



# Mobile-IoT Roaming Testing

## Version 4.0

### 07 April 2023

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## 1 Introduction

### 1.1 Overview

This document is the specification of end-to-end functional capability tests relating to the roaming of a Mobile-IoT (mobile Internet of Things) module, belonging to a home PMN (Public Mobile Network) (a), to and within a visited PMN(b).

This document is not intended to replace, or contravene, the tests cases intended for the accreditation of LPWA MIoT (Low Power Wide Area MIoT) modules and devices that are deployed in mobile networks.

### 1.2 Scope

This document is the specification for end-to-end roaming testing of Mobile-IoT (“MIoT”) modules subscribed belonging to a home PMN(a), to and within a visited PMN (b). It is intended to provide a minimum set of roaming test cases specific to MIoT modules, regardless of the LPWA technology solution deployed by the network.

This test PRD (Permanent Reference Document) does not contain the Attention Commands, “AT Command(s)” specific to Mobile-IoT modules required to perform the action described in each test case. It is the responsibility of test personnel in both the HPMN (Home Public Mobile Network) and VPMN (Visited Public Land Mobile Network) to ensure all parties have the necessary AT Command string(s) required to perform testing.

Mobility-oriented test cases (Cell Selection, Device Handover, etc.) are out of scope.

### 1.3 Definitions

| Term       | Description  |
|------------|--|
| AT Command | AT (“ATtention”) Commands are instructions used to control modems; in this instance, MIoT modules. These modules do not have key or touchpad functionality used in “traditional” roaming testing, and thus require knowledge of specific command lines to perform the required action. |
| MIoT       | Mobile Internet of Things; for the purposes of this test PRD, it is used as an inclusive term covering both NB-IoT and LTE-M modules.  |
| MS1(a)     | Mobile Station 1 MS1: A communications module complying to one or more of the 3GPP communication technologies such as LTE-M and NB-IoT that includes all necessary eUICC or UICC components. Can also be called User Equipment or UE, or (in various GSMA PRDs, “DUT”).                |

### 1.4 Abbreviations

| Term | Description   |
|------|---|
| 3GPP | 3 <sup>rd</sup> Generation Partnership Project                  |
| AMBR | Aggregate Maximum Bit Rate                                      |
| APN  | Access Point Name   |
| AT   | Abbreviation for “ATtention” Command(s) required by the module. |
| CIoT | Cellular Internet of Things                                     |

| Term   | Description   |
|--------|---|
| CP     | Control Plane   |
| EC-GSM | Extended Coverage GSM   |
| eDRX   | Extended Discontinuous Reception  |
| EPS    | Evolved Packet System   |
| eUICC  | Embedded Universal Integrated Circuit Card  |
| DL     | Downlink  |
| HPMN   | Home Public Mobile Network  |
| IE     | Information Element   |
| Kbps   | Kilobytes per second  |
| LPWA   | Low Power, Wide Area  |
| LTE    | Long Term Evolution   |
| LTE-M  | LTE Mobile  |
| PMN    | Public Mobile Network   |
| PRD    | Permanent Reference Document  |
| Mbps   | Megabytes per second  |
| MIoT   | Mobile Internet of Things   |
| MO     | Mobile Originated   |
| MS1(a) | Mobile Station 1  |
| MT     | Mobile Terminated   |
| NAS    | Non Access Stratus  |
| NB-IoT | Narrow Band IoT   |
| ODB    | Operator Determined Barring   |
| PDN    | Packet Data Network   |
| PSM    | Power Saving Mode   |
| PTW    | Paging Time Window  |
| QCI    | QoS Class Identifier  |
| SCEF   | Service Capability Exposure Function  |
| SCS    | Service Capability Server   |
| SMS    | Short Message Service   |
| SMS/MO | Short Message Service/Mobile Originated   |
| SMS/MT | Short Message Service/Mobile Terminated   |
| TCP/IP | Transmission Control Protocol/Internet Protocol                                     |
| T3324  | Timer specific to IoT Devices, and in particular to Power Saving Mode functionality |
| UE     | User Equipment  |
| UDP/IP | User Datagram Protocol/Internet Protocol  |
| UL     | Uplink  |
| UP     | User Plan   |

| Term    | Description                   |
|---------|-------------------------------|
| VLR     | Visitor Location Register     |
| VPMN(b) | Visited Public Mobile Network |

## 1.5 References

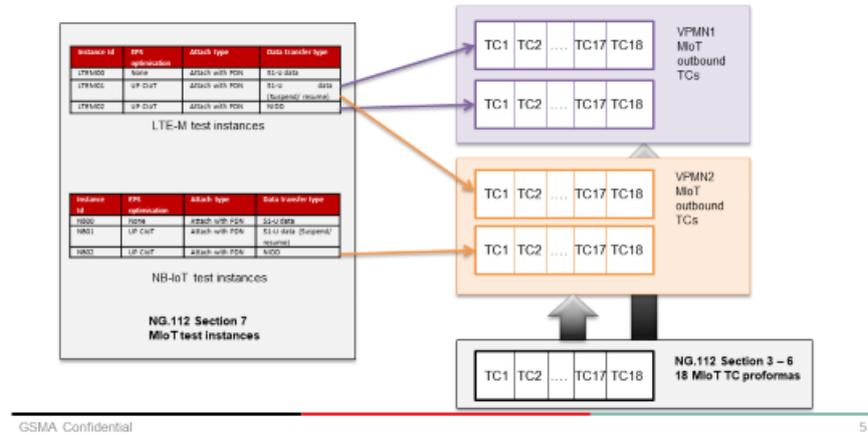
| Ref | Doc Number      | Title  |
|-----|-----------------|--|
| 1   | GSMA PRD IR.24  | End-to-End Functional Capability Specification for Inter-PMN Roaming (Stage 4 Testing) |
| 2   | GSMA PRD IR.35  | End-to-End Functional Capability Test Specifications for Inter-PMN GPRS Roaming.       |
| 3   | GSMA PRD IR.50  | 2G/2.5G/3G Roaming   |
| 4   | GSMA PRD CLP.09 | IoT Device Connection Efficiency Common Test Cases                                     |
| 5   | GSMA PRD CLP.23 | MIoT Test Cases  |
| 6   | GSMA PRD TS.40  | MIoT Field and Lab Test Cases  |
| 7   | 3GPP 24.301.    | Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS);                     |
| 8   | GSMA PRD IR.38  | LTE and EPC Roaming Testing  |

