GTI
NB-IoT Module Test Specification

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Contents

1 Scope

The NB-IoT test and certification solution includes chipset test, module test and terminal tests. Chipset tests utilize 3GPP conformance test to guarantee basic wireless function. Module tests covers key function and performance such as power consumption, RF performance and etc.. Terminal tests mainly focus on antenna OTA performance.

Module test specification is one of the NB-IoT series test specificaions. This document specifies the test content and test method for NB-IoT module, including interconnection testing, power consumption testing, RF performance testing and positioning testing.

For other test contents, such as device management test and eSIM test, please refer to the test specification released by corresponding standard organization.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

[1] 3GPP TS 24.008: "Mobile radio interface Layer 3 specification; Core network protocols; Stage 3".

[2] 3GPP TS 24.301: "Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3".

[3] 3GPP TS 36.304: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode".

[4] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol Specification".

[5] 3GPP TS 36.508: "Common test environments for User Equipment (UE) conformance testing".

3 Definitions, symbols and abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

Abbreviation	Definitions
AS	Application Service
C-IoT	Cellular Internet of Things
CoAP	Constrained Application Protocol
CP	Control Plane
eDRX	extended DRX
EPRE	Energy Per Resource Element

IPSO	IP for Smart Objects
LwM2M	Lightweight Machine To Machine
NB-IoT	Narrow Band Internet of Things
PSM	Power Saving Mode
RoHC	Robust Header Compression

4 Test Environment

4.1 Default Test Environment

A network system simulator is used to model the NB-IoT eNB and EPC. The default configuration of the simulator is described in "3GPP TS 36.508, 3GPP EUTRA and EPC Common Test Environments for User Equipment (UE) conformance Testing" which contains definitions of reference conditions, test signals, default parameters, reference radio bearer configurations, common requirements for test equipment and generic procedures.

4.1.1 Test Frequencies

NB-IoT system operates in HD-FDD duplex mode. The test frequencies are based on the E-UTRA frequency bands defined in the core specifications. The reference test frequencies for the tests in this specification of the operating bands are defined in following tables

Table 4-1: NB-IoT standalone Test frequencies for operating band 3

Test Frequency ID	N_{UL}	M_{UL}	Frequency of Uplink [MHz]	N_{DL}	M_{DL}	Frequency of Downlink [MHz]
f1	19201	0	1710.1	1201	-0.5	1805.1
f2	19575	0	1747.5	1575	-0.5	1842.5
f3	19949	0	1784.9	1949	-0.5	1879.9
NOTE 1: Applicable to either 3.75 kHz or 15 kHz NB-IoT UL subcarrier spacing						

Table 4-2: NB-IoT standalone Test frequencies for operating band 8

Test Frequency ID	N_{UL}	M_{UL}	Frequency of Uplink [MHz]	N_{DL}	M_{DL}	Frequency of Downlink [MHz]
f1	21451	0	880.1	3451	-0.5	925.1
f2	21625	0	897.5	3625	-0.5	942.5
f3	21799	0	914.9	3799	-0.5	959.9
NOTE 1: Applicable to either 3.75 kHz or 15 kHz NB-IoT UL subcarrier spacing						

4.1.2 USIM Parameters

Refer to clause 4.9 in 3GPP TS 36.508[5] except the following parameters.

Table 4-3: USIM Elementary File Parameters

No.	Elementary File	Parameter	Value
1	EF_{IMSI}	(IMSI)	460041234567890
2	$EF_{HPLMNwAcT}$	(HPLMN selector with Access Technology)	CMCC China (460, 04),
3	K	K Value of the USIM	000102030405060708090A0B0C0D0E0F
4	EF AD,	Byte 3 bit4	- b4=1: the ME is authorized to modify the polling interval and/or disable the UICC interface during extended DRX cycle.

4.2 Test System Architecture

4.2.1 Common Test System Architecture

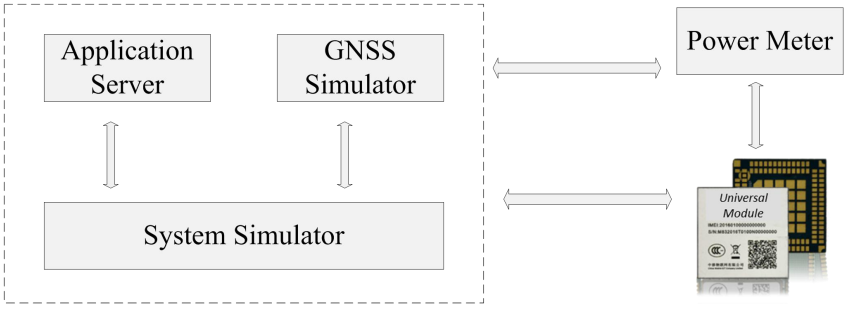

Figure 4-1 Common Test System Architecture

4.2.2 Test Architecture for Communication Suite

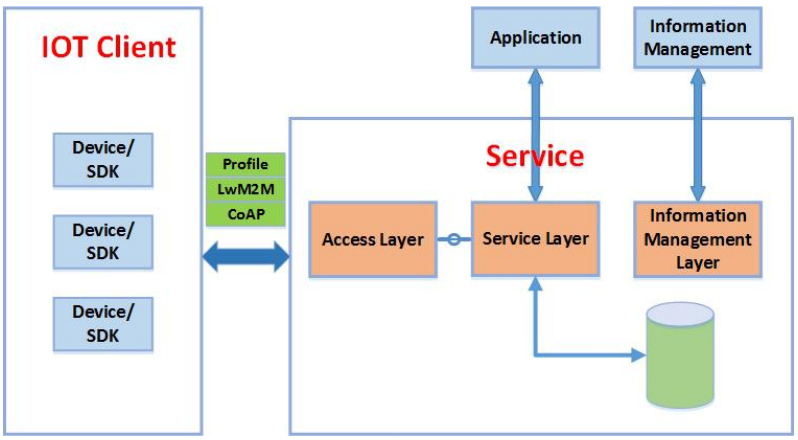

Figure 4-2 Test Architecture for Communication Suite

4.3 UE Configuration

In order to guarantee the test operability and accuracy, the module under test should provide following interfaces, control commands and optimization.

- External RF port to connect to test platform via RF cable
- External power supply interfaces to connect to power meter via power line
- The control commands includes Switch on, Switch off, Attach, Ping, UDP data transmission, NRSRP/NRSRP/SINR output and etc.
- If the module under test is embedded in assistant board, make sure the assistant board does not affect the module RF performance.
- If the module under test is embedded in assistant board, make sure the assistant board does not affect the power consumption performance

5 Connectivity

5.1 Basic Communication Procedure

5.1.1 Test Purpose

To verify that UE could camp on NB-IoT cell and complete the registration when switched on. Verify the end-to-end communication functions are well supported by UE, including NAS RoHC, NAS integraty and ciphering, APN rate control, etc.

5.1.2 Reference Specification

3GPP TS 24.301, TS 36.331

5.1.3 Test Applicability;

This test applies to NB-IoT modules

5.1.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-04[TBD]

Standalone Operation.
Test Frequency ID = f1

NB-IoT Uplink setting：
Channel Bandwidth = 200kHz
Number of Tones=1
Sub-carrier spacing=15kHz

NB-IoT Downlink setting：
Channel Bandwidth = 200kHz
Number of Tones=12
NRS EPRE = - 85dBm/15kHz (The power level is specified at the UE Rx antenna)

[Initial conditions]
System Simulator
- NB-IoT Cell A is active
- The test shall be performed under ideal radio conditions.

