-M1	Category M1 (3GPP Rel-13 onwards)
CAT-M2	Category M2 (3GPP Rel-14 onwards)
C-DRX	Connected mode DRX
CIoT	Cellular Internet of Things
dB	Decibel
dBm	Decibel-referenced to 1 milliwatt
DFN	Dual Flat No lead package
DRX	Discontinuous Reception
DL	Downlink
DUT	Device Under Test
EC-GSM-IoT	Extended Coverage GSM Internet of Things
EDGE	Enhanced Data Rates for GSM Evolution
ECID	Enhanced Cell ID
eDRX	Extended Discontinuous Receive
EGPRS	Enhanced General packet radio service
eMTC	Enhanced Machine Type Communications
E-SLMC	Evolved Serving Mobile Location Center
ETSI	European Telecommunications Standards Institute
eUICC	Embedded Universal Integrated Circuit Card
feMTC	Further Enhanced of Machine Type Communications
FDD	Frequency Division Duplexing
GERAN	GSM EDGE Radio Access Network
GPRS	General Packet Radio Service
GMSK	Gaussian minimum shift keying
GSM	Global System for Mobile Communications
GSMA	GSM Association
I-DRX	Idle mode DRX
IoT	Internet of Things
IMEI	International Mobile Station Equipment Identity
IP	Internet Protocol

Term	Description
IPSec	Internet Protocol Security
LoRa	Long Range
LPP	Location Positioning Protocol
LPUC	Low Power Use Case
LPWA	Low Power Wide Area
LTE	Long-Term Evolution
LTE eMTC	Long-Term Evolution Enhanced Machine Type Communications
LTE MTC	Long-Term Evolution Machine Type Communications
M2M	Machine-to-machine
MCL	Maximum Coupling Loss
MFF2	M2M Form Factor 2
MHz	Mega Hertz
MNO	Mobile Network Operator
MS	Mobile Station
MTC	Machine Type Communications
NB-IoT	Narrow Band Internet of Things
OFDMA	Orthogonal Frequency-Division Multiple Access
OTA	Over The Air
OTDOA	Observed Time Difference of Arrival
PLMN	Public Land Mobile Network
PSM	Power Save Mode
QoS	Quality of Service
RAI	Release Assistance Indication
RAN	Radio Access Network
RF	Radio Frequency
SC-FDMA	Single-carrier frequency-division multiple access
SIM	Subscriber Identity Module (an application running on a UICC)
SMS	Short Message Service
TA	Tracking Area
TAU	Tracking Area Update
TCO	Total Cost of Ownership
TDMA	Time division multiple access
TR	Technical Report
UE	User Equipment
UICC	Universal Integrated Circuit Card (sometimes known as the SIM card)
UL	Uplink
USIM	Universal Subscriber Identity Module

Term	Description
UTDOA	Uplink-Time Difference of Arrival
WAN	Wide Area Network
Wi-Fi	Wireless Fidelity
WLCSP	Wafer-level redistribution Chip Scale Package

1.6 References

Ref	Doc Number	Title
[1]	3GPP TS 31.120	UICC-Terminal Interface; Physical, electrical and logical test specification, Release 13 or higher.
[2]	3GPP TS 31.121	“UICC-Terminal interface; Universal Subscriber Identity Module (USIM) application test specification, Release 13 or higher.
[3]	3GPP TS 31.124	Mobile Equipment (ME) conformance test specification; Universal Subscriber Identity Module Application Toolkit (USAT) conformance test specification, Release 13 or higher.
[4]	OMA-ETS-LightweightM2M-V1_0_1	Enabler Test Specification for Lightweight M2M v1.0, publication date 20170830 or later.
[5]	oneM2M TS 0013	oneM2M Interoperability Testing
[6]	oneM2M TS 0017	oneM2M Implementation Conformance Statements
[7]	oneM2M TS 0018	oneM2M Test Suite Structure and Test Purposes
[8]	oneM2M TS 0019	oneM2M Abstract Test Suite & Implementation eXtra Information for Test
[9]	GSMA PRD TS.35	IoT Device Connection Efficiency Test Book, Version 3.0, 30 March 2016
[10]	3GPP TS.34 114	User Equipment (UE) / Mobile Station (MS) Over The Air (OTA) antenna performance; Conformance testing
[11]	3GPP TS.37 544	Universal Terrestrial Radio Access (UTRA) and Evolved UTRA (E-UTRA); User Equipment (UE) Over The Air (OTA) performance; Conformance testing
[12]	CTIA OTA Test Plan v3.6	Test Plan for Wireless Device Over-the-Air Performance
[13]	RFC2119	Key words for use in RFCs to Indicate Requirement Levels
[14]	3GPP TS.36 304	Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode
[15]	3GPP TS36 321	Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification
[16]	3GPP TS.36 331	Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification

2 Basic Operation

2.1 Registration (Attach/Detach)

2.1.1 CAT-M Device Attach Procedure with Control Plane CIoT EPS Optimization

Description

CAT-M device could successfully perform LTE Attach Procedure with Control Plane CIoT EPS Optimizations.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.2.2_REQ_001 (Attach)

GSMA TS.39_2.3.2_REQ_001 (Device Capabilities)

3GPP TS 23.401, 24.301 and 36.331

Reason for test

To verify that CAT-M device could successfully perform LTE Attach Procedure with Control Plane CIoT EPS Optimizations.

Initial configuration

DUT is configured with “Control Plane CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”

DUT is Switched OFF

The NW is configured to support CAT-M and “Control Plane CIoT EPS Optimizations”

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT is in EMM-IDLE mode reads SIB2; set up RRC connection and sends Attach Request message indicating support of “Control Plane CIoT EPS Optimization” together with PDN CONNECTIVITY REQUEST Message.
2	Verify the DUT sends Attach AcceptComplete after reception of Attach Accept message from NW	Upon reception of Attach Accept message from NW DUT successfully completes attach procedure by sending Attach Complete Message

Example message flow:

Step	Direction UE - NW	Message	Comments
1a	-->	RRC: RRCConnection Request	After DUT has read SIB-2 to verify that “Control Plane CIoT EPS Optimizations” is broadcast in EUTRAN Cell it sends RRC Connection Request
1b	<--	RRC: *RRCConnectionSetup*	
1c	-->	RRC: *RRCConnectionSetupComplete* NAS: ATTACH REQUEST NAS: PDN CONNECTIVITY REQUEST	Attach Request message indicates support of “Control Plane CIoT EPS Optimization”
1d	<--	RRC: *DLInformationTransfer* NAS: AUTHENTICATION REQUEST	
1e	-->	RRC: *ULInformationTransfer* NAS: AUTHENTICATION RESPONSE	
1f	<--	RRC: *DLInformationTransfer* NAS: SECURITY MODE COMMAND	
1g	-->	RRC: *ULInformationTransfer* NAS: SECURITY MODE COMPLETE	
1h	<--	RRC: *DLInformationTransfer* NAS: ESM INFORMATION REQUEST	
1i	-->	RRC: *ULInformationTransfer* NAS: ESM INFORMATION RESPONSE	
1j	<--	RRC: *SecurityModeCommand*	
1k	-->	RRC: *SecurityModeComplete*	
1l	<--	RRC: *UECapabilityEnquiry*	
1m	-->	RRC: *UECapabilityInformation*	RRC UE Capability Information Message will include E-UTRAN parameter, Inter-RAT parameter and Radio Paging Information
2a	<--	RRC: *RRCConnectionReconfiguration* NAS: ATTACH ACCEPT NAS: ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST	
2b	-->	RRC: *RRCConnectionReconfigurationComplete*	

Step	Direction UE - NW	Message	Comments
2c	-->	RRC: *ULInformationTransfer* NAS: ATTACH COMPLETE NAS: ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT	

2.1.2 CAT-M Device Attach Procedure with User Plane CIoT EPS Optimization

Description

CAT-M1 device could successfully perform LTE Attach Procedure with User Plane CIoT EPS Optimizations.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.2.2_REQ_001 (Attach)

GSMA TS.39_2.3.2_REQ_001 (Device Capabilities)

3GPP TS 23.401, 24.301 and 36.331

Reason for test

To verify that CAT-M device could successfully perform LTE Attach Procedure with User Plane CIoT EPS Optimizations.

Initial configuration

DUT is configured with “User Plane CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”

DUT is Switched OFF

The NW is configured to support CAT-M and “User Plane CIoT EPS Optimizations” and “S1-U Data transfer”.

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT is in EMM-IDLE mode reads SIB2-BR; set up RRC connection and sends Attach Request message indicating support of “User Plane CIoT EPS Optimization” and “S1-U Data transfer” together with PDN CONNECTIVITY REQUEST Message.
2	Verify the DUT sends Attach Accept after reception of Attach Accept message from NW	Upon reception of Attach Accept message from NW DUT successfully completes attach procedure by sending Attach Complete Message together with Activate Default EPS Bearer Context Accept Message

Example message flow (optional):

Step	Direction UE - NW	Message	Comments
1a	-->	RRC: RRCConnection Request	After DUT has read SIB2 to verify that “User Plane CIoT EPS Optimizations” is broadcast in EUTRAN Cell it sends RRC Connection Request
1b	<--	RRC: RRCConnectionSetup	
1c	-->	RRC: RRCConnectionSetupComplete NAS: ATTACH REQUEST NAS: PDN CONNECTIVITY REQUEST	Attach Request message indicates support of “User Plane CIoT EPS Optimization” and “S1-U Data Transfer”
1d	<--	RRC: DLInformationTransfer NAS: AUTHENTICATION REQUEST	
1e	-->	RRC: ULInformationTransfer NAS: AUTHENTICATION RESPONSE	
1f	<--	RRC: DLInformationTransfer NAS: SECURITY MODE COMMAND	
1g	-->	RRC: ULInformationTransfer NAS: SECURITY MODE COMPLETE	
1h	<--	RRC: DLInformationTransfer NAS: ESM INFORMATION REQUEST	
1i	-->	RRC: ULInformationTransfer NAS: ESM INFORMATION RESPONSE	
1j	<--	RRC: SecurityModeCommand	
1k	-->	RRC: SecurityModeComplete	
1l	<--	RRC: UECapabilityEnquiry	
1m	-->	RRC: UECapabilityInformation	RRC UE Capability Information Message will include E-UTRAN parameter, Inter-RAT parameter and Radio Paging Information
2a	<--	RRC: RRCConnectionReconfiguration NAS: ATTACH ACCEPT NAS: ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST	
2b	-->	RRC: RRCConnectionReconfigurationComplete	

Step	Direction UE - NW	Message	Comments
2c	-->	RRC: ULInformationTransfer NAS: ATTACH COMPLETE NAS: ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT	

2.1.3 CAT-M Device Attach Procedure with CIoT EPS Optimization (EMM Registered without PDN Connection)

Description

CAT-M device could successfully perform LTE Attach Procedure with CIoT EPS Optimizations without PDN connection.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.2.2_REQ_001 (Attach)

GSMA TS.39_2.3.2_REQ_001 (Device Capabilities)

3GPP TS 23.401, 24.301 and 36.331

Reason for test

To verify that CAT-M device could successfully perform LTE Attach Procedure with CIoT EPS Optimizations without PDN connection.

Initial configuration

DUT is configured with “attachwithoutPDN Connectivity” in “Preferred and Supported Network Behaviour”

DUT is Switched OFF

The NW is configured to support CAT-M and “attachwithoutPDN Connectivity”

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT is in EMM-IDLE mode reads SIB2; set up RRC connection and sends Attach Request message indicating support of “attachwithoutPDN Connectivity” in UE Network Capability IE together with ESM DUMMY Message.
2	Verify the DUT sends Attach Complete with ESM DUMMY MESSAGE after reception of Attach Accept message from NW	Upon reception of Attach Accept message from NW DUT successfully completes attach procedure by sending Attach Complete Message

Example message flow (optional):

Step	Direction UE - NW	Message	Comments
1a	-->	RRC: RRCConnectionRequest	After DUT has read SIB2 to verify that "attachwithoutPDN" is broadcast in EUTRAN Cell it sends RRC Connection Request
1b	<--	RRC: RRCConnectionSetup	
1c	-->	RRC: RRCConnectionSetupComplete NAS: ATTACH REQUEST NAS: ESM DUMMY MESSAGE	Attach Request message specifies support of "attachwithoutPDN Connectivity in UE Network Capability IE
1d	<--	RRC: DLInformationTransfer NAS: AUTHENTICATION REQUEST	
1e	-->	RRC: ULInformationTransfer NAS: AUTHENTICATION RESPONSE	
1f	<--	RRC: DLInformationTransfer NAS: SECURITY MODE COMMAND	
1g	-->	RRC: ULInformationTransfer NAS: SECURITY MODE COMPLETE	
1h	<--	RRC: DLInformationTransfer NAS: ESM INFORMATION REQUEST	
1i	-->	RRC: ULInformationTransfer NAS: ESM INFORMATION RESPONSE	
1j	<--	RRC: SecurityModeCommand	
1k	-->	RRC: SecurityModeComplete	
1l	<--	RRC: UECapabilityEnquiry	
1m	-->	RRC: UECapabilityInformation	RRC UE Capability Information Message will include E-UTRAN parameter, Inter-RAT parameter and Radio Paging Information
2a	<--	RRC: RRCConnectionReconfiguration NAS: ATTACH ACCEPT NAS: ESM DUMMY MESSAGE	NW sends Attach Accept Message that supports "attachwithoutPDN Connectivity" in "EPS Network Feature Support"
2b	-->	RRC: RRCConnectionReconfigurationComplete	

Step	Direction UE - NW	Message	Comments
2c	-->	RRC: ULInformationTransfer NAS: ATTACH COMPLETE NAS: ESM DUMMY MESSAGE	

2.1.4 CAT-NB Device Attach Procedure with Control Plane CIoT EPS Optimization – without PDN

Description

CAT-NB device could successfully perform LTE Attach Procedure with Control Plane CIoT EPS Optimizations.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.2.2_REQ_001 (Attach)

GSMA TS.39_2.3.2_REQ_001 (Device Capabilities)

3GPP TS 23.401, 24.301 and 36.331

Reason for test

To verify that CAT-NB device could successfully perform LTE Attach Procedure with Control Plane CIoT EPS Optimizations with PDN.