## 2 Test Methodology

The MIoT services are based on the different LPWA technologies (Long Term Evolution mobile, LTE-M vs. NB-IoT) and have distinct characteristics in terms of communication patterns (transmission frequency, delivery mode), data sizes, and performance requirements (coverage, battery life, accepted latency).

A common set of end-to end roaming test cases are specified in sections 3 to 6 across the divergent roaming MIoT devices toward the home PMN to enable roaming MIoT services. The test cases are generic and agnostic of Control Plane (CP) vs. User Plane (UP) optimisation. The number of test cases are limited to the minimum, to keep the tests simple. The active test method is applied when performing the test and they are specified and considered as test case pro-formas in the test methodological context.

When using the test case pro-forma to perform MIoT testing, the MIoT distinct characteristics will affect the MIoT module configurations and setting test parameters. For this purpose, a list of test instances is provided in section 8. Each test instance is a combination of a set of parameter values used practically for the end-to-end functional capability tests relating to the roaming of a Mobile-IoT module. The following figure illustrates the relationship between the test case pro-formas and test instances.



**Figure 1- Relationship between the test case pro-formas and test instances**

More test details are specified in the following sections for each test case. The MioT test instance to be selected and applied in the test, and the test result are documented in the Excel NG.112 testbook which is included in Annex A at the end of the present GSMA PRD.

### 3 Basic Network Connectivity Testing

#### 3.1 LTE Attach Procedure

|  |   |
|--|---|
| <b>Purpose</b>   | To verify that MS1(a) held in the Visited Public Land Mobile Network VPMN(b) can successfully perform LTE Attach Procedure (agnostic of Control vs. User Plane C-IoT).  |
| <b>Preconditions</b>   | MS1(a) held in VPMN(b) is switched OFF.   |
| <b>Action</b>  | MS1(a) held in VPMN(b) is switched ON.<br>MS1(b) initiates the Attach Procedure by sending Attach Request Message.<br>VPMN(b) responds to the MS1(a) with Attach Accept Message with the Activate Default EPS Bearer Context Request Message shall include PDN (Packet Data Network) related parameters.<br>MS1(a) completes the Attach Procedure by sending the Attach Complete Message. |
| <b>Expected Results</b>                                      | Verify that MS1(a) is able to successfully attach to VPMN(b) by sending Attach Complete Message.  |
| <b>MS Details<br/>(Manufacturer, Model,<br/>S/W version)</b> |   |
| <b>MSISDN of MS1(a)</b>                                      |   |
| <b>IMSI of MS1(a)</b>  |   |
| <b>APN (Access Point<br/>Name) of MS1(a)</b>                 |   |
| <b>Test Case Result<br/>(Pass/Fail)</b>                      |   |
| <b>Date of Test</b>  |   |
| <b>Time of Test</b>  |   |
| <b>Signature of Tester(s)</b>                                |   |
| <b>Comments</b>  | NOTE: This test is present in GSMA PRD CLP.23 [5], but differentiated between LTE-M (LTE-Mobile) and NB-IoT (Narrow Band IoT) modules. GSMA PRD CLP.23 [5] also differentiates between Control Plane and User Plan CloT (Cellular Internet of Things) EPS (Evolved Packet System) optimizations.  |

### 3.2 LTE Detach Procedure

|  |  |
|--|--|
| <b>Purpose</b>   | To verify that MS1(a) held in VPMN(b) can successfully perform LTE Detach Procedure (agnostic of Control vs. User Plane C-IoT).  |
| <b>Preconditions</b>   | MS1(a) held in VPMN(b) is switched ON.   |
| <b>Action</b>  | MS1(a) will initiate an Explicit Detach procedure to VPMN(b).<br>MS1(a) sends Detach Request Message (GUTI, Switch Off) in NAS (Non Access Stratum) Level to VPMN(b)<br>If Switch Off indicated that detach is not due to a switch off situation, the network sends a Detach Accept Message to MS1(a). |
| <b>Expected Results</b>                                      | Verify that MA1(a) sends Detach Request Message to VPMN(b).  |
| <b>MS Details<br/>(Manufacturer, Model,<br/>S/W version)</b> |  |
| <b>MSISDN of MS1(a)</b>                                      |  |
| <b>IMSI of MS1(a)</b>  |  |
| <b>APN of MS1(a)</b>   |  |
| <b>Test Case Result<br/>(Pass/Fail)</b>                      |  |
| <b>Date of Test</b>  |  |
| <b>Time of Test</b>  |  |
| <b>Signature of Tester(s)</b>                                |  |
| <b>Comments</b>  | NOTE: This test is present in GSMA CLP.23 [5], but differentiated between LTE-M and NB-IoT module tests.   |