UE
- The UE is equipped with a USIM containing default values
- The UE is powered off

5.1.5 Test Procedure

PREAMBLE
1. Activate NB-IoT Cell A
2. Power on the UE

MAIN BODY
3. The UE performs registration. Steps (1) to (13) of the registration procedure described in Table 5-1 are performed on Cell A. Check the points listed in Table 5-1.
4. Trigger uplink UDP data transmission. UE and SS transmission of user data via the control plane. Test steps described in Table 5-2 are performed on Cell A. Check the points listed in Table 5-2.
5. Trigger downlink UDP data transmission. UE and SS transmission of user data via the control plane. Test steps described in Table 5-3 are performed on Cell A. Check the points listed in Table 5-3
6. SS sends MODIFY EPS BEARER CONTEXT REQUEST to setup APN data rate control. “APN rate control parameters(0016H)” is included in PCO. In APN rate control parameters container, the AER is set to “Additional exception reports at maximum rate reached are not allowed”, the Uplink Time Unit is set to “minute (001B)”(1 message per minute) and the Maximum uplink rate is set to 256 Octets.
7. Verify UE transmits MODIFY EPS BEARER CONTEXT ACCEPT.

8. Trigger successive uplink UDP data transmission. The data generation interval is 30s and the data size is 256 octets
9. Verify that UE transmits ESM DATA TRANSPORT message containing user data with 256 octets.
10. SS starts 1 minute timer.Waits until timer expires. Verify that UE hasn't send any more user data during timer running.
11. Stop uplink UDP data generation.
12. Trigger successive uplink UDP data transmission. The data generation interval is 1minute and the data size is 512 octets
13. Verify that UE transmits ESM DATA TRANSPORT message containing user data with 256 octets.
14. SS starts 1 minute timer.Waits until timer expires. Verify that UE hasn't send any more user data during timer running.
15. Stop uplink UDP data generation .
16. The SS sends DETACH REQUEST to initiate Detach procedure.
17. UE transmits DETACH ACCEPT
18. The SS transmits an RRCConnectionRelease-NB message

POSTAMBLE

19. Deactive NB-IoT Cell A

Table 5-1: Message Sequence in Step3

Step	U - S	Message Sequence	Check Points/SS configuration
(1)	-->	RRC: *RRCConnectionRequest-NB*	
(2)	<--	RRC: *RRCConnectionSetup-NB*	
(3)	-->	RRC: *RRCConnectionSetupComplete-NB* NAS: ATTACH REQUEST NAS: PDN CONNECTIVITY REQUEST	**Check points:** ***RRCConnectionSetupComplete*** 1. "attachWithoutPDN-Connectivity-r13" in RRCConnectionSetupComplete is not present ***ATTACH REQUEST*** 2."Control plane CIoT EPS optimization" is set to "supported" in Attach Request 3. " Preferred CIoT network behaviour (PNB-CIoT)" is set to "control plane CIoT EPS optimization ('01'B)" 3."EMM-REGISTED without PDN connection" is set to "supported" in Attach Request 4." Header compression for control plane CIoT EPS optimization" is set to "supported" in Attach Request 5. "Security header type" in ATTACH REQUEST is set to "Integrity protected and ciphered (0010)"

			6. The ciphering algorithm "EEA0","EEA1","EEA2" and "EEA3" are included in the IE of "UE network capability" 7.The integrity protection algorithm "EIA1","EIA2" and "EIA3" are included in the IE of "UE network capability" ***PDN CONNECTIVITY REQUEST*** 8. "Access point name" is not present 9. The "PDN Type" in PDN CONNECTIVITY REQUEST is set to "IPv4v6". 10." 0010H (IPv4 Link MTU Request)" and " 0015H (Non-IP Link MTU Request)" is included in PCO 8." 0016H (APN rate control support indicator)" is included in PCO 11. "Header compression configuration" is set to "RoHC profile 0x0002 (UDP/IP) is supported"
(4)	<--	RRC: *DLInformationTransfer-NB* NAS: AUTHENTICATION REQUEST	
(5)	-->	RRC: *ULInformationTransfer-NB* NAS: AUTHENTICATION RESPONSE	
(6)	<--	RRC: *DLInformationTransfer-NB* NAS: SECURITY MODE COMMAND	**SS configuration:** NAS security algorithms are selected as: "Type of integrity protection algorithm" is "001" (EPS integrity algorithm 128-EIA1 (SNOW 3G)) "Type of ciphering algorithm" is "001" (EPS encryption algorithm 128-EEA1 (SNOW3G))
(7)	-->	RRC: *ULInformationTransfer-NB* NAS: SECURITY MODE COMPLETE	**Check Point:** Check that UE transmit a SECURITY MODE COMPLETE message ciphered and starts applying ciphering and the NAS Integrity protection in both UL and DL
(8)	<--	*Optional* RRC: *DLInformationTransfer-NB* NAS: ESM INFORMATION REQUEST	**Note:** If UE sets the ESM information transfer flag in PDN CONNECTIVITY REQUEST
(9)	-->	*Optional* RRC: *ULInformationTransfer-NB*	

		NAS: ESM INFORMATION RESPONSE	
(10)	<--	RRC: *UECapabilityEnquiry-NB*	
(11)	-->	RRC: *UECapabilityInformation-NB*	**Check points:** 1. If UE supports User Plane, check that UE reports the capability of RoHC 2. MultiTone
(12)	<--	RRC: *DLInformationTransfer-NB* NAS: ATTACH ACCEPT NAS: ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST	**SS Configuration:** The following IEs are indicated in ATTACH ACCEPT 1. “EMM-REGISTERED without PDN connection supported” 2. “Control plane CIoT EPS optimization supported” 3.” User plane CIoT EPS optimization not supported” 3. “Header compression for control plane CIoT EPS optimization supported” 4. “control plane CIoT EPS optimization accepted” 5.” user plane EPS optimization not accepted” ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST 1. “Serving PLMN rate control” is set to “unrestricted (FFFFH)”
(13)	-->	RRC: *ULInformationTransfer-NB* NAS: ATTACH COMPLETE NAS: ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT	

Table 5-2: Message Sequence in Step4

Step	U - S	Message Sequence	Check Points/SS configuration
(1)	-->	RRC: ULInformationTransfer-NB NAS: CONTROL PLANE SERVICE REQUEST NAS: ESM DATA TRANSPORT	
(2)	<--	RRC: DLInformationTransfer-NB NAS: SERVICE ACCEPT NAS: ESM DATA TRANSPORT	**NOTE:** IP ACK
(3)	<--	RRC: RRCConnectionRelease-NB	

Table 5-3: Message Sequence in Step5

Step	U - S	Message Sequence	Check Points/SS configuration
(1)	<--	RRC: *Paging-NB*	
(2)	-->	RRC: RRCConnectionRequest-NB	
(3)	<--	RRC: RRCConnectionSetup-NB	
(4)	-->	RRC: *RRCConnectionSetupComplete-NB* NAS: CONTROL PLANE SERVICE REQUEST NAS: ESM DATA TRANSPORT	
(5)	<--	RRC: DLInformationTransfer-NB NAS: SERVICE ACCEPT NAS: ESM DATA TRANSPORT	NOTE: IP ACK

5.1.6 Expected Result

In Step 3, UE could complete the registration procedure. UE supports RoHC compression /de-compression, NAS integrity and cipher/decipher

In Step 4, UE supports uplink control plane data transmission.

In Step 5, UE supports donwlink control plane data transmission.

In Step 6-15, UE supports APN data rate control.

