

Mobile-IoT Roaming Testing
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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	3rd 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
VLR	Visitor Location Register

Term	Description
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.

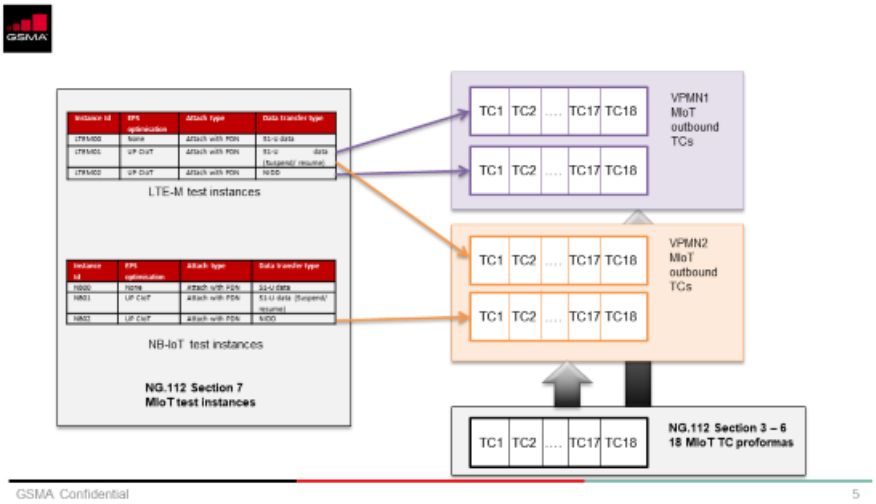

Figure 1- Relationship between the test case pro-formas and test instances

3 Basic Network Connectivity Testing

3.1 LTE Attach Procedure

Purpose	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).
Preconditions	MS1(a) held in VPMN(b) is switched OFF.
Action	MS1(a) held in VPMN(b) is switched ON. MS1(b) initiates the Attach Procedure by sending Attach Request Message. 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. MS1(a) completes the Attach Procedure by sending the Attach Complete Message.
Expected Results	Verify that MS1(a) is able to successfully attach to VPMN(b) by sending Attach Complete Message.
MS Details (Manufacturer, Model, S/W version)	
MSISDN of MS1(a)	
IMSI of MS1(a)	
APN (Access Point Name) of MS1(a)	
Test Case Result (Pass/Fail)	
Date of Test	
Time of Test	
Signature of Tester(s)	
Comments	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 CIoT (Cellular Internet of Things) EPS (Evolved Packet System) optimizations.

3.2 LTE Detach Procedure

Purpose	To verify that MS1(a) held in VPMN(b) can successfully perform LTE Detach Procedure (agnostic of Control vs. User Plane C-IoT).
Preconditions	MS1(a) held in VPMN(b) is switched ON.
Action	MS1(a) will initiate an Explicit Detach procedure to VPMN(b). MS1(a) sends Detach Request Message (GUTI, Switch Off) in NAS (Non Access Stratum) Level to VPMN(b) If Switch Off indicated that detach is not due to a switch off situation, the network sends a Detach Accept Message to MS1(a).
Expected Results	Verify that MA1(a) sends Detach Request Message to VPMN(b).
MS Details (Manufacturer, Model, S/W version)	
MSISDN of MS1(a)	
IMSI of MS1(a)	
APN of MS1(a)	
Test Case Result (Pass/Fail)	
Date of Test	
Time of Test	
Signature of Tester(s)	
Comments	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

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

4 Data Transfer and Throughput

4.1 Basic Data Transfer

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

5 Power Saving Mode/PSM Operation

5.1 PSM Request and Activation

Purpose	To verify that MS1(a) can successfully request PSM (Power Saving Mode) during attach.
Preconditions	MS1(a) is configured to use Power Saving Mode MS1(a) is powered off.
Action	Power on MS1(a) in VPMN(b). MS1(a) initiates the Attach procedure by sending the “Attach Request” message that contains the “T3324 and T3412 Values” VPMN(b) responds to MS1(a) with “Attach Accept” message that contains the “T3324 and T3412 values”. MS1(a) completes the Attach procedure by sending the “Attach Complete” message. MS1(a) releases the connection.
Expected Results	MS1(a) shall contain “T3324 Value” in Attach Request in order to request PSM in step 2.
MS Details (Manufacturer, Model, S/W version)	
MSISDN of MS1(a)	
IMSI of MS1(a)	
APN of MS1(a)	
Test Case Result (Pass/Fail)	
Date of Test	
Time of Test	
Signature of Tester(s)	
Comments	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 2.4.2. 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