### 3.3 Basic Ping Test

|  |   |
|--|---|
| <b>Purpose</b>   | To ensure MS1(a) data packets are capable of being distributed to a public address without errors.                        |
| <b>Preconditions</b>   | MS1(a) is registered on the VPMN.   |
| <b>Action</b>  | MS1(a) is powered off<br>Wait +/- ten (10) seconds.<br>MS1(a) is powered on.<br>MS1(a) sends ping to a public IP address. |
| <b>Expected Results</b>                                      | Confirm successful ping result via response from the target server (without error or blocking)                            |
| <b>MS Details<br/>(Manufacturer, Model,<br/>S/W version)</b> |   |
| <b>MSISDN of MS1(a)</b>                                      |   |
| <b>IMSI of MS1(a)</b>  |   |
| <b>APN of MS1(a)</b>   |   |
| <b>Public IP Address Used<br/>(Example: 8.8.8.8)</b>         |   |
| <b>Test Case Result<br/>(Pass/Fail)</b>                      |   |
| <b>Date of Test</b>  |   |
| <b>Time of Test</b>  |   |
| <b>Signature of Tester(s)</b>                                |   |
| <b>Comments</b>  | This test may be best suited for modules that do not support mobility.  |

## 4 Data Transfer and Throughput

### 4.1 Basic Data Transfer

|  |   |
|--|---|
| <b>Purpose</b>   | Verify a data transfer from MS1(a).   |
| <b>Preconditions</b>   | MS1(a) is powered on.<br>MS1(a) is LTE Attach to VPMN(b).   |
| <b>Action</b>  | MS1(a) initiates a data packet upload.  |
| <b>Expected Results</b>                                      | Verify that MS1(a) sends the data traffic in the uplink (UL) and the downlink (DL) direction.<br>Record total Data sent in UL and/or DL, and record volume measured in kb.<br>Check RAT in GTP-C signalling (RAT=8 for NB-IoT, RAT=9 for LTE-M (available since R15 MME)) |
| <b>MS Details<br/>(Manufacturer, Model,<br/>S/W version)</b> |   |
| <b>MSISDN of MS1(a)</b>                                      |   |
| <b>IMSI of MS1(a)</b>  |   |
| <b>APN of MS1(a)</b>   |   |
| <b>Total Data Sent from<br/>MS1(a)<br/>(Upload)</b>          | kb  |
| <b>Total Data Received by<br/>MS1(a)<br/>(Download)</b>      | kb  |
| <b>Total Data<br/>(Sent/Received)</b>                        | kb  |
| <b>Test Case Result<br/>(Pass/Fail)</b>                      |   |
| <b>Date of Test</b>  |   |
| <b>Time of Test</b>  |   |
| <b>Signature of Tester(s)</b>                                |   |
| <b>Comments</b>  | NOTE: This test is present in GSMA PRD CLP.23 [5], but differentiated between LTE-M and NB-IoT module tests.<br>GSMA PRD CLP.23 [5] also differentiates between Control Plane and User Plan Clot EPS optimizations.   |

## 5 Power Saving Mode/PSM Operation

### 5.1 PSM Request and Activation

|  |   |
|--|---|
| <b>Purpose</b>   | To verify that MS1(a) can successfully request PSM (Power Saving Mode) during attach.   |
| <b>Preconditions</b>   | MS1(a) is configured to use Power Saving Mode, T3324 and T3412 ext are enabled and set to a suitable value as required.<br>MS1(a) is powered off.   |
| <b>Action</b>  | Power on MS1(a) in VPMN(b).<br>MS1(a) initiates the Attach procedure by sending the "Attach Request" message that contains the "T3324 and T3412 ext Values"<br>VPMN(b) responds to MS1(a) with "Attach Accept" message that contains the "T3324 and T3412 ext values".<br>MS1(a) completes the Attach procedure by sending the "Attach Complete" message.<br>MS1(a) releases the connection.    |
| <b>Expected Results</b>                                      | MS1(a) shall contain "T3324 and T3412 ext Value" in Attach Request in order to request PSM in step 2.   |
| <b>MS Details<br/>(Manufacturer, Model,<br/>S/W version)</b> |   |
| <b>MSISDN of MS1(a)</b>                                      |   |
| <b>IMSI of MS1(a)</b>  |   |
| <b>APN of MS1(a)</b>   |   |
| <b>Test Case Result<br/>(Pass/Fail)</b>                      |   |
| <b>Date of Test</b>  |   |
| <b>Time of Test</b>  |   |
| <b>Signature of Tester(s)</b>                                |   |
| <b>Comments</b>  | This test is originally contained in GSMA PRD CLP.23 [5]. However, GSMA PRD CLP.23 [5] validates both original timer settings and a change to the timer settings. For this test PRD, the changed timers are validated in test 5.2.<br>It is recommended configurable timers settings are of sufficient duration in seconds to permit the tester to proceed through the necessary testing steps. |