5.2 Communication Suite

5.2.1 Test Purpose

The purpose of standard communication suite is to unified upper layer interfaces, including transport layer and application layer, for MIoT devices to communicate with service platform

This test case is to verify that the implementation of communication suite in UE is conformance with the requirements in < The Technical Solution for NB-IOT Service Layer> and <The Communication Protocol and Format between Device and OneNET >

5.2.2 Reference Specification

< The Technical Solution for NB-IOT Service Layer>

<The Communication Protocol and Format between Device and OneNET >

5.2.3 Test Applicability;

This test applies to NB-IoT modules supporting communication suite defined in CMCC specification

5.2.4 Test Conditions

[SS configuration]

NB-IoT Cell A

Cell Id=01 TAC = 01

MCC-MNC = 460-04[TBD]

Standalone Operation.

Test Frequency ID = f1

NRS EPRE = - 85dBm/15kHz

[Initial conditions]

System Simulator

- NB-IoT Cell A is active
- The test shall be performed under ideal radio conditions.

UE

- The UE is equipped with a USIM containing default values
- The UE is powered off

5.2.5 Test Procedure

PREAMBLE

1. Activate NB-IoT Cell A
2. Power on the UE

MAIN BODY

3. The UE performs registration. Steps (1) to (13) of the registration procedure described in Table 5-1 are performed on Cell A.
4. UE sends Register Request with configured information to register to OneNET server.
5. OneNET server responses with Register Response.
6. UE sends Online Request with token to OneNET server.
7. Server responses with Online response.
8. Server sends "AP request (read)" to UE in order to request data report.
9. UE sends "AP response" with required data and token to server.
10. Server sends "Response confirm"
11. Server sends "AP request (write)" to UE.
12. UE sends "AP response" with required data and token to server.
13. Server sends "Response confirm"
14. Server sends "AP request (Exec)" to UE.
15. UE sends "AP response" with required data and token to server.
16. Server sends "Response confirm"
17. Server sends "AP request (Observe)" to UE.
18. UE sends "AP response" with required data and token to server.

19. Server sends "Response confirm"
20. UE un-registers

POSTAMBLE

21. Deactive NB-IoT Cell A

5.2.6 Expected Result

UE could support the communication suite, communication protocol and interface.

6 Throughput and RF performance

6.1 UL Service in Enhanced Coverage/Throughput/TX RF performance

6.1.1 Test Purpose

Test and measure the uplink throughput in normal coverage and extreme corverage. During data transmission, verify that UE support the NAS security with AES algorithm under CP.

To verify that the error of the UE maximum output power does not exceed the range prescribed by the specified nominal maximum output power and tolerance.

6.1.2 Reference Specification

3GPP TS 24.301, TS 36.331, TS 36.101

6.1.3 Test Applicability;

This test applies to NB-IoT modules

6.1.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-04[TBD]
Standalone Operation.
Test Frequency ID = f1

NB-IoT Uplink setting：
Channel Bandwidth = 200kHz

Number of Tones=1
Sub-carrier spacing=15kHz

NB-IoT Downlink setting:
Channel Bandwidth = 200kHz
Number of Tones=12

[Initial conditions]
System Simulator
- NB-IoT Cell A is active
- The test shall be performed under EVA 5Hz fading channel.
- Connect the SS to the UE antenna connectors as shown in TS 36.508[7] Annex A Figure A.3 using only the main UE Tx/Rx antenna.

UE
- The UE is equipped with a USIM containing default values
- The UE is powered off

6.1.5 Test Procedure

Table 6-1: Time of cell power level and parameter changes

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-88	MCL 120
T1			-112	MCL 144
T3			-132	MCL 164

PREAMBLE
1. Activate NB-IoT Cell A. 2. Set the Downlink signal level to the NRS EPRE value defined in Table 6-1 Time T0.
2. Power on the UE

MAIN BODY
3. The UE performs registration. Refer to Steps (1) to (13) described in Table 5-1, with the exception that “Type of integrity protection algorithm” is set to “010”(AES) and “Type of ciphering algorithm” is set to “010”(AES) in SECURITY MODE COMMAND in step (6).
4. Trigger uplink UDP data transmission. UE and SS transmission of user data via the control plane. Refer to test steps described in Table 5-2.
5. Test and Measure the average uplink throughput at UDP layer for 5 minutes. Record the throughput test results as TH1.
6. Stop uplink data transmission. SS release RRC CONNECTION.
7. Decrease downlink signal level of Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 6-1 Time T1
8. Trigger uplink UDP data transmission. UE and SS transmission of user data via the control plane. Refer to test steps described in Table 5-2.

9. Test and Measure the average uplink throughput at UDP layer for 5 minutes. Record the throughput test results as TH2.
10. Stop uplink data transmission. SS release RRC CONNECTION.
11. Decrease downlink signal level of Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 6-1 Time T2
12. Trigger uplink UDP data transmission. UE and SS transmission of user data via the control plane. Refer to test steps described in Table 5-2.
13. Test and Measure the average uplink throughput at UDP layer for 5 minutes. Record the throughput test results as TH3.
14. Measure the maximumtransmit power of the UE in the channel bandwidth of the radio access mode.
15. Stop uplink data transmission.
16. The SS sends DETACH REQUEST to initiate Detach procedure.
17. UE transmits DETACH ACCEPT
18. The SS transmits an RRCConnectionRelease-NB message

POSTAMBLE

19. Deactive NB-IoT Cell A

6.1.6 Expected Result

The average uplink throughput at the UDP layer shall meet or exceed the expected value and tolerance in Table 6-2.

Table 6-2: Requirment for throughput

Test Results	Expected Value	Tolerance
TH1	TBD	TBD
TH2	TBD	TBD
TH3	TBD	TBD

In step 14, the maximum output power shall be within the range prescribed by the nominal maximum output power and tolerance in Table 6-3.

Table 6-3: Requirment for maximum output power

EUTRA band	Class 3 (dBm)	Tolerance (dB)
3	23	±2.7
8	23	±2.7

6.2 DL Service in Enhanced Coverage/Throughput/RX RF performance

6.2.1 Test Purpose

Test and measure the downlink throughput in normal coverage and extreme corverage. During data transmission, verify that UE support the NAS security with ZUC algorithm under CP.

To verify RF extreme sensitivity in normal coverage and extreme coverage. A UE unable to meet the throughput requirement under these conditions will decrease the effective coverage area of an e-NodeB.

6.2.2 Reference Specification

3GPP TS 24.301, TS 36.331, TS 36.101

6.2.3 Test Applicability

This test applies to NB-IoT modules

6.2.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-04[TBD]
Standalone Operation.
Test Frequency ID = f1

NB-IoT Uplink setting：
Channel Bandwidth = 200kHz
Number of Tones=1
Sub-carrier spacing=15kHz

NB-IoT Downlink setting：
Channel Bandwidth = 200kHz
Number of Tones=12

[Initial conditions]
System Simulator
- NB-IoT Cell A is active
- The test shall be performed under EVA 5Hz fading channel.
- Connect the SS to the UE antenna connectors as shown in TS 36.508[7] Annex A Figure A.3 using only the main UE Tx/Rx antenna.