Purpose	To verify that MS1(a) can successfully request PSM during attach.
Preconditions	MS1(a) is configured to use Power Saving Mode MS1(a) is powered off.
Action	Change the values of T3412 and T3324 in the MS1(a). Power on MS1(a) in VPMN(b). MS1(a) initiates the Attach procedure by sending the “Attach Request” message that contains the “T3324 and T3412 Values” Change the values of T3412 and T3324 in the MS1(a). VPMN(b) responds to MS1(a) with “Attach Accept” message that contains the “T3324 and T3412 values”. MS1(a) completes the Attach procedure by sending the “Attach Complete” message. MS1(a) releases the connection.
Expected Results	Successful result if the changed T3412 and T3324 timers are sent in the “Attach Request” and VPMN(b) responds with the same timers values.
MS Details (Manufacturer, Model, S/W version)	
MSISDN of MS1(a)	
IMSI of MS1(a)	
APN of MS1(a)	
Test Case Result (Pass/Fail)	
Date of Test	
Time of Test	
Signature of Tester(s)	
Comments	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. 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

Purpose	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.
Preconditions	MS1(a) is configured to use Power Saving Mode MS1(a) is powered off.
Action	Power on MS1(a) in VPMN(b). MS1(a) initiates the Attach procedure by sending the “Attach Request” message that contains the “T3324 Value” VPMN(b) responds to the MS1(a) with “Attach Accept” message that contains the “T3324 value”. MS1(a) completes the Attach procedure by sending the “Attach Complete” message. MS1(a) releases the connection. Initiate MT user data before T3324 expires. Stop MT data. MS1(a) releases the connection, enters in idle state and starts T3324 timer. Initiate MT user data after T3324 expires.
Expected Results	MS1(a) shall respond to the paging message, establish connection and receive MT data in step 6 MS1(a) shall not give any response in step 8.
MS Details (Manufacturer, Model, S/W version)	
MSISDN of MS1(a)	
IMSI of MS1(a)	
APN of MS1(a)	
Test Case Result (Pass/Fail)	
Date of Test	
Time of Test	
Signature of Tester(s)	
Comments	This test is originally contained in GSMA PRD CLP.23 [5]. It is recommended the TS2234 timer (definition contained in 3GPP 24.301) be of sufficient duration (in seconds) to permit testing personnel to initiate MT user data.

5.4 MO Data in Power Saving Mode/PSM State

Purpose	To verify that the MS1(a) could successfully deactivate PSM at any time for the transfer of mobile originated user data.

Preconditions	MS1(a) is configured to use Power Saving Mode. MS1(a) is powered off.
Action	Power on MS1(a) in VPMN(b). MS1(a) initiates the Attach procedure by sending the “Attach Request” message that contains the “T3324 Value”, VPMN(b) responds to the MS1(a) with “Attach Accept” message that contains the “T3324 value”. MS1(a) completes the Attach procedure by sending the “Attach Complete” message. MS1(a) releases the connection. Wait for T3324 Timer to expire. Check MS1(a) entered PSM after expiry of T3324 by attempting to page the MS1(a) Initiate MO (Mobile Originated) user data after T3324 expires.
Expected Results	Check MS1(a) enters PSM after the expiry of T3324 in step 5. MS1(a) shall deactivate PSM establish connection and send data in step 7.
MS Details (Manufacturer, Model, S/W version)	
MSISDN of MS1(a)	
IMSI of MS1(a)	
APN of MS1(a)	
Test Case Result (Pass/Fail)	
Date of Test	
Time of Test	
Signature of Tester(s)	
Comments	This test is originally contained in GSMA PRD CLP.23 [5]. It is recommended the TS2234 timer be of sufficient duration (in seconds) to permit testing personnel to initiate MT user data.