## 5.2 PSM Timers Change Validation

|  |  |
|--|--|
| <b>Purpose</b>   | To verify that MS1(a) can successfully request PSM during attach after PSM timers change.  |
| <b>Preconditions</b>   | MS1(a) is configured to use Power Saving Mode<br>MS1(a) is powered off.  |
| <b>Action</b>  | Change the values of T3412 ext and T3324 in the MS1(a) setting to a different value than tested in test 5.1.<br>Power on MS1(a) in VPMN(b).<br>MS1(a) initiates the Attach procedure by sending the "Attach Request" message that contains the changed "T3324 and T3412 ext Values"<br>VPMN(b) responds to MS1(a) with "Attach Accept" message that contains the "T3324 and T3412 ext values".<br>MS1(a) completes the Attach procedure by sending the "Attach Complete" message.<br>MS1(a) releases the connection. |
| <b>Expected Results</b>                                      | Successful result if the changed T3412 ext and T3324 timers are sent in the "Attach Request" and VPMN(b) responds with the same timers values.   |
| <b>MS Details<br/>(Manufacturer, Model,<br/>S/W version)</b> |  |
| <b>MSISDN of MS1(a)</b>                                      |  |
| <b>IMSI of MS1(a)</b>  |  |
| <b>APN of MS1(a)</b>   |  |
| <b>Test Case Result<br/>(Pass/Fail)</b>                      |  |
| <b>Date of Test</b>  |  |
| <b>Time of Test</b>  |  |
| <b>Signature of Tester(s)</b>                                |  |
| <b>Comments</b>  | This test is originally contained in GSMA PRD CLP.23 [5], but is included in a single PSM test that validates the original timers setting and a change to the timers initiated by the tester.<br>It is recommended configurable timers settings are of sufficient duration in seconds to permit the tester to proceed through the necessary testing steps.   |

### 5.3 MT Data in PSM State

|  |   |
|--|---|
| <b>Purpose</b>   | To verify that the MS1(a) can successfully monitor Paging message and receive MT (Mobile Terminated) user data when T3324 Timer running and then enter PSM again when T3324 timer expires.  |
| <b>Preconditions</b>   | MS1(a) is configured to use Power Saving Mode, T3324 and T3412 ext are enabled and set to a suitable value as required.<br>MS1(a) is powered off.   |
| <b>Action</b>  | Power on MS1(a) in VPMN(b).<br>MS1(a) initiates the Attach procedure by sending the "Attach Request" message that contains the "T3324 and T3412 ext Value"<br>VPMN(b) responds to the MS1(a) with "Attach Accept" message that contains the "T3324 and T3412 ext value".<br>MS1(a) completes the Attach procedure by sending the "Attach Complete" message.<br>MS1(a) releases the connection.<br>Initiate MT user data before T3324 expires.<br>Stop MT data. MS1(a) releases the connection, enters in idle state and starts T3324 timer.<br>Initiate MT user data after T3324 expires. |
| <b>Expected Results</b>                                      | MS1(a) shall respond to the paging message, establish connection and receive MT data in step 6<br>MS1(a) shall not give any response in step 8.   |
| <b>MS Details<br/>(Manufacturer, Model,<br/>S/W version)</b> |   |
| <b>MSISDN of MS1(a)</b>                                      |   |
| <b>IMSI of MS1(a)</b>  |   |
| <b>APN of MS1(a)</b>   |   |
| <b>Test Case Result<br/>(Pass/Fail)</b>                      |   |
| <b>Date of Test</b>  |   |
| <b>Time of Test</b>  |   |
| <b>Signature of Tester(s)</b>                                |   |
| <b>Comments</b>  | This test is originally contained in GSMA PRD CLP.23 [5].<br>It is recommended the TS3324 timer (definition contained in 3GPP 24.301) be of sufficient duration ( $\geq 16$ seconds) to permit testing personnel to initiate MT user data.  |

#### 5.4 MO Data in Power Saving Mode/PSM State

|  |  |
|--|--|
| <b>Purpose</b>   | To verify that the MS1(a) could successfully deactivate PSM at any time for the transfer of mobile originated user data.   |
| <b>Preconditions</b>   | MS1(a) is configured to use Power Saving Mode. T3324 and T3412 ext are enabled and set to a suitable value as required.<br>MS1(a) is powered off.  |
| <b>Action</b>  | Power on MS1(a) in VPMN(b).<br>MS1(a) initiates the Attach procedure by sending the "Attach Request" message that contains the "T3324 and T3412 ext Value",<br>VPMN(b) responds to the MS1(a) with "Attach Accept" message that contains the "T3324 and T3412 ext value".<br>MS1(a) completes the Attach procedure by sending the "Attach Complete" message.<br>MS1(a) releases the connection. Wait for T3324 Timer to expire.<br>Check MS1(a) entered PSM after expiry of T3324 by attempting to page the MS1(a)<br>Initiate MO (Mobile Originated) user data after T3324 expires. |
| <b>Expected Results</b>                                      | Check MS1(a) enters PSM after the expiry of T3324 in step 5.<br>MS1(a) shall deactivate PSM establish connection and send data in step 7.  |
| <b>MS Details<br/>(Manufacturer, Model,<br/>S/W version)</b> |  |
| <b>MSISDN of MS1(a)</b>                                      |  |
| <b>IMSI of MS1(a)</b>  |  |
| <b>APN of MS1(a)</b>   |  |
| <b>Test Case Result<br/>(Pass/Fail)</b>                      |  |
| <b>Date of Test</b>  |  |
| <b>Time of Test</b>  |  |
| <b>Signature of Tester(s)</b>                                |  |
| <b>Comments</b>  | This test is originally contained in GSMA PRD CLP.23 [5].  |