Initial configuration

DUT is configured with “Control Plane CIoT EPS Optimizations with PDN” in “Preferred and Supported Network Behaviour”

DUT is Switched OFF

The NW is configured to support CAT-NB and “Control Plane CIoT EPS Optimizations”

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT in EMM_IDLE mode reads SIB2-NB; set up RRC connection and sends Attach Request message indicating support of “Control Plane CIoT EPS Optimization” together with PDN CONNECTIVITY REQUEST Message.
2	Verify the DUT sends Attach Complete after reception of Attach Accept message from NW	Upon reception of Attach Accept message from NW DUT successfully completes attach procedure by sending Attach Complete Message

Example message flow:

Step	Direction UE - NW	Message	Comments
1a	-->	RRC: RRCConnection Request-NB	After DUT has read SIB2-NB to verify that “Control Plane CIoT EPS Optimizations” is broadcast in EUTRAN Cell it sends RRC Connection Request
1b	<--	RRC: *RRCConnectionSetup-NB*	
1c	-->	RRC: *RRCConnectionSetupComplete* NAS: ATTACH REQUEST NAS: ESM DUMMY MESSAGE	Attach Request message indicates support of “Control Plane CIoT EPS Optimization”
1d	<--	RRC: *DLInformationTransfer-NB* NAS: IDENTITY REQUEST	
1e	-->	RRC: *ULInformationTransfer-NB* NAS: IDENTITY RESPONSE	
1f	<--	RRC: *DLInformationTransfer-NB* NAS: AUTHENTICATION REQUEST	
1g	-->	RRC: *ULInformationTransfer-NB* NAS: AUTHENTICATION RESPONSE	
1h	<--	RRC: *DLInformationTransfer-NB* NAS: SECURITY MODE COMMAND	
1i	-->	RRC: *ULInformationTransfer-NB* NAS: SECURITY MODE COMPLETE	
2a	<--	RRC: *DLInformationTransfer-NB* NAS: ATTACH ACCEPT NAS: ESM DUMMY MESSAGE	
2b	-->	RRC: *ULInformationTransfer-NB* NAS: ATTACH COMPLETE NAS: ESM DUMMY MESSAGE	
2c	<--	RRC: *RRCConnectionRelease-NB*	

2.1.5 CAT-NB Device Attach Procedure with Control Plane CIoT EPS Optimization – with PDN

Description

CAT-NB device could successfully perform LTE Attach Procedure with Control Plane CIoT EPS Optimizations.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.2.2_REQ_001 (Attach)

GSMA TS.39_2.3.2_REQ_001 (Device Capabilities)

3GPP TS 23.401, 24.301 and 36.331

Reason for test

To verify that CAT-NB device could successfully perform LTE Attach Procedure with Control Plane CIoT EPS Optimizations with PDN.

Initial configuration

DUT is configured with “Control Plane CIoT EPS Optimizations with PDN” in “Preferred and Supported Network Behaviour”

DUT is Switched OFF

The NW is configured to support CAT-NB and “Control Plane CIoT EPS Optimizations”

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT in EMM_IDLE mode reads SIB2-NB; set up RRC connection and sends Attach Request message indicating support of “Control Plane CIoT EPS Optimization” together with PDN CONNECTIVITY REQUEST Message.
2	Verify the DUT sends Attach Complete after reception of Attach Accept message from NW	Upon reception of Attach Accept message from NW DUT successfully completes attach procedure by sending Attach Complete Message

Example message flow:

Step	Direction UE - NW	Message	Comments
1a	-->	RRC: RRCConnection Request-NB	After DUT has read SIB-2-NB to verify that “Control Plane CIoT EPS Optimizations” is broadcast in EUTRAN Cell it sends RRC Connection Request
1b	<--	RRC: *RRCConnectionSetup-NB*	
1c	-->	RRC: *RRCConnectionSetupComplete* NAS: ATTACH REQUEST NAS: PDN CONNECTIVITY REQUEST	Attach Request message indicates support of “Control Plane CIoT EPS Optimization”
1d	<--	RRC: *DLInformationTransfer-NB* NAS: IDENTITY REQUEST	
1e	-->	RRC: *ULInformationTransfer-NB* NAS: IDENTITY RESPONSE	
1f	<--	RRC: *DLInformationTransfer-NB* NAS: AUTHENTICATION REQUEST	
1g	-->	RRC: *ULInformationTransfer-NB* NAS: AUTHENTICATION RESPONSE	
1h	<--	RRC: *DLInformationTransfer-NB* NAS: SECURITY MODE COMMAND	
1i	-->	RRC: *ULInformationTransfer-NB* NAS: SECURITY MODE COMPLETE	
1j	<--	RRC: *DLInformationTransfer-NB* NAS: ESM INFORMATION REQUEST	
1k	-->	RRC: *ULInformationTransfer-NB* NAS: ESM INFORMATION RESPONSE	
2a	<--	RRC: *DLInformationTransfer-NB* NAS: ATTACH ACCEPT NAS: ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST	
2b	-->	RRC: *ULInformationTransfer-NB* NAS: ATTACH COMPLETE NAS: ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT	
2c	<--	RRC: *RRCConnectionRelease-NB*	

2.1.6 CAT-NB Device Attach Procedure with User Plane CIoT EPS Optimization – without PDN

Description

CAT-NB device could successfully perform LTE Attach Procedure with User Plane CIoT EPS Optimizations without PDN connection.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.1.2_REQ_001 (Cell Selection Procedure)

GSMA TS.39_2.2.2_REQ_001 (Attach)

GSMA TS.39_2.3.2_REQ_001 (Device Capabilities)

3GPP TS 23.401, 24.301 and 36.331

Reason for test

To verify that CAT-NB device could successfully perform LTE Attach Procedure with User Plane CIoT EPS Optimizations without PDN.

Initial configuration

DUT is configured with “User Plane CIoT EPS Optimizations without PDN” in “Preferred and Supported Network Behaviour”

DUT is Switched OFF

The NW is configured to support CAT-NB and “User Plane CIoT EPS Optimizations without PDN-Connectivity”

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT in EMM_IDLE mode reads SIB2-NB; set up RRC connection and sends Attach Request message indicating support of “User Plane CIoT EPS Optimization” together with ESM DUMMY Message.
2	Verify the DUT sends Attach Complete after reception of Attach Accept message from NW	Upon reception of Attach Accept message from NW DUT successfully completes attach procedure by sending Attach Complete Message

Example message flow:

Step	Direction UE - NW	Message	Comments
1a	-->	RRC: RRCConnection Request-NB	After DUT has read SIB2-NB to verify that “User Plane CIoT EPS Optimizations” and “EPS Attach without PDN

Step	Direction UE - NW	Message	Comments
			Connectivity" is broadcasted in EUTRAN Cell
1b	<--	RRC: RRCConnectionSetup-NB	
1c	-->	RRC: RRCConnectionSetupComplete NAS: ATTACH REQUEST NAS: ESM DUMMY MESSAGE	Attach Request message indicates support of "User Plane CIoT EPS Optimization" and "EPS Attach without PDN connectivity"
1d	<--	RRC: DLInformationTransfer-NB NAS: IDENTITY REQUEST	
1e	-->	RRC: ULInformationTransfer-NB NAS: IDENTITY RESPONSE	
1f	<--	RRC: DLInformationTransfer-NB NAS: AUTHENTICATION REQUEST	
1g	-->	RRC: ULInformationTransfer-NB NAS: AUTHENTICATION RESPONSE	
1h	<--	RRC: DLInformationTransfer-NB NAS: SECURITY MODE COMMAND	
1i	-->	RRC: ULInformationTransfer-NB NAS: SECURITY MODE COMPLETE	
2a	<--	RRC: DLInformationTransfer-NB NAS: ATTACH ACCEPT NAS: ESM DUMMY MESSAGE	
2b	-->	RRC: ULInformationTransfer-NB NAS: ATTACH COMPLETE NAS: ESM DUMMY MESSAGE	
2c	<--	RRC: RRCConnectionRelease-NB	

2.1.7 CAT-NB Device Attach Procedure with User Plane CIoT EPS Optimization – with PDN

Description

CAT-NB device could successfully perform LTE Attach Procedure with User Plane CIoT EPS Optimizations with PDN connection.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.1.2_REQ_001 (Cell Selection Procedure)

GSMA TS.39_2.2.2_REQ_001 (Attach)

GSMA TS.39_2.3.2_REQ_001 (Device Capabilities)

3GPP TS 23.401, 24.301 and 36.331

Reason for test

To verify that CAT-NB device could successfully perform LTE Attach Procedure with User Plane CIoT EPS Optimizations with PDN.

Initial configuration

DUT is configured with “User Plane CIoT EPS Optimizations with PDN” in “Preferred and Supported Network Behaviour”

DUT is Switched OFF

The NW is configured to support CAT-NB and “User Plane CIoT EPS Optimizations”

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT in EMM_IDLE mode reads SIB2-NB; set up RRC connection and sends Attach Request message indicating support of “User Plane CIoT EPS Optimization” together with PDN CONNECTIVITY REQUEST Message.
2	Verify the DUT sends Attach Complete after reception of Attach Accept message from NW	Upon reception of Attach Accept message from NW DUT successfully completes attach procedure by sending Attach Complete Message

Example message flow:

Step	Direction UE - NW	Message	Comments
1a	-->	RRC: RRCConnection Request-NB	After DUT has read SIB2-NB to verify that “User Plane CIoT EPS Optimizations” is broadcast in EUTRAN Cell it sends RRC Connection Request
1b	<--	RRC: RRCConnectionSetup-NB	
1c	-->	RRC: RRCConnectionSetupComplete NAS: ATTACH REQUEST NAS: PDN CONNECTIVITY REQUEST	Attach Request message indicates support of “User Plane CIoT EPS Optimization”
1d	<--	RRC: DLInformationTransfer-NB NAS: IDENTITY REQUEST	
1e	-->	RRC: ULInformationTransfer-NB NAS: IDENTITY RESPONSE	
1f	<--	RRC: DLInformationTransfer-NB NAS: AUTHENTICATION REQUEST	

Step	Direction UE - NW	Message	Comments
1g	-->	RRC: ULInformationTransfer-NB NAS: AUTHENTICATION RESPONSE	
1h	<--	RRC: DLInformationTransfer-NB NAS: SECURITY MODE COMMAND	
1i	-->	RRC: ULInformationTransfer-NB NAS: SECURITY MODE COMPLETE	
1j	<--	RRC: DLInformationTransfer-NB NAS: ESM INFORMATION REQUEST	
1k	-->	RRC: ULInformationTransfer-NB NAS: ESM INFORMATION RESPONSE	
2a	<--	RRC: DLInformationTransfer-NB NAS: ATTACH ACCEPT NAS: ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST	
2b	-->	RRC: ULInformationTransfer-NB NAS: ATTACH COMPLETE NAS: ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT	
2c	<--	RRC: RRCConnectionRelease-NB	

2.1.8 CAT-NB Device Attach Procedure with CIoT EPS Optimizations (SMS transfer without Combined Attach)

Description

Check that CAT-NB device could successfully perform LTE Attach Procedure for “SMS transfer without Combined Attach”.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.1.2_REQ_001 (Cell Selection Procedure)

GSMA TS.39_2.2.2_REQ_001 (Attach)

GSMA TS.39_2.3.2_REQ_001 (Device Capabilities)

3GPP TS 23.401, 24.301 and 36.331

Reason for test

To verify that CAT-NB device could successfully perform LTE Attach Procedure for “SMS transfer without Combined Attach”

Initial configuration

DUT configured with “SMS transfer without Combined Attach” and “Control Plane CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”.

The NW is configured to support “SMS transfer without Combined Attach” and “Control Plane CIoT EPS Optimizations”.

DUT is Switched OFF

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT set up RRC connection and sends Attach Request message indicating support of "SMS only"
2	Verify the DUT sends Attach Complete together with Activate Default EPS Bearer Context Accept Message in the *ESM Message Container Information Element* after reception of Attach Accept message from NW	Upon reception of Attach Accept message from NW DUT successfully completes attach procedure by sending Attach Complete Message

Example message flow:

Step	Direction UE - NW	Message	Comments
1a	-->	RRC: RRCConnectionRequest-NB	After DUT has read SIB2-NB to verify that “Control Plane CIoT EPS Optimizations” is broadcast in EUTRAN Cell it sends RRC Connection Request
1b	<--	RRC: *RRCConnectionSetup-NB*	
1c	-->	RRC: *RRCConnectionSetupComplete-NB* NAS: ATTACH REQUEST NAS: PDN CONNECTIVITY REQUEST (optional)	Attach Request message indicates support of "SMS only" in the additional update type IE and shall set the EPS attach type IE to "EPS attach" optional: PDN CONNECTIVITY REQUEST Message in *ESM Message Container Information Element* to request PDN Connectivity
1d	<--	RRC: *DLInformationTransfer*-NB NAS: AUTHENTICATION REQUEST	
1e	-->	RRC: *ULInformationTransfer-NB* NAS: AUTHENTICATION RESPONSE	
1f	<--	RRC: *DLInformationTransfer-NB* NAS: SECURITY MODE COMMAND	
1g	-->	RRC: *ULInformationTransfer-NB* NAS: SECURITY MODE COMPLETE	

Step	Direction UE - NW	Message	Comments
1h	<--	RRC: *DLInformationTransfer-NB* NAS: ESM INFORMATION REQUEST	
1i	-->	RRC: *ULInformationTransfer-NB* NAS: ESM INFORMATION RESPONSE	
1j	<--	RRC: *SecurityModeCommand*	
1k	-->	RRC: *SecurityModeComplete*	
1l	<--	RRC: *UECapabilityEnquiry*	
1m	-->	RRC: *UECapabilityInformation*	RRC UE Capability Information Message will include E-UTRAN parameter, Inter-RAT parameter and Radio Paging Information
2a	<--	RRC: *RRCConnectionReconfiguration-NB* NAS: ATTACH ACCEPT NAS: ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST (optional)	
2b	-->	RRC: *RRCConnectionReconfigurationComplete-NB*	
2c	-->	RRC: *ULInformationTransfer* NAS: ATTACH COMPLETE NAS: ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT (optional)	Optional: Activate Default EPS Bearer Context Accept Message in the *ESM Message Container Information Element*

2.1.9 Attach Procedure / Reject / No suitable cell in TA (EMM cause #15)

Description

Check a CAT-M or CAT-NB device behaviour on the reject message with cause 15 ‘No suitable cells in TA’ in a MIoT environment that is incompatible with DUTs’ CIoT EPS optimisation.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.1.2_REQ_001 (Cell Selection Procedure)

GSMA TS.39_2.2.2_REQ_001 (Attach)

GSMA TS.39_2.3.2_REQ_001 (Device Capabilities)

GSMA TS.39_2.2.2_REQ_005 (Reject Cause)

3GPP TS 23.401, 24.301 and 36.331

Reason for test

To verify that CAT-M or CAT-NB DUT behaves correctly on a reject message ‘‘No suitable cell in TA” from the E-UTRA cell. The DUT shall indicate the loss of service with an appropriate error message (e.g. limited service).

Initial configuration

DUT and NW configured “CIoT EPS Optimizations” are not compatible.