UE
- The UE is equipped with a USIM containing default values
- The UE is powered off

6.2.5 Test Procedure

Table 6-4: Time of cell power level and parameter changes

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-88	MCL 120
T1			-112	MCL 144
T3			-132	MCL 164
T4			-128	

PREAMBLE

1. Activate NB-IoT Cell A. 2. Set the Downlink signal level to the NRS EPRE value defined in Table 6-4 Time T0.
2. Power on the UE

MAIN BODY

3. The UE performs registration. Refer to Steps (1) to (13) described in Table 5-1, with the exception that “Type of integrity protection algorithm” is set to “011”(ZUC) and “Type of ciphering algorithm” is set to “011”(ZUC) in SECURITY MODE COMMAND in step (6).
4. Trigger downlink UDP data transmission. UE and SS transmission of user data via the control plane. Refer to test steps described in Table 5-3.
5. Test and Measure the average downlink throughput at UDP layer for 5 minutes. Record the throughput test results as TH1.
6. Stop downlink data transmission. SS release RRC CONNECTION.
7. Decrease downlink signal level of Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 6-4 Time T1
8. Trigger downlink UDP data transmission. UE and SS transmission of user data via the control plane. Refer to test steps described in Table 5-3.
9. Test and Measure the average downlink throughput at UDP layer for 5 minutes. Record the throughput test results as TH2.
10. Stop downlink data transmission. SS release RRC CONNECTION.
11. Decrease downlink signal level of Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 6-4 Time T2
12. Trigger downlink UDP data transmission. UE and SS transmission of user data via the control plane. Refer to test steps described in Table 5-3.
13. Test and Measure the average downlink throughput at UDP layer for 5 minutes. Record the throughput test results as TH3.
14. Stop downlink data transmission. SS release RRC CONNECTION.
15. SS configure NPDCCH, NPDSCH and DCI to it’s maximum repetition transmission level.
16. Adjust downlink signal level of Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 6-4 Time T4.
17. SS decrease downlink signal level from -128dBm/15kHz with 1dB step and in every power level measure the downlink throughput at UDP layer for 3 minutes.
    1) If the average throughput is higher than 95% of TH1 then continue the test until the throughput becomes lower than 95% of TH1 then go to step 18.

2) If the average throughput becomes lower than 95% of TH1 then go to step 18.

18. Increase the downlink signal level with 0.5dB and measure the througthput for 3 minutes. If the throughput becomes higher than 95% of TH1 then record this power level as P1, if not then record the power level minus 0.5dB as P1.
19. SS stop downlink data transmission. SS release RRC CONNECTION.
20. The SS sends DETACH REQUEST to initiate Detach procedure.
21. UE transmits DETACH ACCEPT
22. The SS transmits an RRCConnectionRelease-NB message

POSTAMBLE

23. Deactive NB-IoT Cell A

6.2.6 Expected Result

The average downlink throughput at the UDP layer shall meet or exceed the expected value and tolerance in Table 6-5.

Table 6-5: Throughput Requirement

Test Results		Expected Value	Tolerance
TH1		TBD	TBD
TH2		TBD	TBD
TH3		TBD	TBD

Note: The NB-IoT UE throughput shall be ≥ 95% of the maximum throughput

The downlink signal power P1 in step 17 shall meet the expected value and tolerance in Table 6-6.

Table 6-6: Throughput Requirement

Test Result		Expected Value	Tolerance
P1		TBD	TBD

6.3 NRSRP/NRSRQ/SINR measurement under no interference environment

6.3.1 Test Purpose

The purpose of this test is to verify that the NRSRP, NRSRQ and SINR measurement accuracy is within the specified limits.

6.3.2 Reference Specification

3GPP TS 36.133

6.3.3 Test Applicability

This test applies to NB-IoT modules.

6.3.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-04 [TBD]
Standalone Operation.
Test Frequency ID = f1

NB-IoT Uplink setting：
Channel Bandwidth = 200kHz
Number of Tones=1
Sub-carrier spacing=15kHz

NB-IoT Downlink setting：
Channel Bandwidth = 200kHz
Number of Tones=12
NRS EPRE = - 88dBm/15kHz (The power level is specified at the UE Rx antenna)

[Initial conditions]
System Simulator
- NB-IoT Cell A is active
- The test shall be performed under ideal radio conditions.

UE
- The UE is equipped with a USIM containing default values
- The UE is powered off

6.3.5 Test Procedure

Table 6-7: Time of cell power level and parameter changes

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-88	
T1			-112	
T2			-132	

PREAMBLE
1. Activate NB-IoT Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 6-7 Time T0.

2. Power on the UE

MAIN BODY

3. The UE performs registration. Refer to Steps (1) to (13) described in Table 5-1.
4. Trigger UE to measure the NRSRP, NRSRQ and SINR for 5 minutes. UE record the measurement results.
5. Change the downlink signal level to the NRS EPRE value defined in Table 6-7 Time T1;
6. Trigger UE to measure the NRSRP, NRSRQ and SINR for 5 minutes. UE record the measurement results.
7. Change the downlink signal level to the NRS EPRE value defined in Table 6-7 Time T2;
8. Trigger UE measure the NRSRP, NRSRQ and SINR for 5 minutes. UE record the measurement results.
9. The SS sends DETACH REQUEST to initiate Detach procedure.
10. UE transmits DETACH ACCEPT
11. The SS transmits an RRCConnectionRelease-NB message

POSTAMBLE

12. Deactive NB-IoT Cell A

6.3.6 Expected Result

The average RSRP measurement results should be within the limits in Table 6-5.

Table 6-8: NRSRP measurement accuracy requirements

Test Results		Expected Value	Tolerance
T0		-88	±TBD
T1		-112	±TBD
T2		-132	±TBD

6.4 NRSRP/NRSRQ/SINR measurement under AWGN environment

6.4.1 Test Purpose

The purpose of this test is to verify that the NRSRP, NRSRQ and SINR measurement accuracy under AWGN is within the specified limits.

6.4.2 Reference Specification

3GPP TS 36.133

6.4.3 Test Applicability

This test applies to NB-IoT modules.

6.4.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-04 [TBD]
Standalone Operation.
Test Frequency ID = f1

NB-IoT Uplink setting：
Channel Bandwidth = 200kHz
Number of Tones=1
Sub-carrier spacing=15kHz

NB-IoT Downlink setting：
Channel Bandwidth = 200kHz
Number of Tones=12
NRS EPRE = - 88dBm/15kHz (The power level is specified at the UE Rx antenna)

[Initial conditions]
System Simulator
- NB-IoT Cell A is active
- The test shall be performed under ideal radio conditions.

UE
- The UE is equipped with a USIM containing default values
- The UE is powered off

6.4.5 Test Procedure

Table 6-9: Time of cell power level and parameter changes

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-88	
T1			-112	
T2			-132	

PREAMBLE
1. Activate NB-IoT Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 6-9 Time T0.

2. Power on the UE

MAIN BODY

3. The UE performs registration. Refer to Steps (1) to (13) described in Table 5-1.
4. Add AWGN noise to the downlink signal and make the SINR to be 5dB. Trigger UE to measure the NRSRP, NRSRQ and SINR for 5 minutes. UE record the measurement results.
5. Increase AWGN noise to make SINR to 0dB and -5dB. In every SINR value. Trigger UE to measure the NRSRP, NRSRQ and SINR for 5 minutes. UE record the measurement results.
6. Change the downlink signal level to the NRS EPRE value defined in Table 6-9 Time T1; Repeat step 4 to 5.
7. Change the downlink signal level to the NRS EPRE value defined in Table 6-9 Time T2; Repeat step 4 to 5.
8. The SS sends DETACH REQUEST to initiate Detach procedure.
9. UE transmits DETACH ACCEPT
10. The SS transmits an RRCConnectionRelease-NB message

POSTAMBLE

11. Deactive NB-IoT Cell A

6.4.6 Expected Result

The average RSRP measurement results should be within the limits in Table 6-10.