## 5.5 PSM Timer Range

|  |  |
|--|--|
| <b>Purpose</b>   | MS1(a) will negotiate specific PSM timer values with VPMN(b) within a predefined range.  |
| <b>Preconditions</b>   | <p>EPS subscription of MS1(a) is provisioned correctly (APNs, QCI, AMBR, etc.).</p> <p>MS1(a) does not have a current PDN connection.</p> <p>MS1(a) timers T3324 and T3412 ext are enabled and set to a suitable value as required.</p>  |
| <b>Action</b>  | MS1(a) successfully negotiates specified T3412 ext value with VPMN(b).   |
| <b>Expected Results</b>                                      | MS1(a) successfully sends PSM timers in Attach request and accepts the VPMN(b) response containing the different values in Attach Accept message. The test also verifies the deviations between the original requested value and the VPMN(b) granted value of the T3324 and T3412 ext within a set of HPMN(a)-predefined ranges $\{(T3324_{min}, T3324_{max}), (T3412_{ext_{min}}, T3412_{ext_{max}})\}$ |
| <b>MS Details<br/>(Manufacturer, Model,<br/>S/W version)</b> |  |
| <b>MSISDN of MS1(a)</b>                                      |  |
| <b>IMSI of MS1(a)</b>  |  |
| <b>APN of MS1(a)</b>   |  |
| <b>Test Case Result<br/>(Pass/Fail)</b>                      |  |
| <b>Date of Test</b>  |  |
| <b>Time of Test</b>  |  |
| <b>Signature of Tester(s)</b>                                |  |
| <b>Comments</b>  | The present test case is a mirror test case of 5.1 if VPMN(b) grants the T3324 and T3412 ext with the different values based on the local policy and/or MME configurations.  |

## 6 Extended Discontinuous Reception/eDRX Testing

### 6.1 Validate eDRX Request and Activation

|  |   |
|--|---|
| <b>Purpose</b>   | To verify that MS1(a) can successfully request eDRX (Extended Discontinuous Reception) during attach and monitor Paging according to eDRX cycle and PTW Paging Time Window (except EC-GSM, Extended Coverage GSM).  |
| <b>Preconditions</b>   | Idle mode eDRX is allowed in the serving cell of VPMN(b). The eDRX parameters are configured and set to a suitable value as required.<br>MS1(a) is configured to use eDRX.<br>MS1(a) is powered off.  |
| <b>Action</b>  | Power on MS1(a) in VPMN(b).<br>MS1(a) initiates the Attach procedure by sending the "Attach Request" message that contains the "Extended DRX parameters" IE (Information Element).<br>The network responds to the MS1(a) with "Attach Accept" message that contains the "Extended DRX parameters" to indicate the eDRX cycle and PTW (except EC-GSM).<br>MS1(a) completes the Attach procedure by sending the "Attach Complete" message.<br>MS1(a) releases the connection.<br>Initiate MT user data and the network sends Paging message.<br>MS1(a) responds to the Paging and receives the MT data. |
| <b>Expected Results</b>                                      | MS1(a) shall contain "Extended DRX parameters" in Attach Request in order to request eDRX in step 2<br>MS1(a) shall correctly receive Paging message, establish connection and receive MT user data in step 7.  |
| <b>MS Details<br/>(Manufacturer, Model,<br/>S/W version)</b> |   |
| <b>MSISDN of MS1(a)</b>                                      |   |
| <b>IMSI of MS1(a)</b>  |   |
| <b>APN of MS1(a)</b>   |   |
| <b>Test Case Result<br/>(Pass/Fail)</b>                      |   |
| <b>Date of Test</b>  |   |
| <b>Time of Test</b>  |   |
| <b>Signature of Tester(s)</b>                                |   |
| <b>Comments</b>  | This test is originally contained in GSMA PRD CLP.23 [5]. However, GSMA CLP.23 [5] included the changed eDRX parameters and a subsequent re-test. The retest to validate the changed eDRX parameter is test case 6.2 of this PRD.   |



## **6.2 Validate eDRX Parameter Change**

|  |  |
|--|--|
| <b>Purpose</b>   | To verify that MS1(a) can successfully request eDRX during attach and monitor Paging according to eDRX cycle and PTW (except EC-GSM) after eDRX parameters change.   |
| <b>Preconditions</b>   | Idle mode eDRX is allowed in the serving cell of VPMN(b).<br>MS1(a) is configured to use eDRX.<br>MS1(a) is powered off.   |
| <b>Action</b>  | Change the "Extended DRX parameters IE setting to a different value than tested in test case 6.1.<br>Power on MS1(a) in VPMN(b).<br>MS1(a) initiates the Attach procedure by sending the "Attach Request" message that contains the "Extended DRX parameters" IE.<br>The network responds to the MS1(a) with "Attach Accept" message that contains the "Extended DRX parameters" to indicate the eDRX cycle and PTW (except EC-GSM).<br>MS1(a) completes the Attach procedure by sending the "Attach Complete" message.<br>MS1(a) releases the connection.<br>Initiate MT user data and the network sends Paging message.<br>MS1(a) responds to the Paging and receives the MT data. |
| <b>Expected Results</b>                                      | MS1(a) shall contain "Extended DRX parameters" in Attach Request in order to request eDRX in step 2<br>MS1(a) shall correctly receive Paging message, establish connection and receive MT user data in step 7.<br>MS1(a) shall correct request and use the requested eDRX parameter as defined in Step 8   |
| <b>MS Details<br/>(Manufacturer, Model,<br/>S/W version)</b> |  |
| <b>MSISDN of MS1(a)</b>                                      |  |
| <b>IMSI of MS1(a)</b>  |  |
| <b>APN of MS1(a)</b>   |  |
| <b>Test Case Result<br/>(Pass/Fail)</b>                      |  |
| <b>Date of Test</b>  |  |
| <b>Time of Test</b>  |  |
| <b>Signature of Tester(s)</b>                                |  |