DUT is Switched OFF

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT in EMM_IDLE mode reads SIB2-NB; set up RRC connection and sends Attach Request message indicating support of “CIoT EPS Optimization”.
2	Verify the DUT enters EMM DEREGISTERED.LIMITED-SERVICE and indicates appropriate error message upon EMM reject cause #15.	Upon reception of Attach Reject with EMM cause value #15 (no suitable cell in TA) from NW the DUT enters EMM.DEREGISTERED.LIMITED-SERVICE

2.1.10 Device Detach Procedure Description

CAT-M or CAT-NB device could successfully perform Detach Procedure.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.2.2_REQ_002 (Detach)

3GPP TS 23.401, 24.301 and 36.331

Reason for test

To verify that CAT-M or CAT-NB device could successfully perform Detach Procedure.

Initial configuration

DUT is configured with “CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”

DUT is Switched ON (EMM-REGISTERED)

The NW is configured to support “CIoT EPS Optimizations”

Test procedure

Step	Test procedure	Expected behaviour
1	Switch off DUT	DUT in EMM-REGISTERED sends DETACH REQUEST message for a period of 5 s. The DUT switches off as soon as the detach message has been sent.

2.2 Paging

2.2.1 Paging Procedure

Description

The CAT-NB and CAT-M device should initiate RRC connection establishment, when receiving the Paging message, e.g. to receive an incoming call.

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 36.331

Reason for test

To verify that CAT-NB and CAT-M device could successfully initiate RRC connection establishment, when receiving the Paging message.

Initial configuration

DUT is in RRC_IDLE.

The NW supports the paging procedure when downlink data request is generated.

Test procedure

Step	Test procedure	Expected behaviour
1	Downlink data request is sent to DUT in RRC_IDLE	DUT set up the RRC connection establishment upon receiving the paging message.
2	Verify the DUT successfully establish RRC Connection and act as requested.	DUT successfully establish RRC Connection and act as requested.

2.3 Data Transfer

2.3.1 Data Transfer use IP/non-IP/SMS with CP/UP

2.3.1.1 Data Transfer with Control Plane CIoT EPS Optimizations - IP PDN Type

Description

Data transfer via IP

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 23.401, TS 24.301, TS 36.211, TS 36.213

TS.39_2.4.2_REQ_001

Reason for test

Verify CAT-M and CAT-NB device can transport data use IP PDN Type with Control Plane CIoT EPS Optimizations.

Initial configuration

DUT is configured with “Control Plane CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”.

DUT is configured to support IP PDN Type

DUT is in RRC_CONNECTED State.

Test procedure

Step	Test procedure	Expected behaviour
1	Perform uplink data transfer on DUT	DUT sends ESM DATA TRANSPORT message which contains IP data
2	Perform downlink data transfer on DUT	DUT receives ESM DATA TRANSPORT message which contains IP data

2.3.1.2 Data Transfer with Control Plane CIoT EPS Optimizations - Non IP PDN Type

Description

Data transfer via non-IP

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 23.401, 3GPP TS 24.301, TS 36.211, TS 36.213

TS.39_2.4.2_REQ_001

Reason for test

Verify CAT-M and CAT-NB device can transport data use Non IP PDN Type with Control Plane CIoT EPS Optimizations.

Initial configuration

DUT is configured with “Control Plane CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”.

DUT is configured to support Non IP PDN Type

DUT is in RRC_CONNECTED State.

Test procedure

Step	Test procedure	Expected behaviour
1	Perform uplink data transfer on DUT	DUT sends ESM DATA TRANSPORT message which contains Non IP data
2	Perform downlink data transfer on DUT	DUT receives ESM DATA TRANSPORT message which contains Non IP data

2.3.1.3 Data Transfer with User Plane CIoT EPS Optimizations - IP PDN Type

Description

Data transfer via IP

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 23.401, 3GPP TS 24.301, TS 36.211, TS 36.213

TS.39_2.4.2_REQ_001

Reason for test

Verify CAT-M and CAT-NB device can transport data use IP PDN Type with User Plane CIoT EPS Optimizations.

Initial configuration

DUT is configured with “User Plane CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”.

DUT is configured to support IP PDN Type

DUT is in RRC_CONNECTED State.

Test procedure

Step	Test procedure	Expected behaviour
1	Perform uplink data transfer on DUT	DUT sends ESM DATA TRANSPORT message which contains IP data
2	Perform downlink data transfer on DUT	DUT receives ESM DATA TRANSPORT message which contains IP data

2.3.1.4 Data Transfer with User Plane CIoT EPS Optimizations - Non IP PDN Type

Description

Data transfer via non-IP

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 23.401, 3GPP TS 24.301, TS 36.211, TS 36.213

TS.39_2.4.2_REQ_001

Reason for test

Verify CAT-M and CAT-NB device can transport data use Non IP PDN Type with User Plane CIoT EPS Optimizations.

Initial configuration

DUT is configured with “User Plane CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”.

DUT is configured to support Non IP PDN Type

DUT is in RRC_CONNECTED State.

Test procedure

Step	Test procedure	Expected behaviour
1	Perform uplink data transfer on DUT	DUT sends ESM DATA TRANSPORT message which contains Non IP data
2	Perform downlink data transfer on DUT	DUT receives ESM DATA TRANSPORT message which contains Non IP data

2.3.1.5 Data Transfer with Control Plane CIoT EPS Optimizations - SMS

Description

SMS message transfer

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 24.301, TS 23.401, 3GPP TS 23.040

Reason for test

Verify CAT-M and CAT-NB device can transport and receive SMS message with Control Plane CIoT EPS Optimizations.

Initial configuration

DUT and Client 1 are configured with “Control Plane CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”.

Client 1 indicates the same UE category as DUT.

DUT is in RRC_IDLE State.

Test procedure

Step	Test procedure	Expected behaviour
1	Send the SMS message from DUT to Client 1	DUT sends Control Plane Service Request message which contains SMS message SMS is successfully received on Client 1.
2	Send the SMS message from Client 1 to DUT	SMS is successfully received on DUT.

2.3.2 Suspend Resume

2.3.2.1 CAT-M Device Suspend-Resume procedure with User Plane CIoT EPS Optimization

Description

CAT-M device could successfully perform the suspend-resume procedure. After resuming the RRC connection the CAT-M device shall re-activate security and re-establish the DRB connection

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.6.2_REQ_001 (Suspend)

GSMA TS.39_2.6.2_REQ_002 (Resume)

3GPP TS 36.331

Reason for test

To verify that CAT-M device could successfully perform the suspend and resume procedure. After resuming the RRC connection the CAT-M device shall re-activate security and re-establish the DRB connection.

Initial configuration

DUT is configured with “User Plane CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”

DUT is Switched ON

DUT has DRB connection established

The NW is configured to support CAT-M and “User Plane CIoT EPS Optimizations”

Test procedure

Step	Test procedure	Expected behaviour
1	Trigger the NW to send an RRCConnectionRelease Message including the “resumeIdentity” and “release cause: rrc-Suspend”	DUT releases RRC connection and moves into RRC_IDLE state. (DUT stores resumeIdentity during RC connection release)
2	Trigger the DUT to send some user data in UL	DUT transmits RRCConnectionResume Request Message with “resumeIdentity” and including information needed by the eNodeB to access the DUT's stored AS Context. Security is fully resumed on DUT side after reception and processing of RRCConnectionResume Message. Some EPS bearer can’t be resumed by the NW, in that case eNB will reconfigure the radio bearers. UL Data from DUT is sent

Example message flow:

Step	Direction UE - NW	Message	Comments
1a	<--	RRC: RRCConnectionRelease	The NW transmits an RRCConnectionRelease message including “resumeIdentity” and “rrc-Suspend” as releaseCause.
2a	-->	RRC: RRCConnectionResumeRequest	DUT transmits an RRCConnectionResumeRequest message including the “resumeIdentity” and “AS security context” stored in step 1a
2b	<--	RRC: RRCConnectionResume	
2c	-->	RRC: RRCConnectionResumeComplete	

2.3.2.2 CAT-NB Device Suspend-Resume procedure with User Plane CIoT EPS Optimization

Description

CAT-NB device could successfully perform the suspend-resume procedure.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.6.2_REQ_001

GSMA TS.39_2.6.2_REQ_002

3GPP TS 36.331

Reason for test

To verify that CAT-NB device could successfully perform the suspend and resume procedure.

Initial configuration

DUT is configured with “User Plane CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”

DUT is Switched ON

The NW is configured to support CAT-NB and “User Plane CIoT EPS Optimizations”

Test procedure

Step	Test procedure	Expected behaviour
1	Trigger the NW to send an RRCConnectionRelease-NB Message including the “resumeIdentity” and “release cause: rrc-Suspend”	DUT releases RRC connection and moves into RRC_IDLE state. (DUT stores resumeIdentity during RC connection release)

2	Trigger the DUT to send some user data in UL	DUT transmits RRCConnectionResumeRequest-NB Message with “resumeIdentity” and including information needed by the eNB to access the DUT's stored AS Context. Some EPS bearer can’t be resumed by the network, in that case eNodeB will reconfigures the radio bearers UL Data from DUT is sent

Example message flow:

Step	Direction UE - NW	Message	Comments
1a	<--	RRC: RRCConnectionRelease-NB	The NW transmits an RRCConnectionRelease-NB message including “resumeIdentity” and “rrc-Suspend” as releaseCause.
2a	-->	RRC: RRCConnectionResumeRequest-NB	DUT transmits an *RRCConnectionResumeRequest-NB* message including the “resumeIdentity” and “AS security context” stored in step 1a
2b	<--	RRC: RRCConnectionResume-NB	
2c	-->	RRC: RRCConnectionResumeComplete-NB	

2.3.3 Serving PLMN Rate Control / APN Rate Control

2.3.3.1 Serving PLMN Rate Control

Description

CAT-NB device could support Serving PLMN Rate Control.

Related core specifications

GSMA TS.39_2.7.1_REQ_001 (Serving PLMN Rate Control)

3GPP TS 23.401, 24.301

Reason for test

To verify that CAT-NB device could support Serving PLMN Rate Control.

Applicability

3GPP Release 13 or later

Initial configuration

DUT is configured to support Serving PLMN Rate Control；

DUT is Switched OFF

DUT attach Procedure with Control Plane CIoT EPS

The NW is configured to support CAT NB and “Serving PLMN Rate Control”

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT is in EMM-IDLE mode; set up RRC connection and sends Attach Request message indicating support of “Control Plane CIoT EPS” together with PDN CONNECTIVITY REQUEST Message.
2	Wait until the DUT sends Attach Complete message to NW, verify the DUT receive of ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message from NW, which including “serving PLMN rate control” parameter	DUT receive of ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message from NW, which including “serving PLMN rate control” parameter, such as：10．（It indicate the maximum number of uplink ESM DATA TRANSPORT messages including User data container IEs , which indicate that the DUT is allowed to send via a PDN connection per 6 minute interval is 10 (see 3GPP TS 23.401)）.
3	DUT send the uplink user data.	DUT send the uplink user data by ESM DATA TRANSPORT message via the control plan.
4	Verify the DUT limit the rate once the number of ESM DATA TRANSPORT message is more than the “serving PLMN rate control” parameter, to comply with the serving PLMN policy provided by the network.	Once the number of ESM DATA TRANSPORT message is more than the “serving PLMN rate control” parameter, DUT can’t send the uplink user data.

2.3.3.2 APN Rate Control

Description

CAT-NB device could support APN Rate Control.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.7.2_REQ_002 (APN Rate Control)

3GPP TS 24.008, 23.401 and 24.301

Reason for test

To verify that CAT-NB device could support APN Rate Control.

Initial configuration

DUT is configured to support APN Rate Control；

DUT is Switched OFF

DUT attach Procedure

The NW is configured to support APN Rate Control

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT is in EMM-IDLE mode; set up RRC connection and sends Attach Request message with PDN CONNECTIVITY REQUEST Message. The PDN CONNECTIVITY REQUEST Message indicating support of “APN rate control support indicator”.
2	Wait until the DUT sends Attach Complete message to NW， verify the DUT receive of ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message from NW, which including “APN rate control” parameter	DUT receive of ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message from NW, which including “APN rate control” parameter, such as：10. （It indicate the maximum allowed limit of uplink user data related to the corresponding APN in accordance with 3GPP TS 23.401 .
3	DUT send the uplink user data.	DUT send the uplink user data by ESM DATA TRANSPORT message via the control plan.
4	Verify the DUT limit the rate once the number of ESM DATA TRANSPORT message is more than the “APN rate control” parameter, to comply with the APN rate control policy provided by the network.	Once the number of ESM DATA TRANSPORT message is more than the “APN rate control” parameter, DUT can’t send the uplink user data.

2.3.4 Release Assistance Indication - RAN Initiate Connection Release

Description

CAT-NB and CAT-M device should support Access Stratum (AS) Release Assistance Indication (RAI) to indicate the network release the connection if it does not expect to send or receive more data in the near future.

Applicability

3GPP Release 14 or later

Related core specifications

GSMA TS.39_2.4.2_REQ_003

3GPP TS 36.321 and TS 36.331

Reason for test

To verify that CAT-NB and CAT-M device could support AS Release Assistance Indication (RAI)

Initial configuration

DUT and network is configured to support AS RAI

DUT is in RRC_IDLE state

Test procedure

Step	Test procedure	Expected behaviour
1	Initiate Data transfer on DUT	DUT receives RRCConnectionSetup with “rai-Activation ” set to true DUT is in RRC_CONNECTED
2	Verify that DUT enters RRC_IDLE state right after the completion of data transfer	DUT triggers a Buffer Status Report (BSR) with buffer size of zero bytes DUT receives RRCConnectionRelease and enters into RRC_IDLE

Example message flow:

Step	Direction UE - NW	Message	Comments
1a	-->	RRC: RRCConnection Request	
1b	<--	RRC: RRCConnectionSetup	“rai-Activation ” set to true
1c	-->	RRC: RRCConnectionSetupComplete	
2a	-->	MAC: BSR MAC control element	Buffer Size=0
2b	<--	RRC: RRCConnectionRelease	

2.3.5 Release Assistance Indication – Core Network Initiate Connection Release

Description

CAT-NB and CAT-M device supports Non-Acess Stratum (NAS) Release Assistance Indication (RAI) to indicate the network release the connection if no further data transfer or only a single downlink data transmission (e.g. acknowledgement or response to uplink data) is expected.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.4.2_REQ_004

3GPP TS 24.301

Reason for test

To verify that CAT-NB and CAT-M device could support NAS Release Assistance Indication (RAI)

Initial configuration

DUT is configured with “Control Plane CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour

DUT and network is configured to support NAS RAI

DUT is in RRC_IDLE state

Test procedure

Step	Test procedure	Expected behavior
1	Initiate Data transfer on DUT	DUT sends Control Plane Service Request DUT is in RRC_CONNECTED
2	Verify that DUT enters RRC_IDLE state right after the completion of data transfer	DUT includes Release assistance indication IE in the ESM DATA TRANSPORT message with value set to 01 or 10 DUT receives RRCConnectionRelease and enters into RRC_IDLE

Example message flow:

Step	Direction UE - NW	Message	Comments
1	-->	NAS: Control Plane Service Request/ ESM DATA Transport	Release assistance indication value = 01 or 10
2	<--	RRC: RRCConnectionRelease	

2.4 Mobility

2.4.1 IDLE-Mode Mobility

2.4.1.1 CAT-M Device Cell Reselection Procedure

Description

CAT-M device performs Cell Reselection Procedure with CIoT EPS Optimizations when re-selection criteria and ranking criteria are met.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.5.1_REQ_001 (Cell Reselection)

3GPP TS 36.304, TS 36.300 and TS 36.331

Reason for test

To verify that CAT-M device could successfully perform Cell Reselection to new cell.