6 Extended Discontinuous Reception/eDRX Testing

6.1 Validate eDRX Request and Activation

Purpose	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).

Preconditions	Idle mode eDRX is allowed in the serving cell of VPMN(b). MS1(a) is configured to use eDRX. MS1(a) is powered off.
Action	Power on MS1(a) in VPMN(b). MS1(a) initiates the Attach procedure by sending the “Attach Request” message that contains the “Extended DRX parameters” IE (Information Element). 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). MS1(a) completes the Attach procedure by sending the “Attach Complete” message. MS1(a) releases the connection. Initiate MT user data and the network sends Paging message. MS1(a) responds to the Paging and receives the MT data.
Expected Results	MS1(a) shall contain “Extended DRX parameters” in Attach Request in order to request eDRX in step 2 MS1(a) shall correctly receive Paging message, establish connection and receive MT user data in step 7.
MS Details (Manufacturer, Model, S/W version)	
MSISDN of MS1(a)	
IMSI of MS1(a)	
APN of MS1(a)	
Test Case Result (Pass/Fail)	
Date of Test	
Time of Test	
Signature of Tester(s)	
Comments	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.

6.2 Validate eDRX Parameter Change

Purpose	To verify that MS1(a) can successfully request eDRX during attach and monitor Paging according to eDRX cycle and PTW (except EC-GSM).
Preconditions	Idle mode eDRX is allowed in the serving cell of VPMN(b). MS1(a) is configured to use eDRX. MS1(a) is powered off.
Action	Power on MS1(a) in VPMN(b). Change the “Extended DRX parameters IE setting to a different value than tested in test case 3.1. MS1(a) initiates the Attach procedure by sending the “Attach Request” message that contains the “Extended DRX parameters” IE. 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). MS1(a) completes the Attach procedure by sending the “Attach Complete” message. MS1(a) releases the connection. Initiate MT user data and the network sends Paging message. MS1(a) responds to the Paging and receives the MT data.
Expected Results	MS1(a) shall contain “Extended DRX parameters” in Attach Request in order to request eDRX in step 2 MS1(a) shall correctly receive Paging message, establish connection and receive MT user data in step 7. MS1(a) shall correct request and use the requested eDRX parameter as defined in Step 8
MS Details (Manufacturer, Model, S/W version)	
MSISDN of MS1(a)	
IMSI of MS1(a)	
APN of MS1(a)	
Test Case Result (Pass/Fail)	
Date of Test	
Time of Test	
Signature of Tester(s)	
Comments	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 Timer Minimum

Purpose	MS1(a) will negotiate specific eDRX timer value with VPMN(b).
Preconditions	EPS subscription of MS1(a) is provisioned correctly (APNs, QCI (QoS Class Identifier), AMBR (Aggregate Maximum Bit Rate), etc.) MS1(a) does not have a current PDN connection MS1(a) timers T3324 and T3412-Ext are enabled and set. T3324=xx (incremented in multiples of 2 seconds) and T3412-Ext=xx (incremented in multiples of 30 seconds).
Action	MS1(a) successfully negotiates specified T3412 value with VPMN(b).
Expected Results	MS1(a) successfully sends timers in Attach request and the response contains the same values in Attach Accept message.
MS Details (Manufacturer, Model, S/W version)	
MSISDN of MS1(a)	
IMSI of MS1(a)	
APN of MS1(a)	
Test Case Result (Pass/Fail)	
Date of Test	
Time of Test	
Signature of Tester(s)	
Comments	