|                 |   |
|-----------------|---|
| <b>Comments</b> | This test is originally contained in GSMA PRD CLP.23 [5]. However, GSMA CLP.23 [5] included the changed eDRX parameters and a subsequent re-test. The retest to validate the changed eDRX parameter is test case 3.2 of this PRD. |
|-----------------|---|

### 6.3 eDRX Parameter Range

|  |  |
|--|--|
| <b>Purpose</b>   | MS1(a) will negotiate specific eDRX parameters value with VPMN(b) within a predefined range.   |
| <b>Preconditions</b>   | EPS subscription of MS1(a) is provisioned correctly (APNs, QCI (QoS Class Identifier), AMBR (Aggregate Maximum Bit Rate), etc.)<br>MS1(a) does not have a current PDN connection.<br>The eDRX parameters are configured and set to a suitable value as required.   |
| <b>Action</b>  | MS1(a) successfully negotiates specified eDRX parameters value with VPMN(b).   |
| <b>Expected Results</b>                                      | MS1(a) successfully sends eDRX parameterstimers in Attach request, and accepts the VPMN(b) response containings the same different values in Attach Accept message. The test also verifies the deviations between the original requested value and the VPMN(b) granted value of the eDRX parameters within a set of HPMN(a)-predefined ranges {(PTWmin, PTWmax), (TeDRXmin, TeDRXmax)} |
| <b>MS Details<br/>(Manufacturer, Model,<br/>S/W version)</b> |  |
| <b>MSISDN of MS1(a)</b>                                      |  |
| <b>IMSI of MS1(a)</b>  |  |
| <b>APN of MS1(a)</b>   |  |
| <b>Test Case Result<br/>(Pass/Fail)</b>                      |  |
| <b>Date of Test</b>  |  |
| <b>Time of Test</b>  |  |
| <b>Signature of Tester(s)</b>                                |  |
| <b>Comments</b>  | The present test case is a mirror test case of 6.1 if VPMN(b) grants the eDRX parameters with the different values based on the local policy and/or configurations.  |

## 6.4 Exit eDRX Cycle

|  |   |
|--|---|
| <b>Purpose</b>   | MS1(a) will exit dormant state based on specified eDRX value and receive SMS (Short Message Service).   |
| <b>Preconditions</b>   | <p>EPS subscription of MS1(a) is provisioned correctly (APNs, QCI, AMBR, etc.)</p> <p>MS1(a) does not have a current PDN connection</p> <p>eDRX is enabled and set PTW and eDRX cycle to a suitable value as required,</p> <p>for example, setting PTW value between 7.68 – 15.36 seconds, eDRX value to 163.84 seconds</p> |
| <b>Action</b>  | An SMS is sent to MS1(a) during the eDRX cycle, when the MS(a) is in a sleep mode but VPMN(b) does not page MS1(a) during the duration of the cycle.  |
| <b>Expected Results</b>                                      | VPMN(b) does not page MS1(a) to deliver the SMS until the device wakes up after the PTW timer is expired.   |
| <b>MS Details<br/>(Manufacturer, Model,<br/>S/W version)</b> |   |
| <b>MSISDN of MS1(a)</b>                                      |   |
| <b>IMSI of MS1(a)</b>  |   |
| <b>APN of MS1(a)</b>   |   |
| <b>Test Case Result<br/>(Pass/Fail)</b>                      |   |
| <b>Date of Test</b>  |   |
| <b>Time of Test</b>  |   |
| <b>Signature of Tester(s)</b>                                |   |
| <b>Comments</b>  |   |

## 7 Short Message Service MO/MT Testing

### 7.1 MS1(a) sends mobile originated SMS to MSISDN(a)

|  |  |
|--|--|
| <b>Purpose</b>   | To validate the MS1(a) is able to send an SMS with text to MSISDN(a)   |
| <b>Preconditions</b>   | MS1(a) is provisioned to send a mobile-originated SMS message containing text.<br>MSISDN(a) is registered on the network and able to receive SMS/MO (Short Message Service Mobile Originated).<br>SGs (or SGd) interface is used for SMS transmission.<br>NOTE: When SMS over NAS is selected, SGs or SGd interface should be specified. |
| <b>Action</b>  | MS1(a) sends an SMS/MO containing text to a MSISDN(a)<br>MSISDN(a) confirms receipt of SMS/MO text from MS1(a)   |
| <b>Expected Results</b>  | Successful result if Short Message is correctly delivered within two (2) minutes of switching MSISDN(a) on.  |
| <b>MS1(a) Details<br/>(Manufacturer, Model,<br/>S/W version)</b> |  |
| <b>SMS Protocol<br/>(e.g., SMS over NAS,<br/>SMS over IP)</b>    |  |
| <b>MSISDN of MS1(a)</b>  |  |
| <b>IMSI of MS1(a)</b>  |  |
| <b>SMSC of MS1(a)</b>  |  |
| <b>MSISDN(a)</b>   |  |
| <b>Test Case Result<br/>(Pass/Fail)</b>                          |  |
| <b>Date of Test</b>  |  |
| <b>Time of Test</b>  |  |
| <b>Signature of Tester(s)</b>                                    |  |
| <b>Comments</b>  | In this test, it is recommended that MS1(a) sends a mobile originated SMS to a MSISDN(1) that is a "traditional" mobile device (e.g., smartphone, flip phone, etc.), to ensure the tester can read and confirm the SMS/MO content.   |