Initial configuration

DUT is configured with “CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”

DUT is in RRC_IDLE state

Two EUTRAN cells (Cell 1 and Cell 2) are configured to support CAT M and “CIoT EPS Optimizations”

Test procedure

Step	Test procedure	Expected behaviour
1	Change the radio conditions that Cell 1 (serving cell) becomes unsuitable and Cell 2 (neighbour cell) becomes visible.	DUT reselects to Cell 2 and starts to read System Information to check that “CIoT EPS Optimizations are broadcasted.
2	Verify the DUT is attached to new Cell 2	DUT performs TAU procedure in Cell 2 and releases RRC connection.

2.4.1.2 CAT-NB Device Intra-Frequency Cell Reselection

Description

CAT-NB device performs the cell reselection within the Intra-frequency NB-IoT cells under RRC-Idle mode when serving cell becomes unsuitable.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.5.1_REQ_001 (Cell Reselection)

3GPP TS 36.304, TS 36.300, and TS 36.331

Reason for test

To verify that CAT-NB device successfully performs the Cell Reselection within the Intra-frequency NB-IoT cells under RRC-Idle mode.

Initial configuration

DUT is configured with “CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”

DUT is in RRC_IDLE on serving Cell 1

Two Intra-frequency cells (Cell 1 and Cell 2) are configured to support NB-IoT and “CIoT EPS Optimizations”

The two cells (Cell 1 and Cell 2) have different tracking areas and neighbouring cell related information available.

Test procedure

Step	Test procedure	Expected behaviour
1	Change the radio conditions that Cell 1 (serving cell) becomes unsuitable (Srxlev < $S_{IntraSearchP}$) and Cell 2 (neighbour cell) becomes visible (Srxlev > $S_{IntraSearchP}$)	DUT reselects to Cell 2 and sends TAU to complete procedure. DUT releases RRC connection and moves to RRC-IDLE

Example message flow:

Step	Direction UE - NW	Message	Comments
1a	-->	RRC: RRCConnectionRequest-NB	
1b	<--	RRC: RRCConnectionSetup-NB	
1c	-->	RRC: RRCConnectionSetupComplete-NB NAS: TRACKING AREA UPDATE REQUEST	DUT transmits an RRCConnectionSetupComplete-NB message to confirm the successful completion of the connection establishment and a TRACKING AREA UPDATE REQUEST message is sent to update the registration of the actual tracking area.
1d	<--	RRC: DLInformationTransfer-NB NAS: TRACKING AREA UPDATE ACCEPT	
1e	-->	RRC: ULInformationTransfer-NB NAS: TRACKING AREA UPDATE COMPLETE	
1f	<--	RRC: RRCConnectionRelease-NB	NW transmits an RRCConnectionRelease-NB message to release RRC connection and move to RRC_IDLE.

2.4.1.3 CAT-NB Device Inter-Frequency Cell Reselection

Description

To verify that CAT-NB device successfully performs the Cell Reselection within the Inter-frequency NB-IoT cells under RRC-Idle mode.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.5.1_REQ_001 (Cell Reselection)

3GPP TS 36.304, TS 36.300, and TS 36.331

Reason for test

To verify that CAT-NB device successfully performs the Cell Reselection within the Inter-frequency NB-IoT cells under RRC-Idle mode.

Initial configuration

DUT is configured with “CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”

DUT is in RRC_IDLE on serving Cell 1

Two Inter-frequency cells (Cell 1 and Cell 2) are configured to support NB-IoT and “CIoT EPS Optimizations”

The two cells (Cell 1 and Cell 2) have different tracking areas and neighbouring cell related information available.

Test procedure

Step	Test procedure	Expected behaviour
1	Change the radio conditions that Cell 1 (serving cell) becomes unsuitable (Srxlev < $S_{nonIntraSearchP}$) and Cell 2 (neighbour cell) becomes visible (Srxlev > $S_{nonIntraSearchP}$).	DUT reselects to Cell 2 and sends TAU to complete procedure. DUT releases RRC connection and moves to RRC-IDLE

Example message flow:

Step	Direction UE - NW	Message	Comments
1a	-->	RRC: RRCConnectionRequest-NB	
1b	<--	RRC: RRCConnectionSetup-NB	
1c	-->	RRC: RRCConnectionSetupComplete-NB NAS: TRACKING AREA UPDATE REQUEST	DUT transmits an RRCConnectionSetupComplete-NB message to confirm the successful completion of the connection establishment and a TRACKING AREA UPDATE REQUEST message is sent to update the registration of the actual tracking area.
1d	<--	RRC: DLInformationTransfer-NB NAS: TRACKING AREA UPDATE ACCEPT	
1e	-->	RRC: ULInformationTransfer-NB NAS: TRACKING AREA UPDATE COMPLETE	
1f	<--	RRC: RRCConnectionRelease-NB	NW transmits an RRCConnectionRelease-NB message to release RRC connection and move to RRC_IDLE.

2.4.2 Connected Mode Mobility

2.4.2.1 CAT-M Device Handover Procedure with CIoT EPS Optimization

Description

CAT-M1 device performs the handover procedure with CIoT EPS Optimization.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.5.1_REQ_002 (Handover)

3GPP TS 23.401, TS 36.300 and TS 36.331

Reason for test

To verify that CAT-M device could successfully perform the handover procedure with CIoT EPS Optimization

Initial configuration

DUT is configured with “CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”

DUT is in RRC_IDLE state

Two EUTRAN cells (Cell 1 and Cell 2) are configured to support CAT M and “CIoT EPS Optimizations”

Test procedure

Step	Test procedure	Expected behaviour
1	Initiate Data transfer on DUT. (Amount of data should outlast HO procedure)	DUT enters RRC_CONNECTED and data transfer is ongoing.
2	Change the radio conditions that Cell 1 (serving cell) becomes unsuitable and Cell 2 (neighbour cell) becomes visible.	DUT transmits measurement reports when conditions are met and performs handover to Cell 2. (RRCConnectionReconfiguration)
3	Verify that DUT performed the handover to Cell 2.	DUT is in RRC_CONNECTED at Cell 2 and the data transfer is ongoing

Example message flow:

Step	Direction UE - NW	Message	Comments
2a	<--	RRCConnectionReconfiguration	
2b	-->	RRCConnectionReconfigurationComplete	
2c	-->	MeasurementReport	
2d	<--	RRCConnectionReconfiguration	
2e	-->	RRCConnectionReconfigurationComplete	

2.4.2.2 CAT-NB Device Cell Redirection

Description

CAT-NB device completes redirection to another NB-IoT cell by leaving RRC-Connected Mode to RRC-Idle Mode.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.5.1_REQ_001 (Cell Reselection)

3GPP TS 36.304, TS 36.300, and TS 36.331

Reason for test

To verify that CAT-M device could successfully complete redirection procedure to another NB-IoT cell by leaving RRC-Connected Mode to RRC-Idle Mode.

Initial configuration

DUT is configured with “CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”

DUT is in RRC_Connected on Cell 1

Two Inter-frequency cells (Cell 1 and Cell 2) are configured to support NB-IoT and “CIoT EPS Optimizations”

The two cells (Cell 1 and Cell 2) have different tracking areas and neighbouring cell related information available.

Cell 2 with the target frequency is in a good condition.

Test procedure

Step	Test procedure	Expected behaviour
1	Change the radio conditions that Cell 1 (serving cell) becomes unsuitable and NW sends RRCConnectionRelease-NB	NW sends RRCConnectionRelease-NB message (IE *redirectedCarrierInfo* including carrierFreq-r13 of Cell 2) DUT leaves RRC-Connected to RRC-IDLE reselects to Cell 2 and sends TAU to complete procedure. DUT releases RRC connection and moves to RRC-IDLE

Example message flow:

Step	Direction UE - NW	Message	Comments
1a	<--	*RRCConnectionRelease-NB*	NW transmits an RRCConnectionRelease-NB message (IE redirectedCarrierInfo including carrierFreq-r13 of Cell 2).
1b	-->	RRC: RRCConnectionRequest-NB	
1c	<--	RRC: RRCConnectionSetup-NB	
1d	-->	RRC: RRCConnectionSetupComplete-NB NAS: TRACKING AREA UPDATE REQUEST	DUT transmits an RRCConnectionSetupComplete-NB message to confirm the successful completion of the connection establishment and a TRACKING AREA UPDATE REQUEST message is sent to update the registration of the actual tracking area.
1e	<--	RRC: DLInformationTransfer-NB NAS: TRACKING AREA UPDATE ACCEPT	
1f	-->	RRC: ULInformationTransfer-NB NAS: TRACKING AREA UPDATE COMPLETE	

Step	Direction UE - NW	Message	Comments
1g	<--	RRC: RRCConnectionRelease-NB	NW transmits an RRCConnectionRelease-NB message to release RRC connection and move to RRC_IDLE.

2.4.2.3 CAT-NB Device Connection Re-establishment with Control Plane CIoT EPS Optimization

Description

CAT-NB device performs the connection re-establishment with Control Plane CIoT EPS Optimization within the NB-IoT cells under RRC-Connected mode when serving cell becomes unsuitable.

Applicability

3GPP Release 14 or later

Related core specifications

3GPP TS 36.304, TS 36.300, and TS 36.331

TS.39_2.5.1_REQ_005

Reason for test

To verify that CAT-NB device successfully perform the connection re-establishment with Control Plane CIoT EPS Optimization within the NB-IoT cells under RRC-Connected mode.

Initial configuration

DUT is configured with “Control Plane CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”

DUT is in RRC_IDLE state on serving Cell 1

Two NB-IoT cells (Cell 1 and Cell 2) are configured to support “Control Plane CIoT EPS Optimizations” and RRC connection re-establishment with “Control Plane CIoT EPS Optimizations” (The cp-Reestablishment-r14 in SystemInformationBlockType2-NB is configured true).

Test procedure

Step	Test procedure	Expected behaviour
1	Initiate Data transfer on DUT. (Amount of data should outlast connection re-establishment procedure)	DUT enters RRC_CONNECTED and data transfer is ongoing.
2	Change the radio conditions that Cell 1 (serving cell) becomes unsuitable and Cell 2 (neighbour cell) becomes visible.	DUT performs the connection re-establishment with Cell 2
3	Verify that DUT successfully performed the connection re-establishment.	DUT is in RRC_CONNECTED at Cell 2 and the data transfer is ongoing

Example message flow:

Step	Direction UE - NW	Message	Comments
2a	-->	RRC: *RRCConnectionReestablishmentRequest-NB*	
2b	<--	RRC: *RRCConnectionReestablishment-NB*	
2c	-->	RRC: *RRCConnectionReestablishmentComplete-NB*	

2.4.2.4 CAT-NB Device Connection Re-establishment with User Plane CIoT EPS Optimization

Description

CAT-NB device performs the connection re-establishment with User Plane CIoT EPS Optimization within the NB-IoT cells under RRC-Connected mode when serving cell becomes unsuitable.

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 36.304, TS 36.300, and TS 36.331

TS.39_2.5.1_REQ_004

Reason for test

To verify that CAT-NB device successfully perform the connection re-establishment with User Plane CIoT EPS Optimization within the NB-IoT cells under RRC-Connected mode.

Initial configuration

DUT is configured with “User Plane CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”

DUT is in RRC_IDLE state on serving Cell 1

Two NB-IoT cells (Cell 1 and Cell 2) are configured to support “User Plane CIoT EPS Optimizations”.

Test procedure

Step	Test procedure	Expected behaviour
1	Initiate Data transfer on DUT. (Amount of data should outlast connection re-establishment procedure)	DUT enters RRC_CONNECTED and data transfer is ongoing.
2	Change the radio conditions that Cell 1 (serving cell) becomes unsuitable and Cell 2 (neighbour cell) becomes visible.	DUT performs the connection re-establishment with Cell 2
3	Verify that DUT successfully performed the connection re-establishment.	DUT is in RRC_CONNECTED at Cell 2 and the data transfer is ongoing

Example message flow:

Step	Direction UE - NW	Message	Comments
2a	-->	RRC: *RRCConnectionReestablishmentRequest-NB*	
2b	<--	RRC: *RRCConnectionReestablishment-NB*	
2c	-->	RRC: *RRCConnectionReestablishmentComplete-NB*	

2.5 Device Capabilities

2.5.1 CAT-NB Uplink Transmission Capability – 3.7 kHz (Single-tone)

Description

For CAT-NB1 device, uplink transmission capability (3.75 kHz, single-tone) needs to be verified.

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 36.211, TS 36.331

Reason for test

Verify CAT-NB device can support single-tone transmission with 3.75 kHz subcarrier spacing.

Initial configuration

NB-IoT eNodeB is configured to only support single-tone transmission with 3.75 kHz subcarrier spacing.

This test requires logging tools.

Test procedure

Step	Test procedure	Expected behaviour
1	Powers on DUT	DUT successfully access the cell
2	Perform uplink data transfer	Using logging tool to verify DCI Format N0 indicate 3.75kHz/single-tone. Uplink data is successfully transferred

2.5.2 CAT-NB Uplink Transmission Capability – 15 kHz (Single-tone)

Description

For CAT-NB device, uplink transmission capability (15 kHz, single-tone) needs to be verified.

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 36.211, TS 36.331.

Reason for test

Verify CAT-NB device can support single-tone transmission with 15 kHz subcarrier spacing.

Initial configuration

NB-IoT eNodeB is configured to only support single-tone transmission with 15 kHz subcarrier spacing.

This test requires logging tools.

Test procedure

Step	Test procedure	Expected behaviour
1	Powers on DUT	DUT successfully access the cell
2	Perform uplink data transfer	Using logging tool to verify DCI Format N0 indicate 15kHz/single-tone. Uplink data is successfully transferred

2.5.3 CAT-NB Uplink Transmission Capability – 15 kHz (Multi-tone)

Description

For CAT-NB device, uplink transmission capability (15 kHz, multi-tone) needs to be verified.

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 36.211, TS 36.331

Reason for test

Verify CAT-NB device can support multi-tone transmission with 15 kHz subcarrier spacing.

Initial configuration

NB-IoT eNodeB is configured to only support multi-tone transmission with 15 kHz subcarrier spacing.