Table 6-10: NRSRP measurement accuracy requirements

Test Results		Expected Value	Tolerance
T0		-88	±TBD
T1		-112	±TBD
T2		-132	±TBD

The average RSRP measurement results should be within the limits in Table 6-11.

Table 6-11: SINR measurement accuracy requirements

Test Results		Expected Value	Tolerance
T0		5dB	±TBD
T1		0dB	±TBD
T2		-5dB	±TBD

6.5 NRSRP/NRSRQ/SINR measurement under neighbor cell interference environment

6.5.1 Test Purpose

The purpose of this test is to verify that the NRSRP, NRSRQ and SINR measurement accuracy is within the specified limits.

6.5.2 Reference Specification

3GPP TS 36.133

6.5.3 Test Applicability

This test applies to NB-IoT modules.

6.5.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-04 [TBD]
Standalone Operation.
Test Frequency ID = f1

NB-IoT Uplink setting：
Channel Bandwidth = 200kHz
Number of Tones=1
Sub-carrier spacing=15kHz

NB-IoT Downlink setting：
Channel Bandwidth = 200kHz
Number of Tones=12
NRS EPRE = - 88dBm/15kHz (The power level is specified at the UE Rx antenna)

[Initial conditions]
System Simulator
- NB-IoT Cell A is active
- NB-IoT neighbout Cell B with same frequency is inactive
- The test shall be performed under ideal radio conditions.

UE

- The UE is equipped with a USIM containing default values
- The UE is powered off

6.5.5 Test Procedure

Table 6-12: Time of cell power level and parameter changes

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-88	
T1			-112	
T2			-132	

PREAMBLE

1. Activate NB-IoT Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 6-12 Time T0.
2. Power on the UE

MAIN BODY

3. The UE performs registration. Refer to Steps (1) to (13) described in Table 5-1.
4. Activate Cell B, add its signal to the downlink signal and make the SINR to be 5dB. Trigger UE to measure the NRSRP, NRSRQ and SINR for 5 minutes. UE record the measurement results.
5. Increase Cell B signal to make SINR to be 0dB and -5dB. In every SINR value repeat step 4. Trigger UE to measure the NRSRP, NRSRQ and SINR for 5 minutes. UE record the measurement results
6. Change the downlink signal level to the NRS EPRE value defined in Table 6-12 Time T1; Repeat step 4 to 5.
7. Change the downlink signal level to the NRS EPRE value defined in Table 6-12 Time T2; Repeat step 4 to 5.
8. The SS sends DETACH REQUEST to initiate Detach procedure.
9. UE transmits DETACH ACCEPT
10. The SS transmits an RRCConnectionRelease-NB message

POSTAMBLE

11. Deactive NB-IoT Cell A

6.5.6 Expected Result

The average RSRP measurement results should be within the limits in Table 6-13.

Table 6-13: NRSRP measurement accuracy requirements

Test Results		Expected Value	Tolerance
T0		-88	±TBD
T1		-112	±TBD

T2		-132	±TBD

The average RSRP measurement results should be within the limits in Table 6-14

Table 6-14: SINR measurement accuracy requirements

Test Results		Expected Value	Tolerance
T0		5dB	±TBD
T1		0dB	±TBD
T2		-5dB	±TBD

7 Power Consumption

7.1 Power Consumption in Idle State/PSM

7.1.1 Test Purpose

To verify UE could support the use of PSM. To measure the average current when UE is in idle state and in PSM.

7.1.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.1.3 Test Applicability;

This test applies to NB-IoT modules

7.1.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-04[TBD]
Standalone Operation.
Test Frequency ID = f1

NB-IoT Uplink setting：
Channel Bandwidth = 200kHz
Number of Tones=1
Sub-carrier spacing=15kHz

NB-IoT Downlink setting:

Channel Bandwidth = 200kHz

Number of Tones=12

NRS EPRE = - 85dBm/15kHz (The power level is specified at the UE Rx antenna)

[Initial conditions]

System Simulator

- NB-IoT Cell A is active
- The test shall be performed under ideal radio conditions.
- PSM is enabled. eDRX is disabled

UE

- The UE is equipped with a USIM containing default values
- The UE is powered off
- The UE is equipped with fake battery and connected to the power consumption tester via power line.

7.1.5 Test Procedure

PREAMBLE

1. Activate NB-IoT Cell A. The default paging cycle in SIB2 is set to 2.56s. Refer to Table 7-1
2. Set the output voltage of power consumption tester the same as UE nominal voltage.
3. Switch on power consumption tester and power on the UE.

MAIN BODY

4. The UE transmits RRCConnectionRequest-NB to perform registration. SS transmits RRCConnectionSetup-NB.
5. UE transmits an RRCConnectionSetupComplete-NB message containing an ATTACH REQUEST and a PDN CONNECTIVITY REQUEST. Verify that UE request PSM by including IE “T3324 value” in ATTACH REQUEST.
6. Steps (4) to (9) of the registration procedure described in Table 5-1 are performed on Cell A.
7. SS tranmits an ATTACH ACCEPT message and an ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message. The IE “Extended DRX parameters” and IE “T3324 value” are not included in ATTACH ACCEPT. The periodic tracking area update timer “T3412 value” in ATTACH ACCEPT is set to 6 minutes.
8. UE transmits an ATTACH COMPLETE message and an ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT message.
9. The SS transmits an RRCConnectionRelease-NB message.UE enters into RRC_IDLE state.
10. Start power consumption measurement. Measure the average current when UE is in RRC_IDLE state for 5 minutes.
11. Stop power consumption measurement. Get the average current value from power consumption tester and record it as Current1.

12. Verify UE transmits TRACKING AREA UPDATE REQUEST after the expiry of T3412 timer. Verify that UE request PSM by including IE “T3324 value” in TRACKING AREA UPDATE REQUEST.
13. SS transmits TRACKING AREA UPDATE ACCEPT. The IE “Extended DRX parameters” is not included in the message. The IE “T3324 value” is included and set to 30s to activate PSM.
14. The SS transmits an RRCConnectionRelease-NB message.
15. Start power consumption measurement. Measure the average current when UE is in RRC_IDLE state(The T3324 timer is running). Verify that UE enters PSM after the expiry of T3324 (The current drain in PSM should be several orders of magnitude lower than the one in idle mode). Measure the average current when UE is in PSM.
16. Stop power consumption measurement. Get the average current value when T3324 timer running and record it as Current2. Get the average current value when UE is in PSM and record it as Current3.
17. Verify UE transmits TRACKING AREA UPDATE REQUEST after the expiry of T3312 timer.
18. The SS sends DETACH REQUEST to initiate Detach procedure.
19. UE transmits DETACH ACCEPT
20. The SS transmits an RRCConnectionRelease-NB message

POSTAMBLE

21. Deactive NB-IoT Cell A

Table 7-1: PCCH configuration in SystemInformationBlockType2-NB

Information Element	Value	Comment
RadioResourceConfigCommonSIB-NB-DEFAULT ::= SEQUENCE {		
bcch-Config-r13 SEQUENCE {		
modificationPeriodCoeff-r13	n16	
}		
pcch-Config-r13 SEQUENCE {		
defaultPagingCycle-r13	rf256	
}		
}		

7.1.6 Expected Result

In step 5, UE could request the activation of PSM via ATTACH ACCEPT. In step 7, UE could follow the network configuration thus the eDRX and PSM are not activated.

In step 12, UE could request the activation of PSM via TRACKING AREA UPDATE REQUEST. In step 16, UE could follow the network configuration and the PSM is activated.

In step 17, UE could wake up from PSM and transmit TRACKING AREA UPDATE REQUEST when T3412 timer expires.