**7.2 MS1(a) receives mobile terminated SMS from MSISDN(a)**

|  |  |
|--|--|
| <b>Purpose</b>   | To validate the MS1(a) is able to receive an SMS with text from MSISDN(a)  |
| <b>Preconditions</b>   | MS1(a) is provisioned to receive a mobile-originated SMS message containing text.<br>MSISDN(a) is registered on the network and able to receive SMS/MT. SGs (or SGd) interface is used for SMS transmission.<br>NOTE: When SMS over NAS is selected, SGs or SGd interface should be specified. |
| <b>Action</b>  | MSISDN(a) sends an SMS/MO containing text to a MS1(a).<br>MS1(a) confirms receipt of SMS/MT (Short Message Service Mobile Terminated) text from MSISDN(a).   |
| <b>Expected Results</b>  | Successful result if Short Message is correctly delivered within two (2) minutes of switching MS1(a) on.   |
| <b>MS1(a) Details<br/>(Manufacturer, Model,<br/>S/W version)</b> |  |
| <b>SMS Protocol<br/>(e.g., SMS over NAS,<br/>SMS over IP)</b>    |  |
| <b>MSISDN of MS1(a)</b>  |  |
| <b>IMSI of MS1(a)</b>  |  |
| <b>SMSC of MSISDN(a)</b>   |  |
| <b>MSISDN(a)</b>   |  |
| <b>Test Case Result<br/>(Pass/Fail)</b>                          |  |
| <b>Date of Test</b>  |  |
| <b>Time of Test</b>  |  |
| <b>Signature of Tester(s)</b>                                    |  |
| <b>Comments</b>  | In this test, it is recommended that the tester with MSISDN(a) uses a "traditional" mobile device (e.g., smartphone or flip phone) with text to MS1(a) for ease in testing and to ensure the tester can read and confirm the SMS/MT content.   |

## 8 MLoT test instances

While the previous sections mainly provide the generic test case pro-formas for the MLoT roaming tests, this section is intended to list MLoT test instances. Each instance consists of a certain combination of MLoT test parameters. The parameters encompass:

1. LTE-M or NB-IoT
2. Control Plane CloT EPS Optimisation (CP CloT)
3. User Plane CloT EPS Optimisation (UP CloT)
4. Attach with or without PDN connection
5. S1-U data transfer (S1-U data) or S11-U data transfer (S11 -U data)
6. Data size
7. SMS transfer without or with Combined Attach
8. Header compression for Control Plane CloT EPS Optimisation is supported (HC-CP CloT)
9. TCP/IP (Transmission Control Protocol/Internet Protocol), UDP/IP (User Datagram Protocol/Internet Protocol) or non-IP
10. PSM and eDRX timers
11. Because of the nature of the home-routed MLoT roaming architecture, it is assumed that the MLoT platform is intermediated between the HPMN core network and the MLoT Application Server or co-located with HPMN Service Capability Server (SCS) in the trusted domain. The home MLoT platform is responsible for the application service data management, the device data management and the storage, optimizes and determines, for example, the timer values for battery saving. If PSM and eDRX timers are set differently between the HPMN and VPMN, the device and service behaviour in roaming would change, impacting their responsiveness to backend-originated commands and the longevity of the battery. VPMN should be more flexible and accepts the values proposed by the inbound roaming IoT devices, valid in the 3GPP specs.

### 8.1 LTE-M test instances

The table below is not exhaustive and can be extended when the MLoT roaming test is evolved. The roaming interface T7 is applied if the HPMN (Home PMN) and VPMN (Visited PMN) are capable of exposure of the non-IP data services (SCEF, Service Capability Exposure Function) via SCS to the MLoT Application Servers.

| Instanc e Id | EPS opti miza tion | Attach type     | Data transfe r type | Data size | IP / Non IP        | Core interfa ces | Core network elements                 | Head er comp ressi on | PSM / eDR X |
|--------------|--------------------|-----------------|---------------------|-----------|--------------------|------------------|---------------------------------------|-----------------------|-------------|
| LTE M00      | None               | Attach with PDN | S1-U data           |           | TCP/I P or UDP/I P | S1-U – S8        | S-GW (VPMN) – P-GW (HPMN) – AS (HPMN) | Possib le             |             |