Scenario A:

NB-IoT eNodeB schedules 3 subcarriers for DUT in multi-tone transmission. (3 tones)

Scenario B:

NB-IoT eNodeB schedules 6 subcarriers for DUT in multi-tone transmission. (6 tones)

Scenario C:

NB-IoT eNodeB schedules 12 subcarriers for DUT in multi-tone transmission. (12 tones)

This test requires logging tools.

Test procedure

Step	Test procedure	Expected behaviour
1	Powers on DUT	DUT successfully access the cell.
2	Perform uplink data transfer	Using logging tool to verify DCI Format N0 indicate 15kHz/Multi-tone. Scenario A: Duration of RU is 4ms Scenario B: Duration of RU is 2ms

		Scenario C: Duration of RU is 1ms Uplink data is successfully transferred

2.6 Positioning

2.6.1 E-CID Positioning

2.6.1.1 UE-assisted, E-SMLC-based E-CID Positioning – UE InitiateDescription

CAT-NB and CAT-M device should support UE initiated downlink E-CID (enhanced cell ID) position method as defined in 3GPP TS 36.305 and TS 36.355.

Applicability

3GPP Release 14 or later

Related core specifications

3GPP TS 36.355, TS 36.305

Reason for test

To verify that CAT-NB and CAT-M device support UE initiated downlink E-CID.

Initial configuration

DUT and network is configured to support LPP and E-CID

DUT is in RRC Connected state

Local Server (E-SLMC) is available

Logging tools are required

Test procedure

Step	Test procedure	Expected behaviour
1	Request location service on DUT, e.g. open an App which has location service and can trigger the positioning request on the DUT.	DUT sends a NAS level MO-LR request. DUT receives LPP Request Location Information which includes the E-CID measurements requested by the E-SMLC and supported by the UE together with a required response time.
2	Wait until the DUT enters into idle state;	DUT performs the location measurements as requested. DUT sends LPP Provide Location Information message to the network which contains the requested location measurements.
3	Check the location information on the DUT	Location information is received as requested.

Example message flow:

Step	Direction UE - NW	Message	Comments
1	-->	MO-LR Request	
2	<--	LPP RequestCapabilities	
3	-->	LPP ProvideCapabilities	
4	<--	LPP Request Location Information	containing IE ecid-RequestLocationInformation
5	-->	LPP Provide Location Information	containing IE ecid-ProvideLocationInformation
6	<--	MO-LR response	

2.6.1.2 UE-assisted, E-SMLC-based E-CID Positioning –Client Server

InitiateDescription

CAT-NB and CAT-M device should support Client Server initiated downlink E-CID (enhance cell ID) position methods as defined in 3GPP TS 36.305 and TS 36.355.

Applicability

3GPP Release 14 or later

Related core specifications

3GPP TS 36.355, TS 36.305, TS 23.271

Reason for test

To verify that CAT-NB and CAT-M device does support Client Server initiated downlink E-CID.

Initial configuration

DUT and network is configured to support LPP and E-CID

DUT is in RRC Connected state.

Local Server (E-SLMC) is available

Logging tools are required

Test procedure

Step	Test procedure	Expected behavior
1	Trigger the location request at the Client Server.	DUT receives NAS Location Notification Invoke message DUT sends NAS Location Notification Return Result message. DUT receives LPP Request Location information message which includes the E-CID measurements requested by the E-SMLC and supported by the UE together with a required response time;
2	Wait until the DUT enters into idle state;	DUT performs the location measurements as requested. DUT sends LPP Provide Location Information message to the network which contains the requested location measurements. Client Server receives the Location information of DUT.

Example message flow:

Step	Direction UE - NW	Message	Comments
1	<--	NAS Location Notification Invoke	
2	-->	NAS Location Notification Return Result	
3	<--	LPP RequestCapabilities	
4	-->	LPP ProvideCapabilities	
5	<--	LPP Request Location information	containing IE ecid-RequestLocationInformation
6	-->	LPP Provide Location Information	containing IE ecid-ProvideLocationInformation

2.6.1.2 eNB-assisted E-CID Positioning – UE InitiateDescription

CAT-NB and CAT-M device should support UE initiated uplink E-CID (enhanced cell ID) position method as defined in 3GPP TS 36.305 and TS 36.355.

Applicability

3GPP Release 14 or later

Related core specifications

3GPP TS 36.355, TS 36.305

Reason for test

To verify that CAT-NB and CAT-M device support UE initiated uplink E-CID.

Initial configuration

DUT and network is configured to support LPP and E-CID

Local Server (E-SLMC) is available

Logging tools are required

Test procedure

Step	Test procedure	Expected behaviour
1	Request location service on DUT, e.g. open an App which has location service and can trigger the positioning request on the DUT.	DUT sends a NAS level MO-LR request. DUT receives NAS level MO-LR response with location estimate result.
2	Check the location information on the DUT	Location information is received as requested.

Example message flow:

Step	Direction UE - NW	Message	Comments
1	-->	MO-LR Request	
2	<--	MO-LR response	

2.6.1.3 eNB-assisted E-CID Positioning – Client Server InitiateDescription

CAT-NB and CAT-M device should support Client Server initiated uplink E-CID (enhanced cell ID) position method as defined in 3GPP TS 36.305 and TS 36.355.

Applicability

3GPP Release 14 or later

Related core specifications

3GPP TS 36.355, TS 36.305, TS 23.271

Reason for test

To verify that CAT-NB and CAT-M device support Client Server initiated uplink E-CID.

Initial configuration

DUT and network is configured to support LPP and E-CID

Local Server (E-SLMC) is available

Logging tools are required

Test procedure

Step	Test procedure	Expected behaviour
1	Trigger the location request at the Client Server.	DUT receives NAS Location Notification Invoke message DUT sends NAS Location Notification Return Result message. Client Server receives the Location information of DUT.

Example message flow:

Step	Direction UE - NW	Message	Comments
1	<--	NAS Location Notification Invoke	
2	-->	NAS Location Notification Return Result	

2.6.2 OTDOA Positioning

2.6.2.1 OTDOA Positioning – UE initiate

Description

CAT-NB and CAT-M device should support the UE initiated OTDOA (Observed Time Difference of Arrival) positioning method as defined in 3GPP TS 36.305 and TS 36.355.

Applicability

3GPP Release 14 or later

Related core specifications

3GPP TS 36.355, TS 36.305

Reason for test

To verify that CAT-NB and CAT-M device support the UE initiated OTDOA (Observed Time Difference of Arrival) positioning method.

Initial configuration

DUT and network is configured to support LPP and OTDOA positioning

At least three eNodeBs supporting OTDOA positioning are available at the test location

Local Server (E-SLMC) is available

Logging tools are required

Test procedure

Step	Test procedure	Expected behaviour
1	Request location service on DUT, e.g. open an App which has location service and can trigger the positioning request on the DUT.	DUT sends a NAS level MO-LR request. DUT receives LPP Request Location Information which includes the OTDOA measurements requested by the E-SMLC and supported by the UE together with a required response time. DUT sends LPP Request Assistance Data message。 DUT receives LPP Provide Assistance Data message.
2	Wait until the DUT enters into idle state;	DUT performs the location measurements as requested. DUT sends LPP Provide Location Information message to the network which contains the requested location measurements.
3	Check the location information on the DUT	Location information is received as requested.

Example message flow:

Step	Direction UE - NW	Message	Comments
1	-->	MO-LR Request	
2	<--	LPP RequestCapabilities	
3	-->	LPP ProvideCapabilities	
4	<--	LPP Request Location Information	containing IE otdoa-RequestLocationInformation
5	-->	LPP Request Assistance Data	
6	<--	LPP Provide Assistance Data	
7	-->	LPP Provide Location Information	containing IE otdoa-ProvideLocationInformation
8	<--	MO-LR response	

2.6.2.2 OTDOA Positioning – Client Server initiate

Description

CAT-NB and CAT-M device should support the Client Server initiated OTDOA (Observed Time Difference of Arrival) positioning method as defined in 3GPP TS 36.305 and TS 36.355.

Applicability

3GPP Release 14 or later

Related core specifications

3GPP TS 36.355, TS 36.305, TS 23.271

Reason for test

To verify that CAT-NB and CAT-M device support the Client Server initiated OTDOA (Observed Time Difference of Arrival) positioning method.

Initial configuration

DUT and network is configured to support LPP and OTDOA positioning

At least three eNodeBs supporting OTDOA positioning are available at the test location

Local Server (E-SLMC) is available

Logging tools are required.

Test procedure

Step	Test procedure	Expected behavior
1	Trigger the location request at the Client Server.	DUT receives NAS Location Notification Invoke message DUT sends NAS Location Notification Return Result message. DUT receives LPP Request Location information message which includes OTDOA downlink measurements requested by the E-SMLC and supported by the UE together with a required response time; DUT sends LPP Request Assistance Data message. DUT receives LPP Provide Assistance Data message.
2	Wait until the DUT enters into idle state;	DUT performs the location measurements as requested. DUT sends LPP Provide Location Information message to the network which contains the requested location measurements. Client Server receives the Location information of DUT.

Example message flow:

Step	Direction UE - NW	Message	Comments
1	<--	NAS Location Notification Invoke	
2	-->	NAS Location Notification Return Result	
3	<--	LPP Request Location information	containing IE otdoa-RequestLocationInformation
4	-->	LPP Request Assistance Data	
5	<--	LPP Provide Assistance Data	
6	-->	LPP Provide Location Information	containing IE otdoa-ProvideLocationInformation

2.7 SMS and Voice over IMS in CE Mode A

2.7.1 SMS over IMS in CE Mode A

2.7.1.1 CAT-M device SMS over IMS

Description

CAT-M device in CE Mode A should support SMS over IMS. SMS over IMS functionality needs to be verified two scenarios such as device originating and device terminating.

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 24.229, TS 26.114

GSMA TS.39_2.9.2_REQ_001

Reason for test

Test to verify that the CAT-M device is able to send a Mobile Originating SMS over IMS and to receive a status report in CE Mode A.

Test to verify that the CAT-M device correctly implemented the role of an SMS over IMS receiver in CE Mode A.

Initial configuration

DUT, Client 1 and network support SMS over IMS

DUT and Client 1 are on serving Cell 1

DUT is IMS network registered in CE Mode A

Client 1 can be a device capable of receiving a SMS over any RAT, and respond with an acknowledgment report

Test procedure

Step	Test procedure	Expected behaviour
1	DUT sends a IMS SMS to the Client 1	Client 1 receive the SMS successfully and sends delivery report.
2	Client 1 sends a IMS SMS, to DUT	DUT receive the SMS successfully and sends a delivery report.

2.7.2 Voice Call over IMS in CE Mode A

2.7.2.1 CAT-M device Voice Call over IMS initial and receive

Description

CAT-M device in CE Mode A should perform Voice Call over IMS functionality, including initial and receive voice calls. Voice call over IMS in CE Mode B is not required.

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 24.229, TS 26.114, TS 34.229, GSMA IR.92

GSMA TS.39_2.10.2_ REQ_001

Reason for test

To verify that CAT-M device successfully initials and receives Voice Call over IMS when functioning in CE Mode A.

Initial configuration

DUT, Client 1 and network support voice call over IMS

DUT is IMS registered on the network in CE Mode A

Client 1 can be a device capable of receiving a voice call over any RAT

Test procedure

Step	Test procedure	Expected behaviour
1	DUT initiates a Voice Call over IMS to Client 1	Client 1 receives the call and starts ringing.
2	Client 1 accepts the call from DUT.	The voice call is established successfully.
3	DUT and Client 1 hold the call and exchange audio for 60 seconds.	The connection is hold for 60 seconds and audio is audible in both directions.
4	DUT hangs up.	The Voice Call ends successfully.
5	Client 1 initiates a Voice Call to DUT over any radio access technology	Network routes the call over IMS in the terminating side and DUT receives the call over IMS successfully
6	DUT accepts the call from Client 1.	The voice call is established successfully.
7	DUT and Client 1hold the call and voice communicate for 60 seconds.	The connection is hold for 60 seconds and audio is audible in both directions.
8	Client 1 hangs up.	The Voice Call ends successfully.

2.7.2.2 CAT-M device Voice Call over IMS continuity

Description

CAT-M device in CE Mode A should keep Voice Call over IMS continuity during performing handover Procedure.

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 24.229, TS 26.114, TS 34.229, GSMA IR.92

GSMA TS.39_2.10.2_ REQ_002

Reason for test

To verify that the CAT-M device in CE Mode A, is able to continue an ongoing IMS voice call while performing a handover. The voice call should not be dropped during the handover procedure, or until after having successfully camped onto the target cell.

Initial configuration

DUT and network support voice call over IMS

DUT is IMS registered on the network in CE Mode A

Cell 1 is the initial serving cell for DUT

Cell 2 is the target cell for DUT when performing handover

Client 1 can be a device capable of receiving a voice call over any RAT

Test procedure

Step	Test procedure	Expected behaviour
1	DUT is camped on cell 1 and initiates a Voice Call over IMS to Client 1	Client 1 receives the call and starts ringing
2	Client 1 accepts the call.	The voice call is established successfully.
3	DUT and Client 1 continue the call and exchange audio in both directions	The connection is held successfully and audio is audible in both directions
4	DUT moves to cell 2, and performs handover procedure	The voice call keeps continuity during performing handover procedure and is not dropped.
5	DUT moves back to cell 1, performing a second handover procedure	The voice call still keeps continuity during the handover procedure and is not dropped
6	DUT hangs up.	The voice call ends successfully.

3 Device Performance in Enhanced Coverage

3.1 Registration

3.1.1 Attach Performance with Control Plane CIoT EPS Optimizations

Description

Attach performance under different coverage level

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 23.401, TS 24.301, TS 36.331

TS.39_2.2.2_REQ_001

TS.39_3.1.2_REQ_001

Reason for test

Verify attach performance of CAT-M and CAT-NB device in enhanced coverage with Control Plane CIoT EPS Optimizations.

Initial configuration

DUT and Reference 1 are configured with “Control Plane CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”. DUT and Reference 1 are Switched OFF

Reference 1 indicating the same UE category is tested in the same location as DUT.

For CAT-NB device, performance under coverage level 0/1/2 is tested.

For CAT-M device supporting CE mode A, performance under coverage level 0/1 is tested.

For CAT-M device supporting CE mode B, performance under coverage level 0/1/2/3 is tested.

This test requires logging tools.

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT and Reference 1	Record the time difference between transmission of first Random Access Preamble and Attach Complete message. Verify the DUT’s delay performance is comparable to the Reference 1’s delay performance (average value of 10 times is no more than 10% worse).
2	Repeat step 1 10 times under each coverage level.	Verify the DUT’s attach success ratio is comparable to the Reference 1’s success ratio under each coverage level.