Record the average current in Table 7-2. The power consumption performance in Idle state shall meet the requirements in Table 7-2.

Table 7-2: Power Consumption Requirements

Voltage (V)	Test Results (mA)		Expected Value(mA)
	CURRENT1		TBD
	CURRENT2		TBD
	CURRENT3		TBD

7.2 Power Consumption in Idle State with eDRX

7.2.1 Test Purpose

To verify UE could support the use of eDRX. To measure the average current when UE is in idle state with different eDRX cycle.

7.2.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.2.3 Test Applicability;

This test applies to NB-IoT modules

7.2.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-04[TBD]
Standalone Operation.
Test Frequency ID = f1

NB-IoT Uplink setting：
Channel Bandwidth = 200kHz
Number of Tones=1
Sub-carrier spacing=15kHz

NB-IoT Downlink setting：
Channel Bandwidth = 200kHz
Number of Tones=12
NRS EPRE = - 85dBm/15kHz (The power level is specified at the UE Rx antenna)

[Initial conditions]

System Simulator

- NB-IoT Cell A is active
- The test shall be performed under ideal radio conditions.
- PSM is disabled. eDRX is enabled

UE

- The UE is equipped with a USIM containing default values
- The UE is powered off
- The UE is equipped with fake battery and connected to the power consumption tester via power line.

7.2.5 Test Procedure

PREAMBLE

1. Activate NB-IoT Cell A. The default paging cycle in SIB2 is set to 2.56s. Refer to Table 7-3
2. Set the output voltage of power consumption tester the same as UE nominal voltage.
3. Switch on power consumption tester and power on the UE.

MAIN BODY

4. The UE transmits RRCConnectionRequest-NB to perform registration. SS transmits RRCConnectionSetup-NB.
5. UE transmits an RRCConnectionSetupComplete-NB message containing an ATTACH REQUEST and a PDN CONNECTIVITY REQUEST. Verify that UE request Idle-mode eDRX by including IE “extended DRX parameters” in ATTACH REQUEST.
6. Steps (4) to (9) of the registration procedure described in Table 5-1 are performed on Cell A.
7. SS tranmits an ATTACH ACCEPT message and an ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message. The IE “T3324 value” is not included in the message. The IE “Extended DRX parameters” is included to activate eDRX. The “Paging Time Window” is set to 5.12s and the “eDRX value” is set to 20.48s. The periodic tracking area update timer “T3412 value” is set to 3 minutes.
8. UE transmits an ATTACH COMPLETE message and an ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT message.
9. The SS transmits an RRCConnectionRelease-NB message.UE enters into RRC_IDLE state.
10. Start power consumption measurement. Measure the average current when UE is in RRC_IDLE with 20.48s eDRX cycle.
11. Verify UE transmits TRACKING AREA UPDATE REQUEST after the expiry of T3412 timer. Verify that UE request Idle-mode eDRX by including IE “extended DRX parameters” in TRACKING AREA UPDATE REQUEST.
12. SS transmits TRACKING AREA UPDATE ACCEPT. The IE “Extended DRX parameters” is included. The “Paging Time Window” is set to 5.12s and the “eDRX value” is set to 122.88s(about 2 min). The periodic tracking area update timer “T3412 value” is set to 6 minutes.

13. The SS transmits an RRCConnectionRelease-NB message.UE enters into RRC_IDLE state with 122.88s eDRX cycle.
14. Measure the average current when UE is in RRC_IDLE state with eDRX for 122.88s.
15. Verify UE transmits TRACKING AREA UPDATE REQUEST after the expiry of T3412 timer. Verify that UE request Idle-mode eDRX by including IE “extended DRX parameters” in TRACKING AREA UPDATE REQUEST.
16. SS transmits TRACKING AREA UPDATE ACCEPT. The IE “Extended DRX parameters” is included. The “Paging Time Window” is set to 5.12s and the “eDRX value” is set to 655.36s (about 10min). The periodic tracking area update timer “T3412 value” is set to 30 minutes.
17. The SS transmits an RRCConnectionRelease-NB message.UE enters into RRC_IDLE state with 655.36s eDRX cycle.
18. Measure the average current when UE is in RRC_IDLE state with 655.36s eDRX cycle.
19. Verify UE transmits TRACKING AREA UPDATE REQUEST after the expiry of T3412 timer
20. Stop power consumption measurement. Get the average current value when UE is in RRC_IDLE with eDRX cycle 30s, 2min and 10min. Record the test results as Current30s, Current2min and Current10min respectively.
21. The SS sends DETACH REQUEST to initiate Detach procedure.
22. UE transmits DETACH ACCEPT
23. The SS transmits an RRCConnectionRelease-NB message

POSTAMBLE

24. Deactive NB-IoT Cell A

Table 7-3: PCCH configuration in SystemInformationBlockType2-NB

Information Element	Value	Comment
RadioResourceConfigCommonSIB-NB-DEFAULT ::= SEQUENCE {		
bcch-Config-r13 SEQUENCE {		
modificationPeriodCoeff-r13	n16	
}		
pcch-Config-r13 SEQUENCE {		
defaultPagingCycle-r13	rf256	
}		
}		

7.2.6 Expected Result

Record the average current in Table 7-4. The power consumption performance in Idle state shall meet the requirements in Table 7-4.

Table 7-4: Power Consumption Requirements

Voltage (V)	Test Results (mA)		Expected Value(mA)
	CURRENT30s		TBD

	CURRENT2min		TBD
	CURRENT10min		TBD

7.3 UL Aperiodic Service with PSM / Power Consumption

7.3.1 Test Purpose

To verify UE could well handle the aperiodic UL service and PSM. UE could well support PSM function, including PSM request during Attach, PSM activation and PSM de-activation

To measure the power consumption of UL service in different coverage.

7.3.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.3.3 Test Applicability;

This test applies to NB-IoT modules

7.3.4 Test Conditions

[SS configuration]

NB-IoT Cell A

Cell Id=01 TAC = 01

MCC-MNC = 460-04[TBD]

Standalone Operation.

Test Frequency ID = f1

NB-IoT Uplink setting：

Channel Bandwidth = 200kHz

Number of Tones=1

Sub-carrier spacing=15kHz

NB-IoT Downlink setting：

Channel Bandwidth = 200kHz

Number of Tones=12

[Initial conditions]

System Simulator

- NB-IoT Cell A is active
- The test shall be performed under ideal radio conditions.
- PSM is enabled. eDRX is disabled

UE

- The UE is equipped with a USIM containing default values
- The UE is powered off
- The UE is equipped with fake battery and connected to the power consumption tester via power line.

7.3.5 Test Procedure

Table 7-3: Time of cell power level and parameter changes

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-88	MCL 120
T1			-112	MCL 144
T3			-132	MCL 164

Editor Note: The parameters ensuring UE is transmitting NPUSCH with 0dBm/10dBm/maximum power are TBD

PREAMBLE

1. Activate NB-IoT Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 7-3 Time T0. The default paging cycle in SIB2 is set to 2.56s.
2. Set the output voltage of power consumption tester the same as UE nominal voltage.
3. Switch on power consumption tester and power on the UE.