6.4 eDRX Timer Maximum

Purpose	MS1(a) will negotiate specific eDRX timer value within VPMN(b).
Preconditions	EPS subscription of MS1(a) is provisioned correctly (APNs, QCI, AMBR, etc.). MS1(a) does not have a current PDN connection. MS1(a) timers T3324 and T3412-Ext are enabled and set. T3324=xx (incremented in multiples of 2 seconds) and T3412-Ext=xx (incremented in multiples of 30 seconds).
Action	MS1(a) successfully negotiates specified T3412 value with VPMN(b).
Expected Results	MS1(a) successfully sends timers in Attach request and the response contains the same values in Attach Accept message.
MS Details (Manufacturer, Model, S/W version)	
MSISDN of MS1(a)	
IMSI of MS1(a)	
APN of MS1(a)	
Test Case Result (Pass/Fail)	
Date of Test	
Time of Test	
Signature of Tester(s)	
Comments	

6.5 eDRX Invalid Timer Value

Purpose	VPMN(b) will reject LTE Attach by MS1(a) due to invalid eDRX timer.
Preconditions	EPS subscription of MS1(a) is provisioned correctly (APNs, QCI, AMBR, etc.). MS1(a) does not have a current PDN connection. T3324 timer for MS1(a) is enabled and set outside the acceptable range(s) defined by 3GPP (3rd Generation Partnership Project) specifications.
Action	VPMN(b) rejects LTE Attach request by MS1(a).
Expected Results	MS1(a) successfully sends timers in Attach request and VPMN(b) rejects the Attach based on the T3324 value being outside of 3GPP specifications.
MS Details (Manufacturer, Model, S/W version)	
MSISDN of MS1(a)	
IMSI of MS1(a)	
APN of MS1(a)	
Test Case Result (Pass/Fail)	
Date of Test	
Time of Test	
Signature of Tester(s)	
Comments	

6.6 Exit eDRX Cycle

Purpose	MS1(a) will exit dormant state based on specified eDRX value and receive SMS (Short Message Service).
Preconditions	EPS subscription of MS1(a) is provisioned correctly (APNs, QCI, AMBR, etc.) MS1(a) does not have a current PDN connection T3324 and T3412-Ext timers are enabled and set. T3324=xx (incremented in multiples of 2 seconds) and T3412-Ext=xx (incremented in multiples of 30 seconds)
Action	An SMS is sent to MS1(a) during the T3412 cycle, but VPMN(b) does not page MS1(a) during the duration of the cycle.
Expected Results	VPMN(b) does not page MS1(a) to deliver the SMS until the device wakes up after the T3412 timer is reached.
MS Details (Manufacturer, Model, S/W version)	
MSISDN of MS1(a)	
IMSI of MS1(a)	
APN of MS1(a)	
Test Case Result (Pass/Fail)	
Date of Test	
Time of Test	
Signature of Tester(s)	
Comments	

7 Short Message Service MO/MT Testing

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

Purpose	To validate the MS1(a) is able to send an SMS with text to MSISDN(a)
Preconditions	MS1(a) is provisioned to send a mobile-originated SMS message containing text. MSISDN(a) is registered on the network and able to receive SMS/MO (Short Message Service Mobile Originated). SGs (or SGd) interface is used for SMS transmission. NOTE: When SMS over NAS is selected, SGs or SGd interface should be specified.
Action	MS1(a) sends an SMS/MO containing text to a MSISDN(a) MSISDN(a) confirms receipt of SMS/MO text from MS1(a)
Expected Results	Successful result if Short Message is correctly delivered within two (2) minutes of switching MSISDN(a) on.
MS1(a) Details (Manufacturer, Model, S/W version)	
SMS Protocol (e.g., SMS over NAS, SMS over IP)	
MSISDN of MS1(a)	
IMSI of MS1(a)	
SMSC of MS1(a)	
MSISDN(a)	
Test Case Result (Pass/Fail)	
Date of Test	
Time of Test	
Signature of Tester(s)	
Comments	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)