3.1.2 Attach Performance with User Plane CIoT EPS Optimizations

Description

Attach performance under different coverage level

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 23.401, TS 24.301, TS 36.331

TS.39_2.2.2_REQ_001

TS.39_3.1.2_REQ_001

Reason for test

Verify attach performance of CAT-M and CAT-NB device in enhanced coverage with User Plane CIoT EPS Optimizations.

Initial configuration

DUT and Reference 1 are configured with “User Plane CIoT EPS Optimizations” in “Preferred and Supported Network Behaviour”.

DUT and Reference 1 are Switched OFF

Reference 1 indicating the same UE category is tested in the same location as DUT.

For CAT-NB device, performance under coverage level 0/1/2 is tested.

For CAT-M device supporting CE mode A, performance under coverage level 0/1 is tested.

For CAT-M device supporting CE mode B, performance under coverage level 0/1/2/3 is tested.

This test requires logging tools.

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT and Reference 1	Record the time difference between transmission of first Random Access Preamble and Attach Complete message. Verify the DUT’s delay performance is comparable to the Reference 1’s delay performance (average value of 10 times is no more than 10% worse).
2	Repeat step 1 10 times under each coverage level.	Verify the DUT’s attach success ratio is comparable to the Reference 1’s success ratio under each coverage level.

3.2 Paging

3.2.1 Paging performance under different coverage level

Description

Paging performance under different coverage level

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 36.331

Reason for test

Verify paging performance of CAT-M and CAT-NB device under different coverage level.

Initial configuration

The NW supports the paging procedure when downlink data request is generated.

Reference 1 indicating the same UE category is tested in the same location as DUT. For Cat-NB device, performance under coverage level 0/1/2 is tested.

For CAT-M device supporting CE mode A, performance under coverage level 0/1 is tested.

For CAT-M device supporting CE mode B, performance under coverage level 0/1/2/3 is tested.

eDRX is disabled on DUT and Reference 1.

DUT and Reference 1 are in RRC_IDLE.

This test requires logging tools.

Test procedure

a. Step	b. Test procedure	c. Expected behaviour
1	Downlink data request is sent to DUT and Reference 1	None
2	Verify the DUT successfully establishes RRC Connection.	Record the time difference between reception of paging message and transmission of RRCConnetctionSetupComplete message. Verify the DUT's delay performance is comparable to the Reference 1's delay performance (no more than 10% worse).
3	Repeat step 1-2 10 times under each coverage level.	Verify the DUT's paging success ratio is comparable to the Reference 1's success ratio under each coverage level

3.2.2 Paging with eDRX cycle under different coverage level

Description

Performance of paging with eDRX cycle under different coverage level

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 36.331

Reason for test

Verify paging performance of CAT-M and CAT-NB device under different coverage level when eDRX cycle is configured.

Initial configuration

The NW supports the paging procedure when downlink data request is generated.

Reference 1 indicating the same UE category is tested in the same location as DUT.

For CAT-NB device, performance under coverage level 0/1/2 is tested.

For CAT-M device supporting CE mode A, performance under coverage level 0/1 is tested.

For CAT-M device supporting CE mode B, performance under coverage level 0/1/2/3 is tested.

eDRX is enabled on DUT and Reference 1 with similar configuration.

DUT and Reference 1 are in RRC_IDLE.

This test requires logging tools.

Test procedure

Step	Test procedure	Expected behaviour
1	Downlink data request is sent to DUT and Reference 1	Extended DRX parameters is included in downlink data request.
2	Verify the DUT and Reference 1 successfully establishes RRC Connection	DUT's and Reference 1 are in RRC-Connected mode.
3	Repeat step 1-2 10 times under each coverage level.	Verify the DUT's paging success ratio is comparable to the Reference 1's success ratio under each coverage level

3.3 Data Transfer and Throughput

3.3.1 Data Transfer and Throughput with Control Plane CIoT EPS Optimizations - IP PDN Type

Description

Data transfer performance via IP

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 23.401, TS 24.301, TS 36.211, TS 36.213

TS.39_3.2.2_REQ_001, TS.39_3.2.2_REQ_003

Reason for test

Verify data transfer performance of CAT-M and CAT-NB device use IP PDN Type with Control Plane CIoT EPS Optimizations.

Initial configuration

DUT is configured with "Control Plane CIoT EPS Optimizations" in "Preferred and Supported Network Behaviour".

DUT is configured to support IP PDN Type

Reference 1 indicating the same UE category is tested in the same location as DUT.

For CAT-NB device, performance under coverage level 0/1/2 is tested.

For CAT-M device supporting CE mode A, performance under coverage level 0/1 is tested.

For CAT-M device supporting CE mode B, performance under coverage level 0/1/2/3 is tested.

DUT and Reference 1 are switched off

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT and Reference 1	In the attach procedure, check UE Capability Information Message to record the UE capability.
2	Perform uplink data transfer on DUT and Reference 1 for 60s	Verify the DUT's uplink data throughput is comparable to the Reference 1's throughput (no more than 10% worse).
3	Perform downlink data transfer on DUT and Reference 1 for 60s	Verify the DUT's downlink data throughput is comparable to the Reference 1's throughput (no more than 10% worse).
4	Repeat step 1-3 10 times under each coverage level.	Verify the DUT has comparable data performance to the Reference 1 under each coverage level

3.3.2 Data Transfer and Throughput with Control Plane CIoT EPS Optimizations - Non IP PDN Type

Description

Data transfer performance via non-IP

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 23.401, TS 24.301, TS 36.211, TS 36.213

TS.39_3.2.2_REQ_001, TS.39_3.2.2_REQ_003

Reason for test

Verify data transfer performance of CAT-M and CAT-NB device use Non IP PDN Type with Control Plane CIoT EPS Optimizations.

Initial configuration

DUT is configured with "Control Plane CIoT EPS Optimizations" in "Preferred and Supported Network Behaviour".

DUT is configured to support Non IP PDN Type

Reference 1 indicating the same UE category is tested in the same location as DUT.

For CAT-NB device, performance under coverage level 0/1/2 is tested.

For CAT-M device supporting CE mode A, performance under coverage level 0/1 is tested.

For CAT-M device supporting CE mode B, performance under coverage level 0/1/2/3 is tested.

DUT and Reference 1 are switched off

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT and Reference 1	In the attach procedure, check UE Capability Information Message to record the UE capability.
2	Perform uplink data transfer on DUT and Reference 1 for 60s	Verify the DUT's uplink data throughput is comparable to the Reference 1's throughput (average value of 10 times is no more than 10% worse).
3	Perform downlink data transfer on DUT and Reference 1 for 60s	Verify the DUT's downlink data throughput is comparable to the Reference 1's throughput (average value of 10 times is no more than 10% worse).
4	Repeat step 1-3 10 times under each coverage level.	Verify the DUT has comparable data performance to the Reference 1 under each coverage level

3.3.3 Data Transfer and Throughput with User Plane CIoT EPS Optimizations - IP PDN Type

Description

Data transfer performance via IP

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 23.401, TS 24.301, TS 36.211, TS 36.213

TS.39_3.2.2_REQ_001, TS.39_3.2.2_REQ_003

Reason for test

Verify data transfer performance of CAT-M and CAT-NB device use IP PDN Type with User Plane CIoT EPS Optimizations.

Initial configuration

DUT is configured with "User Plane CIoT EPS Optimizations" in "Preferred and Supported Network Behaviour".

DUT is configured to support IP PDN Type

Reference 1 indicating the same UE category is tested in the same location as DUT.

For CAT-NB device, performance under coverage level 0/1/2 is tested.

For CAT-M device supporting CE mode A, performance under coverage level 0/1 is tested.

For CAT-M device supporting CE mode B, performance under coverage level 0/1/2/3 is tested.

DUT and Reference 1 are switched off.

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT and Reference 1	In the attach procedure, check UE Capability Information Message to record the UE capability.
2	Perform uplink data transfer on DUT and Reference 1 for 60s	Verify the DUT's uplink data throughput is comparable to the Reference 1's throughput (average value of 10 times is no more than 10% worse).
3	Perform downlink data transfer on DUT and Reference 1 for 60s	Verify the DUT's downlink data throughput is comparable to the Reference 1's throughput (average value of 10 times is no more than 10% worse).
4	Repeat step 1-3 10 times under each coverage level.	Verify the DUT has comparable data performance to the Reference 1 under each coverage level

3.3.4 Data Transfer and Throughput with User Plane CIoT EPS Optimizations - Non IP PDN Type

Description

Data transfer performance via non-IP

Applicability

3GPP Release 13 or later

Related core specifications

3GPP TS 23.401, TS 24.301, TS 36.211, TS 36.213

TS.39_3.2.2_REQ_001, TS.39_3.2.2_REQ_003

Reason for test

Verify data transfer performance of CAT-M and CAT-NB device use Non IP PDN Type with User Plane CIoT EPS Optimizations.

Initial configuration

DUT is configured with "User Plane CIoT EPS Optimizations" in "Preferred and Supported Network Behaviour".

DUT is configured to support Non IP PDN Type

Reference 1 indicating the same UE category is tested in the same location as DUT.

For CAT-NB device, performance under coverage level 0/1/2 is tested.

For CAT-M device supporting CE mode A, performance under coverage level 0/1 is tested.

For CAT-M device supporting CE mode B, performance under coverage level 0/1/2/3 is tested.

DUT and Reference 1 are switched off

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT and Reference 1	In the attach procedure, check UE Capability Information Message to record the UE capability.
2	Perform uplink data transfer on DUT and Reference 1 for 60s	Verify the DUT's uplink data throughput is comparable to the Reference 1's throughput (average value of 10 times is no more than 10% worse).
3	Perform downlink data transfer on DUT and Reference 1 for 60s	Verify the DUT's downlink data throughput is comparable to the Reference 1's throughput (average value of 10 times is no more than 10% worse).
4	Repeat step 1-3 10 times under each coverage level.	Verify the DUT has comparable data performance to the Reference 1 under each coverage level

3.4 Mobility Performance

3.4.1 Idle Mode Mobility Performance – Cell Reselection

Description

Cell reselection performance in RRC-IDLE mode

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.5.1_REQ_001

3GPP TS 36.300, TS 36.304, TS 36.331

Reason for test

To verify cell reselection performance of CAT-M and CAT-NB device under RRC-IDLE mode in mobility state.

Initial configuration

A number of cells (NB-IoT/ E-UTRAN) is available along the test route.

Reference 1 indicates the same UE category as DUT.

DUT and Reference 1 are moving in the same test route at the same speed.

DUT and Reference 1 are in RRC_IDLE.

This test requires logging tools.

Test procedure

Step	Test procedure	Expected behaviour
1	Drive along the test route,	Verify the DUT's cell reselection success ratio is comparable to the Reference 1's cell reselection success ratio. (no more than 10% worse).

3.4.2 Connected Mode Mobility Performance

3.4.2.1 Cat-M Device Connected Mode Mobility Performance - Handover

Description

Handover performance of CAT-M device

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.5.1_REQ_002

3GPP TS 36.300, TS 36.331

Reason for test

To verify handover performance of CAT-M device under RRC-CONNECTED mode in mobility state.

Initial configuration

A number of E-UTRAN cells is available along the test route.

Reference 1 indicates the same UE category as DUT.

DUT and Reference 1 are moving in the same test route at the same speed.

DUT and Reference 1 are in RRC_CONNECTED state.

This test requires logging tools.

Test procedure

Step	Test procedure	Expected behaviour
1	Drive along the test route. Continuously perform uplink data transfer on DUT and Reference 1	Verify the DUT's handover success ratio is comparable to the Reference 1's handover success ratio. (not more than 10% worse). Verify the DUT's uplink data throughput is comparable to the Reference 1's throughput (no more than 10% worse).

4 Power Optimized Operation

This section should be read in conjunction with TS.39 v2.0, MIoT Requirements document. The Conformance requirements contained with Section 4 of that document apply.

4.1 PSM Operation

4.1.1 PSM Request, Activation and Modification

Description

The DUT successfully requests PSM during attach by adding T3324 into ATTACH REQUEST. The DUT requests different timer values during TAU when modified by the User or Application.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_4.1_REQ_001

GSMA TS.39_4.1_REQ_005

3GPP TS 23.682, TS 23.401, TS 24.301, TS 24.008

Reason for test

To verify that CAT-M or CAT-NB device requests and activated PSM. To verify that DUT initiates a TAU procedure caused by change of PSM usage conditions (change in DUT configuration).

Initial configuration

DUT is configured to use Power Saving Mode

DUT is configured with T3324 value (e.g. 2 minutes)

DUT is switched off

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT sends Attach Request containing “T3324 Value” in order to request PSM. DUT responds ATTACH ACCEPT message from NW with ATTACH COMPLETE message and releases the connection
2	Change the value of T3324 (e.g. to 1 minute) in DUT	DUT initiates TRACKING AREA UPDATE REQUEST including the new value for T3324. DUT responds TAU ACCEPT message from NW with TAU COMPLETE message and releases the connection

4.1.2 MT Data in PSM State

Description

CAT-M and CAT-NB device monitor Paging message and receive MT user data when T3324 Timer running and then enter PSM again when T3324 timer expires.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_4.1_REQ_001

3GPP TS 23.682, TS 24.301 and TS 24.008

Reason for test

To verify that CAT-M or Cat-NB device successfully monitor Paging message and receive MT user data when T3324 Timer running and then enter PSM again when T3324 timer expires.

Initial configuration

DUT is configured to use Power Saving Mode

DUT is configured with T3324 value (e.g. 2 minutes)

DUT is switched off

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT sends Attach Request containing “T3324 Value” in order to request PSM. DUT responds ATTACH ACCEPT message from NW with ATTACH COMPLETE message and releases the connection
2	Initiate MT user date before T3324 expires	DUT responds to paging message, establishes connection and receive MT data
3	Stop MT data.	DUT releases the connection, enters in idle state and starts T3324 timer.
4	Initiate MT user date after T3324 expires	DUT is still in PSM and does not response to MT data.

4.1.3 MO Data in PSM State

Description

CAT-M and CAT-NB device deactivate PSM at any time for the transfer of mobile originated user data.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_4.1_REQ_001

GSMA TS.39_4.1_REQ_007

3GPP TS 23.682, TS 24.301 and TS 24.008

Reason for test

To verify that CAT-M or CAT-NB device successfully deactivate PSM at any time for the transfer of mobile originated user data.

Initial configuration

DUT is configured to use Power Saving Mode

DUT is configured with T3324 value (e.g. 2 minutes)

DUT is switched off

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT sends Attach Request containing "T3324 Value" in order to request PSM. DUT responds ATTACH ACCEPT message from NW with ATTACH COMPLETE message and releases the connection
2	Wait until T3324 expires	DUT enters PSM after T3324 expires
3	Attempt to page DUT to verify PSM state	DUT is in PSM and does not response to MT data.
4	Initiate MO user date	DUT shall deactivate PSM , establish connection and send MO data

4.1.4 Periodic Tracking Area Update

Description

CAT-M and CAT-NB device performs a Periodic Tracking Area Update procedure after the expiry of the T3412/T3312 timer when PSM is activated.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_4.1_REQ_001

3GPP TS 23.682, TS 24.301 and TS 24.008

Reason for test

To verify that CAT-M or CAT-NB device successfully performs a Periodic Tracking Area Update procedure after the expiry of the T3412/T3312 timer when PSM is activated.