MAIN BODY

4. The UE transmits RRCConnectionRequest-NB to perform registration. SS transmits RRCConnectionSetup-NB.
5. UE transmits an RRCConnectionSetupComplete-NB message containing an ATTACH REQUEST and a PDN CONNECTIVITY REQUEST. Verify that UE request Idle-mode eDRX by including IE “extended DRX parameters” in ATTACH REQUEST. Verify that UE request PSM by including IE “T3324 value” in ATTACH REQUEST.
6. Steps (4) to (9) of the registration procedure described in Table 5-1 are performed on Cell A.
7. SS tranmits an ATTACH ACCEPT message and an ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message. The IE “Extended DRX parameters” is not included in ATTACH ACCEPT. The IE “T3324 value” is set to 30s.
8. UE transmits an ATTACH COMPLETE message and an ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT message.
9. The SS transmits an RRCConnectionRelease-NB message.UE enters into RRC_IDLE state.
10. SS sends a Paing message to page UE immediately before the expiry of T3324.
11. Verify that UE perform RACH as the response to paging message.
12. The SS transmits an RRCConnectionRelease-NB message.UE enters into RRC_IDLE state.
13. SS sends a Paing message to page UE after the expiry of T3324.
14. Wait for 1 minutes. Verify that UE doesn’t give any response to paging message.

15. Start power consumption measurement.
16. Trigger uplink data transmission in UDP layer. The data size is 200 octets. The data generation interval is 30 seconds. Verify that UE wakes up from PSM to transmits UL data. Verify UE transmit power is 0dBm
17. Measure the power consumption of data transmission for 5 minutes including 10 times data tarnsmission. Stop power consumption measurement. Get the average current value and duration from power consumption tester for every data transmission. Record the average of 10 current values as Current1. Record the average of 10 duration as Duration1
18. Stop uplink data transmission
19. The SS transmits an RRCConnectionRelease-NB message. Wait until UE enters into PSM.
20. Decrease downlink signal level of Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 7-3 Time T1
21. Trigger of successive uplink data transmission in UDP layer. The data size is 200 octets. The data generation interval is 30 seconds. Verify that UE wakes up from PSM to transmits UL data. Verify UE transmit power is 10dBm
22. Measure the power consumption of data transmission for 5 minutes including 10 times data tarnsmission. Stop power consumption measurement. Get the average current value and duration from power consumption tester for every data transmission. Record the average of 10 current values as Current2. Record the average of 10 duration as Duration2.
23. Stop uplink data transmission
24. The SS transmits an RRCConnectionRelease-NB message. Wait until UE enters into PSM
25. Decrease downlink signal level of Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 7-3 Time T2
26. Trigger of successive uplink data transmission in UDP layer. The data size is 200 octets. Verify that UE wakes up from PSM to transmits UL data. Verify UE transmit power is maximum
27. Measure the power consumption of data transmission for 5 minutes including 10 times data tarnsmission. Stop power consumption measurement. Get the average current value and duration from power consumption tester for every data transmission. Record the average of 10 current values as Current3. Record the average of 10 duration as Duration3
28. Stop uplink data transmission
29. The SS sends DETACH REQUEST to initiate Detach procedure.
30. UE transmits DETACH ACCEPT
31. The SS transmits an RRCConnectionRelease-NB message

POSTAMBLE

32. Deactive NB-IoT Cell A

7.3.6 Expected Result

In step 11, UE could moniter paging during T3324 timer running .
In step 14, UE could enter into PSM and does not monitor paging.
In step 16, UE could wake up from PSM to transmits MO data

Record the average current in Table 7-4. The power consumption performance in Idle state shall meet the requirements in Table 7-4.

Table 7-4: Power Consumption Requirements

Voltage (V)	Test Results (mA)				Expected Value(mA)
	CURRENT1		DURATION1		TBD
	CURRENT2		DURATION2		TBD
	CURRENT3		DURATION3		TBD

7.4 DL Periodic Service with eDRX / Power Consumption

7.4.1 Test Purpose

To verify UE could well handle the periodic service and eDRX. UE could well support eDRX function, including requesting eDRX during Attach and monitoring paging according to eDRX cycle.

To measure the power consumption of downlink data transmission with different eDRX cycle.

7.4.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.4.3 Test Applicability;

This test applies to NB-IoT modules

7.4.4 Test Conditions

[SS configuration]

NB-IoT Cell A

Cell Id=01 TAC = 01

MCC-MNC = 460-04[TBD]

Standalone Operation.

Test Frequency ID = f1

NB-IoT Uplink setting：

Channel Bandwidth = 200kHz

Number of Tones=1

Sub-carrier spacing=15kHz

NB-IoT Downlink setting：

Channel Bandwidth = 200kHz

Number of Tones=12

[Initial conditions]

System Simulator

- NB-IoT Cell A is active
- The test shall be performed under ideal radio conditions.
- PSM is disabled. eDRX is enabled

UE

- The UE is equipped with a USIM containing default values
- The UE is powered off
- The UE is equipped with fake battery and connected to the power consumption tester via power line.

7.4.5 Test Procedure

Table 7-5: Time of cell power level and parameter changes

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-88	MCL 120
T1			-112	MCL 144
T3			-132	MCL 164

PREAMBLE

1. Activate NB-IoT Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 7-5 Time T0. The default paging cycle in SIB2 is set to 2.56s.
2. Set the output voltage of power consumption tester the same as UE nominal voltage.
3. Switch on power consumption tester and power on the UE.

MAIN BODY

4. The UE transmits RRCConnectionRequest-NB to perform registration. SS transmits RRCConnectionSetup-NB.
5. UE transmits an RRCConnectionSetupComplete-NB message containing an ATTACH REQUEST and a PDN CONNECTIVITY REQUEST. Verify that UE request Idle-mode eDRX by including IE “extended DRX parameters” in ATTACH REQUEST. Verify that UE request PSM by including IE “T3324 value” in ATTACH REQUEST.
6. Steps (4) to (9) of the registration procedure described in Table 5-1 are performed on Cell A.
7. SS tranmits an ATTACH ACCEPT message and an ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message. The IE “T3324 value” is not included in ATTACH ACCEPT. The IE “Extended DRX parameters” is included to activate eDRX. The “Paging Time Window” is set to 5.12s and the “eDRX value” is set to 3min.
8. UE transmits an ATTACH COMPLETE message and an ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT message.
9. The SS transmits an RRCConnectionRelease-NB message.UE enters into RRC_IDLE state.
10. Start power consumption measurement.

11. Trigger of downlink periodic data transmission in UDP layer. The data size is 200 octets. The data generation period is 3min (200byte/packet/minute)
12. SS sends a Paging message to page UE.
13. Verify that UE perform RACH as the response to paging message.
14. SS should release RRC connection after the transmission of every packet
15. Measure the power consumption of downlink data transmission for 10 minutes.
16. Stop power consumption measurement. Get the average current value from power consumption tester. Record the average current of data transmission as Current1. Record the average current when UE is in RRC_IDLE with eDRX as Current2.
17. Stop downlink data transmission
18. Decrease downlink signal level of Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 7-5 Time T1
19. Repeat step 10~step 17. The test results are recorded as CURRENT 3 and CURRENT 4.
20. Decrease downlink signal level of Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 7-5 Time T2
21. Repeat step 10~step 17. The test results are recorded as CURRENT 5 and CURRENT 6.
22. The SS sends DETACH REQUEST to initiate Detach procedure.
23. UE transmits DETACH ACCEPT
24. The SS transmits an RRCConnectionRelease-NB message

POSTAMBLE

25. Deactive NB-IoT Cell A

7.4.6 Expected Result

Record the average current in Table 7-8. The power consumption performance in Idle state shall meet the requirements in Table 7-8.