Purpose	To validate the MS1(a) is able to receive an SMS with text from MSISDN(a)
Preconditions	MS1(a) is provisioned to receive a mobile-originated SMS message containing text. MSISDN(a) is registered on the network and able to receive SMS/MT. SGs (or SGd) interface is used for SMS transmission. NOTE: When SMS over NAS is selected, SGs or SGd interface should be specified.
Action	MSISDN(a) sends an SMS/MO containing text to a MS1(a). MS1(a) confirms receipt of SMS/MT (Short Message Service Mobile Terminated) text from MSISDN(a).
Expected Results	Successful result if Short Message is correctly delivered within two (2) minutes of switching MS1(a) on.
MS1(a) Details (Manufacturer, Model, S/W version)	
SMS Protocol (e.g., SMS over NAS, SMS over IP)	
MSISDN of MS1(a)	
IMSI of MS1(a)	
SMSC of MSISDN(a)	
MSISDN(a)	
Test Case Result (Pass/Fail)	
Date of Test	
Time of Test	
Signature of Tester(s)	
Comments	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 MIoT test instances

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

LTE-M or NB-IoT
Control Plane CIoT EPS Optimisation (CP CIoT)
User Plane CIoT EPS Optimisation (UP CIoT)
Attach with or without PDN connection
S1-U data transfer (S1-U data) or S11-U data transfer (S11 -U data)
Data size
SMS transfer without or with Combined Attach
Header compression for Control Plane CIoT EPS Optimisation is supported (HC-CP CIoT)
TCP/IP (Transmission Control Protocol/Internet Protocol), UDP/IP (User Datagram Protocol/Internet Protocol) or non-IP
PSM and eDRX timers

Because of the nature of the home-routed MIoT roaming architecture, it is assumed that the MIoT platform is intermediated between the HPMN core network and the MIoT Application Server or co-located with HPMN Service Capability Server (SCS) in the trusted domain. The home MIoT 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 MIoT 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 MIoT Application Servers.

Instance Id	EPS optimization	Attach type	Data transfer type	Data size	IP / Non IP	Core interfaces	Core network elements	Header compression	PSM / eDRX
LTE M00	None	Attach with PDN	S1-U data		TCP/IP or UDP/IP	S1-U – S8	S-GW (VPMN) – P-GW (HPMN) – AS (HPMN)	Possible	
LTE M01	UP CIoT	Attach with PDN	S1-U data (Suspen		TCP/IP or UDP/I	S1-U – S8	S-GW (VPMN) – P-GW	Possible	

			d/ resume)		P		(HPMN) – AS (HPMN)		
LTE M02	UP CIoT	Attach with PDN	NIDD		Non-IP	S1-U – S8 – SGi (PtP tunnel)	S-GW (VPMN) – P-GW (HPMN) – AS (HPMN)	-	
LTE M03	UP CIoT	Attach with PDN	NIDD (Suspend/ resume		Non-IP	S1-U – S8 – SGi (PtP tunnel)	S-GW (VPMN) – P-GW (HPMN) – AS (HPMN)	-	
LTE M04	CP CIoT	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 CIoT	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.

Instance Id	EPS optimization	Attach type	Data transfer type	Data size	IP / Non IP	Core interfaces	Core network elements	Header compression	PSM / 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 CIoT	Attach with PDN	S1-U data (Suspend/ resume)		TCP/IP or UDP/IP	S1-U – S8	S-GW (VPMN) – P-GW (HPMN) – AS (HPMN)	Possible	
NB02	UP CIoT	Attach with PDN	NIDD		Non-IP	S1-U – S8 – SGi (PtP tunnel)	S-GW (VPMN) – P-GW (HPMN) – AS (HPMN)	-	
NB03	UP CIoT	Attach with PDN	NIDD (Suspend/ resume)		Non-IP	S1-U – S8 – SGi (PtP tunnel)	S-GW (VPMN) – P-GW (HPMN) – AS (HPMN)	-	
NB04	CP CIoT	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 CIoT	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 CIoT	Attach without PDN	SMS only (encapsulate in NAS transport message)		-	S1-MME - SGd – Tsms	MME (VPMN) – SMS-SC (HPMN) – SME (HPMN)	-	

Annex A Document Management

A.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 CR 1003 Implemented	GERI	Mark McGinley, AT&T

A.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

Your comments or suggestions & questions are always welcome.