Initial configuration

DUT is configured to use Power Saving Mode

DUT is configured with T3324 value (e.g.2 minutes)

DUT is switched off

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT sends Attach Request containing “T3324 Value” in order to request PSM. NW sends ATTACH ACCEPT message that contains the “T3324 Value” for PSM and “T3412 Value” for periodic TAU DUT responds with ATTACH COMPLETE message and releases the connection
2	Wait until T3324 and T3412 expire	DUT enters PSM after T3324 expires. After the expiry of T3412, DUT sends a TAU REQUEST message including “T3324 value” IE. The network responds to the DUT with TAU ACCEPT message that contains the “T3324 value” DUT completes the TAU procedure by sending TAU COMPLETE message. DUT releases the connection and enters in idle state.
3	Wait until T3324 expires.	DUT enters PSM after T3324 expires
4	Attempt to page DUT to verify PSM state	DUT is in PSM and does not response to MT data.

4.1.5 Periodic Tracking Area Update, T3412

Description

CAT-M and CAT-NB device could accept T3412 value from NW.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_2.2.2_REQ_001 (Attach)

GSMA TS.39_2.3.2_REQ_001 (Device Capabilities)

GSMA TS.39_4.1_REQ_006 (Accept T3412 from NW)

3GPP TS 23.682, TS 24.301 and TS 24.008

Reason for test

To verify that CAT-M or CAT-NB device accepts T3412 value from NW that is different from pre-configured value.

Initial configuration

DUT is configured to use Power Saving Mode

DUT is configured with T3324 value (e.g. 2 minutes)

DUT is configured with preferred T3412 value (different from NW; default 54min), value e.g. 4 minutes)

DUT is switched off

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT sends Attach Request containing “T3324 Value” and a preferred “T3412 Value” in order to request PSM. The ATTACH ACCEPT message of NW contains different T3412 value. DUT accepts new value for T3412 in ATTACH COMPLETE MESSAGE
2	Wait until DUT is in IDLE and T3324 expires	DUT enters PSM after T3324 expires
3	Wait until T3412 expires and verify that the DUT initiates Tracking Area update.	DUT initiates TAU after expiry of T3412 (NW value)

4.1.6 Reduced Current Drain in PSM

Description

CAT-M and CAT-NB device support a reduced current drain when in Power Saving Mode.

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_4.1_REQ_003

3GPP TS 23.682, TS 24.301 and TS 24.008

Reason for test

To verify that CAT-M or CAT-NB device support a reduced current drain when in PSM.

Initial configuration

DUT is configured to disable Power Saving Mode

DUT is configured with T3324 value (e.g. 2 minutes)

DUT battery is replaced with “dummy battery” that is connected to a combined DC power source and current measurement device.

DUT is switched off

All other radios (e.g. Wi-Fi, BT, etc.) in DUT are switched off

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT registers to the NW
2	Wait 3 min after DUT has completed registration.	DUT is registered and in IDLE mode
3	Record a minimum of 120 samples over a continuous 30 minute period, using ammeters or automated power monitors if available.	'-
4	Calculate the average current drain from the measured samples, denoted by IPSM_Disabled.	'-
5	Configure the DUT to use PSM with timer T3412 set to at least 30 minutes. Switch off the DUT.	'-
6	Switch on DUT and wait 3 minutes after DUT has completed registration	DUT sends ATTACH REQUEST containing "T3324 Value" in order to request PSM.
7	In PSM mode, record a minimum of 120 samples over a continuous 30 minute period, using ammeters or automated power monitors if available	'-
8	Calculate the average current drain from the measured samples, denoted by IPSM_Enabled	The current drain in PSM (IPSM_Enabled) should be several orders of magnitude lower than the one in idle mode (IPSM_Disabled)

4.1.7 Periodic Tracking Area Update Power Consumption Performance

Description

Power consumption performance of periodic tracking area update with CAT-NB1 and CAT-M

Applicability

3GPP Release 13 or later

Related core specifications

GSMA TS.39_4.1_REQ_011

Reason for test

To verify the power consumption performance of periodic tracking area update with CAT-NB and CAT-M in different coverage (normal coverage and enhance coverage).

Initial configuration

The DUT battery is replaced with the "dummy battery".

The dummy battery is connected to a combined DC power source and current measurement device.

The DC power source is configured to maintain a voltage equal to the Nominal Battery Voltage across the dummy battery terminals.

DUT is powered off.

All other radio's (WiFi/BT etc) in the device are switched off. DUT is configured to use Power Saving Mode, with sleep timer (T3412 extended) set to 4 hours (for CAT-M) or 12 hours (for Cat-NB).

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT initiates the Attach procedure.
2	Wait until DUT enters PSM.	DUT has completed the Attach procedure and releases the connection, DUT enters in idle state, DUT enters PSM after T3324 expires, check by attempting to page the DUT
3	After the expiry of the T3412 extended timer, DUT deactivate PSM, establish connection and completes the TAU procedure. Record the power consumption of TAU procedure in different coverage (normal coverage and enhance coverage).	Record the TAU procedure, from transmission of first Random Access Preamble to TRACKING AREA UPDATE ACCEPT message/ or TRACKING AREA UPDATE COMPLETE (if GUTI allocated) message, denoted by $PROCEDURE_{TAU}$. Record the average current of $PROCEDURE_{TAU}$, denoted by I_{TAU}. Record the time interval of $PROCEDURE_{TAU}$, denoted by T_{TAU}. Calculate and record the power consumption of $PROCEDURE_{TAU}$, denote by $POWER_{TAU}$, $POWER_{TAU}$(milliwatt hour)=Voltage(volt)×I_{TAU}(milliampere)×T_{TAU}(second)/3600.

4.2 I-eDRX Operation

4.2.1 eDRX Request, Activation and Modification

Description

The DUT successfully requests eDRX during attach by adding the “Extended DRX parameters” IE into ATTACH REQUEST. The DUT requests different timer values during TAU when modified by the User or Application.

Applicability

3GPP Release 13 or later

Related core specifications

TS.39_4.1_REQ_002

TS.39_4.1_REQ_008

TS.39_4.1_REQ_009

3GPP TS 23.682, TS 23.401, TS 24.301, TS 24.008

Reason for test

To verify that the DUT could successfully request eDRX during attach and monitor Paging according to eDRX cycle and PTW (except EC-GSM). To verify that DUT initiates a TAU procedure caused by change of eDRX usage conditions (change in DUT configuration).

Initial configuration

DUT is configured to use eDRX

DUT is configured with the “Extended DRX parameters” IE (e.g. The “Paging Time Window” is set to 5.12s and the “eDRX value” is set to 20.48s)

DUT is switched off

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT initiates the Attach procedure by sending the “Attach Request” message that contains the “Extended DRX parameters” IE. The network responds to the DUT with “Attach Accept” message that contains the “Extended DRX parameters” to indicate the eDRX cycle and PTW (except EC-GSM). DUT completes the Attach procedure by sending the “Attach Complete” message. DUT releases the connection.
2	Initiate MT user data	The network sends Paging message. DUT responds to the Paging and receives the MT data
3	Change the value of “Extended DRX Parameter” IE (e.g. the “eDRX value” is set to122.88s) in DUT	DUT initiates TRACKING AREA UPDATE REQUEST including the new value for the “eDRX value”. DUT responds TAU ACCEPT message from NW with TAU COMPLETE message and releases the connection

4.2.2 Power Consumption in Idle State with eDRX

Description

Power Consumption performance of CAT-M and CAT-NB device.

Applicability

3GPP Release 13 or later

Related core specifications

TS.39_4.1_REQ_002

TS.39_4.1_REQ_008

TS.39_4.1_REQ_009

TS.39_4.1_REQ_010

3GPP TS 23.682, TS 24.301 and TS 24.008

Reason for test

To measure the power consumption performance of CAT-M and CAT-NB device as eDRX cycle increases.

Initial configuration

DUT is configured to enable eDRX

DUT is configured with the “Extended DRX parameters” IE. The “Paging Time Window” and I-DRX cycle are set to static value, while the eDRX cycle is set to three levels, the level 1 is below 1 minute, such as 20.48s, the level 2 is between 1 and 5 minutes such as 122.88s, and the level 3 is greater than 10 minutes such as 655.36s. The choice of eDRX cycle values depend on the actual network deployment.

Idle mode extended DRX is allowed in the serving cell. The periodic tracking area update timer “T3412 value” is set longer than the test execution time.

DUT battery is replaced with “dummy battery” that is connected to a combined DC power source and current measurement device.

Reference 1 indicating the same UE category has the same eDRX configuration as DUT.

DUT is switched off.

All other radios (e.g. Wi-Fi, BT, etc.) in DUT are switched off.

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT	DUT registers to the NW
2	Wait until DUT enters the eDRX mode.	DUT is registered and in eDRX mode,
3	Record the average current of at least one eDRX cycle over a continuous max{5 minute, one eDRX cycle} period, denoted by I_{eDRX1};record the average current during PTW, denoted by I_{PTW1};record the average current of eDRX sleeping time, denoted by $I_{sleeping1}$.using ammeters or automated power monitors if available.	Output the value of I_{eDRX1}/ I_{PTW1}/$I_{sleeping1}$. The currents of DUT are comparable to the currents of Reference 1.
4	Change the value of “Extended DRX Parameter” IE to level 2 in DUT	
6	Repeat step 1-3, denote as I_{eDRX2}/ I_{PTW2}/ $I_{sleeping2}$	Output the value of I_{eDRX2}/ I_{PTW2}/ $I_{sleeping2}$. The currents of DUT are comparable to the currents of Reference 1.
7	Change the value of “Extended DRX Parameter” IE to level 3 in DUT	
8	Repeat step 1-3, denote as I_{eDRX3}/ I_{PTW3}/ $I_{sleeping3}$	Output the value of I_{eDRX3}/ I_{PTW3}/ $I_{sleeping3}$. The currents of DUT are comparable to the currents of Reference 1.

4.3 Data transmission power consumption

4.3.1 CAT-M Device Uplink Transmission Power Consumption

Description

UL data transmission power consumption of CAT-M1 device in different coverage levels.

Applicability

3GPP Release 13 or later

Related core specifications

TS.39_2.4.2_REQ_001

TS.39_4.1_REQ_011

3GPP TS 36.211, TS 36.331

Reason for test

To measure the UL transmission power consumption of CAT-M device in different coverage level.

Initial configuration

For CAT-M device supporting CE mode A, performance under coverage level 0/1 is tested.

For CAT-M device supporting CE mode B, performance under coverage level 0/1/2/3 is tested.

Reference 1 indicating the same UE category is tested in the similar environment as DUT.

DUT battery is replaced with “dummy battery” that is connected to a combined DC power source and current measurement device.

DUT is switched off.

All other radios (e.g. Wi-Fi, BT, etc.) in DUT are switched off.

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT and Reference 1	DUT and Reference 1 registers to the NW
2	Wait until DUT and Reference 1 enters the standby mode.	DUT and Reference 1 is in standby mode,
3	Start power consumption measurement on DUT and Reference 1: -Trigger consecutive uplink data transmission in UDP layer for 3 minutes. -Record the average current	Record DUT’s and Reference 1 transmit power and average current.
4	Repeat step 1-3 under different coverage level.	The average current of DUT under each coverage level is comparable to the result for Reference 1;

4.3.2 CAT-NB Device Uplink Transmission Power Consumption

Description

UL data transmission power consumption of CAT-NB1 device in different coverage level can meet expectations.

Applicability

3GPP Release 13 or later

Related core specifications

TS.39_2.4.2_REQ_001

TS.39_4.1_REQ_011

3GPP TS 36.211, TS 36.331

Reason for test

To measure the UL transmission power consumption of CAT-NB device in different coverage level.

Initial configuration

Power consumption performance of Cat-NB device under coverage level 0/1/2 is tested.

Sub-carrier spacing of service cell support 15kHz single-tone, 15kHz multi-tone (3/6/12 tones), 3.75kHz single-tone.

Reference 1 indicating the same UE category is tested in the similar environment as DUT.

DUT battery is replaced with “dummy battery” that is connected to a combined DC power source and current measurement device.

DUT is switched off

All other radios (e.g. Wi-Fi, BT, etc.) in DUT are switched off

Test procedure

Step	Test procedure	Expected behaviour
1	Serving cell is configured to support 3.75kHz sub-carrier spacing.	The service cell set up successfully
2	Switch on DUT and Reference 1	DUT registers to the NW
3	Wait until DUT enters the standby mode.	DUT is registered and in standby mode,
4	Start power consumption measurement on DUT and Reference 1: -Trigger consecutive uplink data transmission in UDP layer for 3 minutes. -Record the average current	Record DUT’s transmit power and average current.
5	Repeat step 2-4 under different coverage level.	The average current of DUT under each coverage level is comparable to the result for Reference 1
6	The Sub-carrier spacing is configured to support 15kHz ST, Repeat step 2-5	The average current of DUT under each coverage level is comparable to the result for Reference 1
7	The Sub-carrier spacing is configured to support 15kHz MT, Repeat step 2-5	The average current of DUT under each coverage level is comparable to the result for Reference 1

4.3.3 Downlink Transmission Power Consumption

Description

DL data transmission power consumption of CAT-M and CAT-NB device in different coverage can meet expectations.

Applicability

3GPP Release 13 or later

Related core specifications

TS.39_2.4.2_REQ_001

TS.39_4.1_REQ_011

3GPP TS 36.211, TS 36.331

Reason for test

To measure the DL transmission power consumption of CAT-M and CAT-NB device in different coverage.

Initial configuration

For CAT-NB device, performance under coverage level 0/1/2 is tested.

For CAT-M device supporting CE mode A, performance under coverage level 0/1 is tested. For CAT-M device supporting CE mode B, performance under coverage level 0/1/2/3 is tested.

Reference 1 indicating the same UE category is tested in the similar environment as DUT.

DUT battery is replaced with “dummy battery” that is connected to a combined DC power source and current measurement device.