|         |         |                    |                              |  |                  |                              |  |          |  |
|---------|---------|--------------------|------------------------------|--|------------------|------------------------------|--|----------|--|
| LTE M01 | UP CloT | Attach with PDN    | S1-U data (Suspended/resume) |  | TCP/IP or UDP/IP | S1-U – S8                    | S-GW (VPMN) – P-GW (HPMN) – AS (HPMN)                | Possible |  |
| LTE M02 | UP CloT | Attach with PDN    | NIDD                         |  | Non-IP           | S1-U – S8 – SGi (PtP tunnel) | S-GW (VPMN) – P-GW (HPMN) – AS (HPMN)                | -        |  |
| LTE M03 | UP CloT | Attach with PDN    | NIDD (Suspended/resume)      |  | Non-IP           | S1-U – S8 – SGi (PtP tunnel) | S-GW (VPMN) – P-GW (HPMN) – AS (HPMN)                | -        |  |
| LTE M04 | CP CloT | Attach with PDN    | DoNAS, S11 data              |  | TCP/IP or UDP/IP | S1-MME - S11 – S8            | MME (VPMN) – S-GW (VPMN) – P-GW (HPMN) – AS (HPMN)   | Possible |  |
| LTE M20 | None    | Combined attach    | SMS                          |  | -                | S1-MME - MAP-E – SGs – Tsms  | MME (VPMN) – MSC (VPMN) – SMS-SC (HPMN) – SME (HPMN) | -        |  |
| LTE M21 | CP CloT | Attach without PDN | SMS only                     |  | -                | S1-MME - SGd – Tsms          | MME (VPMN) – SMS-SC (HPMN) – SME (HPMN)              | -        |  |

## 8.2 NB-IoT test instances

The table below is not exhaustive and can be extended when the MIoT roaming test is evolved. The roaming interface T7 is applied if the HPMN and VPMN are capable of exposure of the non-IP data services (SCEF) via SCS to the MIoT Application Servers.

## Annex A MIoT Excel Testbook



NG112\_v1.xlsm

| Instance Id | EPS optimization | Attach type        | Data transfer type                      | Data size | IP / Non IP      | Core interfaces                      | Core network elements                              | Header compression | PS M / eDRX |
|-------------|------------------|--------------------|---|-----------|------------------|--------------------------------------|--|--------------------|-------------|
| NB00        | None             | Attach with PDN    | S1-U data                               |           | TCP/IP or UDP/IP | S1-U – S8                            | S-GW (VPMN) – P-GW (HPMN) – AS (HPMN)              | Possible           |             |
| NB01        | UP CloT          | Attach with PDN    | S1-U data (Suspended/resume)            |           | TCP/IP or UDP/IP | S1-U – S8                            | S-GW (VPMN) – P-GW (HPMN) – AS (HPMN)              | Possible           |             |
| NB02        | UP CloT          | Attach with PDN    | NIDD                                    |           | Non-IP           | S1-U – S8 – SGi (PtP tunnel)         | S-GW (VPMN) – P-GW (HPMN) – AS (HPMN)              | -                  |             |
| NB03        | UP CloT          | Attach with PDN    | NIDD (Suspended/resume)                 |           | Non-IP           | S1-U – S8 – SGi (PtP tunnel)         | S-GW (VPMN) – P-GW (HPMN) – AS (HPMN)              | -                  |             |
| NB04        | CP CloT          | Attach with PDN    | DoNAS, S11 data                         |           | TCP/IP or UDP/IP | S1-MME - S11 – S8                    | MME (VPMN) – S-GW (VPMN) – P-GW (HPMN) – AS (HPMN) | Possible           |             |
| NB05        | CP CloT          | Attach with PDN    | NIDD                                    |           | Non-IP           | S1-MME - S11 – S8 - SGi (PtP tunnel) | MME (VPMN) – S-GW (VPMN) – P-GW (HPMN) – AS (HPMN) | -                  |             |
| NB21        | CP CloT          | Attach without PDN | SMS only (encapsulate in NAS transport) |           | -                | S1-MME - SGd – Tsms                  | MME (VPMN) – SMS-SC (HPMN) – SME (HPMN)            | -                  |             |

|  |  |  |              |  |  |  |  |  |  |
|--|--|--|--------------|--|--|--|--|--|--|
|  |  |  | messag<br>e) |  |  |  |  |  |  |
|--|--|--|--------------|--|--|--|--|--|--|

## Annex B Document Management

### B.1 Document History

| Version | Date         | Brief Description of Change  | Approval Authority | Editor / Company    |
|---------|--------------|--|--------------------|---------------------|
| 0.1     | 18 June 2018 | Proposed PRD presentation  | SIGNAL SWG         | Mark McGinley, AT&T |
| 0.2     | 19 June 2018 | Modifications to document based on SIGNAL101 delegate feedback (including corrections) | SIGNAL SWG         | Mark McGinley, AT&T |
| 0.3     | 14 Aug 2018  | Added section 2 test methodology and section 7 MIoT test instances                     | SIGNAL SWG         | Mark McGinley, AT&T |
| 1.0     | 24 Mar 2019  | Version 1.0 published (CR 1001)  | SIGNAL SWG         | Mark McGinley, AT&T |
| 2.0     | 27 May 2020  | CR 1002 Implemented<br>CR 1003 Implemented   | GERI               | Mark McGinley, AT&T |
| 3.0     | 10 Nov 2020  | NG.112 CR1004 NG.112<br>CR 1004 Clarifications of PSM eDRX Tests                       | GER                | Mark McGinley, AT&T |
| 4.0     | 04 Apr 2023  | CR 1005 Implemented  | NRG                | Mark McGinley, AT&T |

### B.2 Other Information

| Type             | Description              |
|------------------|--------------------------|
| Document Owner   | SIGNAL sub-working group |
| Editor / Company | Mark McGinley, AT&T      |

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](mailto:prd@gsma.com)

Your comments or suggestions & questions are always welcome.