DUT is switched off

All other radios (e.g. Wi-Fi, BT, etc.) in DUT are switched off

Test procedure

Step	Test procedure	Expected behaviour
1	Switch on DUT and Reference 1	DUT registers to the NW
2	Wait until DUT enters the standby mode.	DUT is registered and in standby mode,
3	Start power consumption measurement on DUT and Reference 1: -Trigger consecutive downlink data transmission in UDP layer for 3 minutes. -Record the average current	The average current of DUT is comparable to the result for Reference 1
4	Repeat step 1-3 under different coverage level.	The average current of DUT under each coverage level is comparable to the result for Reference 1

5 Service Layer

5.1 oneM2M

The oneM2M Service Layer interface test case SHALL follow the test case defined in the following oneM2M Specifications:

- TS-0013 - Interoperability_Testing [5]:
  - RemoteCSE Management in Clause 8.1.2
  - Application Entity Registration in Clause 8.1.3
  - Container Management in Clause 8.1.4
- TS-0017 - Implementation Conformance Statements [6]

5.2 LwM2M

The LwM2M standard provides service enabler to the service layer, as part of the simplification needed for the IoT actors. It shall follow the test case defined in the LwM2M Test Specifications:

- OMA-ETS-LightweightM2M-V1_0_1 [4]
    - Application Data Container Management in Clause 6.1.6

6 USIM/eUICC OTA

UICC and USIM device interface test cases SHALL follow the test cases defined in documents [2] and [3] referenced in Section 1.4.

7 USIM Toolkit

USIM ToolKit device interface test cases SHALL follow the test cases defined in document [3], referenced in Section 1.4.

8 Antenna Performance

It is expected that Antenna Performance in a free space environment within relevant bands and areas will be compliant with 3GPP and CTIA specifications, 3GPP TS.34.114 [10], TS.37.544 [11] and CTIA, OTA Test Plan v 3.6 [12] or later versions of these documents when available.

Test cases will be agreed with Operators and Manufacturers on a case by case basis.

9 Device Management (LwM2M)

LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.4

10 Mapping of Test Cases to Requirements

MioT Requirements Document Section		Requirement	Test Case	Comments
2	Basic Operation	TS.39_2.1.2_REQ_001 (Cell selection)	2.1.6 (CAT-NB1) 2.1.7 (CAT-NB1) 2.1.9 (CAT-NB1)	
		TS.39_2.1.2_REQ_002 (Cell Selection EC-GSM-IoT)	EC-GSM-IoT Test Cases to be defined when Manufacturer support is available.	
		TS.39_2.2.2_REQ_001 (Attach)	2.1.1 (CAT-M1) 2.1.2 (CAT-M1) 2.1.3 (CAT-M1) 2.1.4 (CAT-NB1) 2.1.5 (CAT-NB1) 2.1.6 (CAT-NB1) 2.1.7 (CAT-NB1) 2.1.8 (CAT-NB1) 2.1.9 (CAT-M1 & CAT-NB1) 3.1.1 (CAT-M1 & CAT-NB1) 3.1.2 (CAT-M1 & CAT-NB1) 4.1.5 (CAT-M1 & CAT-NB1)	
		TS.39_2.2.2_REQ_002 (Detach)	2.1.10 (CAT-M1 & CAT-NB1)	
		TS.39_2.2.2_REQ_003 (Attach EC-GSM-IoT)	EC-GSM-IoT Test Cases to be defined when Manufacturer support is available.	
		TS.39_2.2.2_ REQ_004 (Detach EC-GSM-IoT)	EC-GSM-IoT Test Cases to be defined when Manufacturer support is available.	
		TS.39_2.2.2_REQ_005 (Attach not accepted by NW)	2.1.9 CAT-M1 & CAT-NB1)	
		TS.39_2.3.2_REQ_001 (Device Capability Procedure)	2.1.1 (CAT-M1) 2.1.2 (CAT-M1) 2.1.3 (CAT-M1) 2.1.4 (CAT-NB1) 2.1.5 (CAT-NB1) 2.1.6 (CAT-NB1) 2.1.7 (CAT-NB1) 2.1.9 (CAT-M1 & CAT-NB1) 4.1.5 (CAT-M1 & CAT-NB1)	
		TS.39_2.4.2_REQ_001 (Data Transfer)	2.3.1.1 (CAT-M1 & CAT-NB1) 2.3.1.2 (CAT-M1 & CAT-NB1) 2.3.1.3 (CAT-M1 & CAT-NB1)	

MioT Requirements Document Section		Requirement	Test Case	Comments
			2.3.1.4 (CAT-M1 & CAT-NB1) 4.3.1 (CAT-M1) 4.3.2 (CAT-NB1) 4.3.3 (CAT-M1 & CAT-NB1)	
		TS.39_2.4.2_REQ_002 (Data Transfer EC-GSM-IoT)	EC-GSM-IoT Test Cases to be defined when Manufacturer support is available.	
		TS.39_2.4.2_REQ_003 (Data Throughput Values)	About the performances tests, it is recommended to run the tests with the terminal to be certified and with a reference terminal such as, for instance, a competitive terminal available on the market. The behaviour of the reference platform will help to remove any ambiguity about the test results.	
		TS.39_2.5.1_REQ_001 (Cell Reselection)	2.4.1.1 (CAT-M1) 2.4.1.2 (CAT-NB1) 2.4.1.3 (CAT-NB1)	
		TS.39_2.5.1_REQ_002 (CAT-M1 Handover)	2.4.2.1 (CAT-M1)	
		TS.39_2.5.1_REQ_003 (Cell Reselection EC-GSM-IoT)	EC-GSM-IoT Test Cases to be defined when Manufacturer support is available.	
		TS.39_2.6.2_REQ_001 (Suspend)	2.3.2.1 (CAT-M1) 2.3.2.2 (CAT-NB1)	
		TS.39_2.6.2_REQ_002 (Resume)	2.3.2.1 (CAT-M1) 2.3.2.2 (CAT-NB1)	
		TS.39_2.7.2_REQ_001 (CAT-NB1 Serving PLMN Rate Control)	2.3.3.1 (CAT-NB1)	
		TS.39_2.7.2_REQ_002 (CAT-NB1 APN Rate Control)	2.3.3.2 (CAT-NB1)	
3	Enhanced Coverage	TS.39_3.1.2_REQ_001 (Random Access)	3.1.1 (CAT-M1 & CAT-NB1) 3.1.2 (CAT-M1 & CAT-NB1)	
		TS.39_3.1.2_REQ_002 (Random Access)	EC-GSM-IoT Test Cases to be defined when Manufacturer support is available.	
		TS.39_3.2.2_REQ_001 (CAT-M1 Data Transfer)	3.3.1 (CAT-M1 & CAT-NB1) 3.3.2 (CAT-M1 & CAT-NB1) 3.3.3 (CAT-M1 & CAT-NB1) 3.3.4 (CAT-M1 & CAT-NB1)	

MioT Requirements Document Section		Requirement	Test Case	Comments
		TS.39_3.2.2_REQ_002 (Data Transfer EC-GSM_IoT)	EC-GSM-IoT Test Cases to be defined when Manufacturer support is available.	
		TS.39_3.2.2_REQ_003 (Data Transfer CAT-NB1)	3.3.1 (CAT-M1 & CAT-NB1) 3.3.2 (CAT-M1 & CAT-NB1) 3.3.3 (CAT-M1 & CAT-NB1) 3.3.4 (CAT-M1 & CAT-NB1)	
4	Power Test Cases	TS.39_4.1_REQ_001 (PSM)	4.1.1 (CAT-M1 & CAT-NB1) 4.1.2 (CAT-M1 & CAT-NB1) 4.1.3 (CAT-M1 & CAT-NB1) 4.1.4 (CAT-M1 & CAT-NB1)	
		TS.39_4.1_REQ_002 (eDRX)	4.2.1 (CAT-M1 & CAT-NB1) 4.2.2 (CAT-M1 & CAT-NB1)	
		TS.39_4.1_REQ_003 (Reduced Power Drain in PSM)	4.1.6 (CAT-M1 & CAT-NB1)	
		TS.39_4.1_REQ_004 (EC-GSM-IoT Reduced Monitoring)	EC-GSM-IoT Test Cases to be defined when Manufacturer support is available.	
		TS.39_4.1_REQ_005 (Configuration of T3324 and T3412 PSM)	4.1.1 (CAT-M1 & CAT-NB1)	
		TS.39_4.1_REQ_006 (Accept T3412 from NW)	4.1.5 (CAT-M1 & CAT-NB1)	
		TS.39_4.1_REQ_007 (Wake up during PSM)	4.1.3 (CAT-M1 & CAT-NB1)	
		TS.39_4.1_REQ_008 (Configurable eDRX cycle times)	4.2.1 (CAT-M1 & CAT-NB1) 4.2.2 (CAT-M1 & CAT-NB1)	
		TS.39_4.1_REQ_009 (paging notoification during eDRX cycle)	4.2.1 (CAT-M1 & CAT-NB1) 4.2.2 (CAT-M1 & CAT-NB1)	
		TS.39_4.1_REQ_010 (eDRX current drain)	4.2.2 (CAT-M1 & CAT-NB1)	
		TS.39_4.1_REQ_011 (low transmit power consumption)	4.3.1 (CAT-M1) 4.3.2 (CAT-NB1) 4.3.3 (CAT-M1 & CAT-NB1)	
5	Service Layer	TS.39_5.1.3_REQ_001 (Register with CSE on SI platform)	The oneM2M Service Layer interface test case SHALL follow the test case defined in the following oneM2M Specifications:	

MioT Requirements Document Section		Requirement	Test Case	Comments
			[5] TS-0013 - Interoperability_Testing: RemoteCSE Management in Clause 8.1.2 Application Entity Registration in Clause 8.1.3 Container Management in Clause 8.1.4 [6] TS-0017 - Implementation Conformance Statements	
		TS.39_5.1.3_REQ_002 (Management by SL platform)	The oneM2M Service Layer interface test case SHALL follow the test case defined in the following oneM2M Specifications: [5] TS-0013 - Interoperability_Testing: RemoteCSE Management in Clause 8.1.2 Application Entity Registration in Clause 8.1.3 Container Management in Clause 8.1.4 [6] TS-0017 - Implementation Conformance Statements	
		TS.39_5.1.3_REQ_003 (App on cloud side config)	The oneM2M Service Layer interface test case SHALL follow the test case defined in the following oneM2M Specifications: [5] TS-0013 - Interoperability_Testing: RemoteCSE Management in Clause 8.1.2 Application Entity Registration in Clause 8.1.3 Container Management in Clause 8.1.4 [6] TS-0017 - Implementation Conformance Statements	
		TS.39_5.2.3_REQ_001	The LwM2M standard provides service enabler to the service layer, as part of the simplification needed for the IoT actors. It shall follow the test case defined in the LwM2M Test Specifications: OMA-ETS-LightweightM2M-V1_0_1[4] Application Data Container Management in Clause 6.1.6	

MioT Requirements Document Section		Requirement	Test Case	Comments
6	SIM/eUICC OTA	TS.39_6.1_REQ_001 (UICC)	UICC and USIM device interface test cases SHALL follow the test cases defined in documents [2] and [3] referenced in Section 1.5.	
		TS.39_6.1_REQ_002 (M2M-IUCC)	UICC and USIM device interface test cases SHALL follow the test cases defined in documents [2] and [3] referenced in Section 1.5.	
		TS.39_6.1_REQ_003 (eUICC)	UICC and USIM device interface test cases SHALL follow the test cases defined in documents [2] and [3] referenced in Section 1.5.	
		TS.39_6.1_REQ_004 (USIM/ISIM)	UICC and USIM device interface test cases SHALL follow the test cases defined in documents [2] and [3] referenced in Section 1.5.	
7	USIM Tool Kit	TS.39_7.3_REQ_001 (USIM Tool Kit)	USIM ToolKit device interface test cases SHALL follow the test cases defined in document [3], referenced in Section 1.5.	
		TS.39_7.3_REQ_002 (Pro-active Commands)	USIM ToolKit device interface test cases SHALL follow the test cases defined in document [3], referenced in Section 1.5	
		TS.39_7.3_REQ_003 (infomation)	USIM ToolKit device interface test cases SHALL follow the test cases defined in document [3], referenced in Section 1.5	
8	Antenna Performance	It is expected that Antenna Performance in a free space environment within relevant bands and areas will be complaint with 3GPP and CTIA specifications where/when they are available.	Test cases will be agreed with Operators and Manufacturers on a case by case basis.	
9	Device Management (LwM2M)	TS.39_9.2_REQ_001 (Bootstrap)	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	
		TS.39_9.2_REQ_002 (ID and registration)	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	

MioT Requirements Document Section		Requirement	Test Case	Comments
		TS.39_9.2_REQ_003 (config communication parameter – normal function)	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	
		TS.39_9.2_REQ_004 (config communication parameter – fallback)	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	
		TS.39_9.2_REQ_005 (firmware update)	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	
		TS.39_9.2_REQ_006 (replace configured comm parameters)	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	
		TS.39_9.2_REQ_007 (security info update ota)	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	
		TS.39_9.2_REQ_008 (report APP health information)	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	
		TS.39_9.2_REQ_009 (report location)	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	
		TS.39_9.2_REQ_010 (data transfer to server)	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	
		TS.39_9.2_REQ_011 (provide host information details)	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	
		TS.39_9.2_REQ_012 (basic diagnostic capabilities)	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	
		TS.39_9.2_REQ_013 (basic observe/notify capabilities)	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	
		TS.39_9.2_REQ_014 (basic queue capabilities)	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	

MioT Requirements Document Section		Requirement	Test Case	Comments
		TS.39_9.2_REQ_015 (report PSM information)	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	
		TS.39_9.2_REQ_016 (update PSM)	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	
		TS.39_9.2_REQ_017	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	
		TS.39_9.2_REQ_018	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	
		TS.39_9.2_REQ_019	LWM2M test cases SHALL follow the test cases defined in document [4], referenced in Section 1.5.	

Annex A Individual Test Scenario Classification and Proforma

This Annex contains the individual classification (i.e. whether a test applies to Field Test, Lab Test or both) of every single test scenario. It can also be used as a blank proforma to record the results of an individual test scenario.

TS 40 Annex A
Individual Test Scena

Annex B Document Management

B.1 Document History

Version	Date	Brief Description of Change	Approval Authority	Editor / Company
1.0	18 November 2016	New PRD (CLP23 v0.1).	TCJWG/PSMC	David Hills
2.0	December 2017	New PRD (TS.40 v2.0) Initial official release of this document, approved by GSMA Plenary (TSG#30)	TSG / TG	Petra Rauer Vodafone
3.0	March 2018	Updated with changes approved in TS.40 CR1003	TSG#31	Paul Gosden GSMA
4.0	June 2018	Updated with changes approved in TS.40 CR1004	TSG#32	Petra Rauer Vodafone / Paul Gosden GSMA
5.0	Dec 2018	Updated with changes approved in TS.40 CR1005	TSG#34	Petra Rauer Vodafone / Paul Gosden GSMA
6.0	June 2019	Updated with changes approved in TS.40 CR1006	TSG#36	Petra Rauer Vodafone / Paul Gosden GSMA

B.2 Other Information

Type	Description
Document Owner	Terminal Steering Group
Editor / Company	Paul Gosden, GSMA

It is our intention to provide a quality product for your use. If you find any errors or omissions, please contact us with your comments. You may notify us at prd@gsma.com