Table 7-8: Power Consumption Requirements

Voltage (V)	Test Results (mA)		Expected Value(mA)
	CURRENT1		TBD
	CURRENT2		TBD
	CURRENT3		TBD
	CURRENT4		TBD
	CURRENT5		TBD
	CURRENT6		TBD

7.5 Bidirectional Service with eDRX / Power Consumption

7.5.1 Test Purpose

To measure the power consumption of bidirectional service in differenct coverage. The service model is that uplink data report from UE is triggered by the data request from application service(AS) platform

7.5.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.5.3 Test Applicability;

This test applies to NB-IoT modules

7.5.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC =460-04[TBD]
Standalone Operation.
Test Frequency ID = f1

NB-IoT Uplink setting：
Channel Bandwidth = 200kHz
Number of Tones=1
Sub-carrier spacing=15kHz

NB-IoT Downlink setting：
Channel Bandwidth = 200kHz
Number of Tones=12

[Initial conditions]
System Simulator
- NB-IoT Cell A is active
- The test shall be performed under ideal radio conditions.
- PSM is disabled. eDRX is enabled

UE
- The UE is equipped with a USIM containing default values

- The UE is powered off
- The UE is equipped with fake battery and connected to the power consumption tester via power line.

7.5.5 Test Procedure

Table 7-9: Time of cell power level and parameter changes

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-88	MCL 120
T1			-112	MCL 144
T3			-132	MCL 164

PREAMBLE

1. Activate NB-IoT Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 7-7 Time T0. The default paging cycle in SIB2 is set to 2.56s.
2. Set the output voltage of power consumption tester the same as UE nominal voltage.
3. Switch on power consumption tester and power on the UE.

MAIN BODY

4. The UE transmits RRCConnectionRequest-NB to perform registration. SS transmits RRCConnectionSetup-NB.
5. UE transmits an RRCConnectionSetupComplete-NB message containing an ATTACH REQUEST and a PDN CONNECTIVITY REQUEST. Verify that UE request Idle-mode eDRX by including IE “extended DRX parameters” in ATTACH REQUEST. Verify that UE request PSM by including IE “T3324 value” in ATTACH REQUEST.
6. Steps (4) to (9) of the registration procedure described in Table 5-1 are performed on Cell A.
7. SS tranmits an ATTACH ACCEPT message and an ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message. The IE “T3324 value” is not included in ATTACH ACCEPT. The IE “Extended DRX parameters” is included to activate eDRX. The “Paging Time Window” is set to 5.12s and the “eDRX value” is set to 3min.
8. UE transmits an ATTACH COMPLETE message and an ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT message.
9. The SS transmits an RRCConnectionRelease-NB message.UE enters into RRC_IDLE state.
10. Start power consumption measurement.
11. SS sends data request from the simulated application service platform every 3 minutes
12. Verify UE transmits uplink data.
13. Measure the power consumption of downlink data transmission for 10 minutes.
14. Stop power consumption measurement. Get the average current value from power consumption tester. Record the average current of data transmission as Current1.
15. Decrease downlink signal level of Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 7-9 Time T1
16. Repeat step 9~step 14. The test results are recorded as CURRENT 2.

17. Decrease downlink signal level of Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 7-9 Time T2
18. Repeat step 9~step 14. The test results are recorded as CURRENT 3.
19. The SS sends DETACH REQUEST to initiate Detach procedure.
20. UE transmits DETACH ACCEPT
21. The SS transmits an RRCConnectionRelease-NB message

POSTAMBLE

22. Deactive NB-IoT Cell A

7.5.6 Expected Result

In step 12, UE should report data when requested by AS.

Record the average current in Table 7-10. The power consumption performance in Idle state shall meet the requirements in Table 7-10.

Table 7-10: Power Consumption Requirements

Voltage (V)	Test Results (mA)		Expected Value(mA)
	CURRENT1		TBD
	CURRENT2		TBD
	CURRENT3		TBD

8 Positioning

8.1 Positioning Service/GPS

8.1.1 Test Purpose

To verify UE could support GPS positioning and report GPS information to server.

8.1.2 Reference Specification

IS-GPS-200

8.1.3 Test Applicability;

This test applies to NB-IoT modules supporting GPS positioning

8.1.4 Test Conditions

[SS configuration]

NB-IoT Cell A

Cell Id=01 TAC = 01

MCC-MNC = 460-04 [TBD]

Standalone Operation.

Test Frequency ID = f1

NB-IoT Uplink setting：

Channel Bandwidth = 200kHz

Number of Tones=1

Sub-carrier spacing=15kHz

NB-IoT Downlink setting：

Channel Bandwidth = 200kHz

Number of Tones=12

NRS EPRE = - 85dBm/15kHz (The power level is specified at the UE Rx antenna)

[Initial conditions]

System Simulator

- NB-IoT Cell A is active
- The test shall be performed under ideal radio conditions.

UE

- The UE is equipped with a USIM containing default values
- The UE is powered off

8.1.5 Test Procedure

PREAMBLE

1. Activate NB-IoT Cell A.
2. Power on the UE.

MAIN BODY

3. The UE performs registration. Steps (1) to (13) of the registration procedure described in Table 5-1 are performed on Cell A. Check the points listed in Table 5-1.
4. GNSS simulator generate GPS signal. The visible satellites are configurable to simulate the test scenario of moving in the city with tall buildings blocks some satellites
5. UE calculates the position information and report the data to location service server periodically
6. The GPS test software collect data and check accuracy

POSTAMBLE

7. The SS sends DETACH REQUEST to initiate Detach procedure.
8. UE transmits DETACH ACCEPT
9. The SS transmits an RRCConnectionRelease-NB message
10. Deactive NB-IoT Cell A

8.1.6 Expected Result

UE could calculate the position information and report to location service server

8.2 Positioning Service/Beidou

8.2.1 Test Purpose

To verify UE could support Beidou positioning and report location information to server.

8.2.2 Reference Specification

BDS_ICD_2.1

8.2.3 Test Applicability;

This test applies to NB-IoT modules supporting Beidou positioning

8.2.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-04 [TBD]
Standalone Operation.
Test Frequency ID = f1

NB-IoT Uplink setting:
Channel Bandwidth = 200kHz
Number of Tones=1
Sub-carrier spacing=15kHz

NB-IoT Downlink setting:
Channel Bandwidth = 200kHz
Number of Tones=12
NRS EPRE = - 85dBm/15kHz (The power level is specified at the UE Rx antenna)

[Initial conditions]

System Simulator

- NB-IoT Cell A is active
- The test shall be performed under ideal radio conditions.

UE

- The UE is equipped with a USIM containing default values
- The UE is powered off

8.2.5 Test Procedure

PREAMBLE

1. Activate NB-IoT Cell A.
2. Power on the UE.

MAIN BODY

3. The UE performs registration. Steps (1) to (13) of the registration procedure described in Table 5-1 are performed on Cell A. Check the points listed in Table 5-1.
4. GNSS simulator generate Beidou signal. The visible satellites are configurable to simulate the test scenario of moving in the city with tall buildings blocks some satellites
5. UE calculates the position information and report the data to location service server periodically
6. The Beidou test software collect data and check accuracy

POSTAMBLE

7. The SS sends DETACH REQUEST to initiate Detach procedure.
8. UE transmits DETACH ACCEPT
9. The SS transmits an RRCConnectionRelease-NB message
10. Deactive NB-IoT Cell A

8.2.6 Expected Result

UE could calculate the position information and report to location service server

8.3 Positioning Service / GPS / Power Consumption

8.3.1 Test Purpose

To measure the average current when UE performs GPS positioning and reports GPS information to server.

8.3.2 Reference Specification

IS-GPS-200

8.3.3 Test Applicability;

This test applies to NB-IoT modules supporting GPS positioning

8.3.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-04 [TBD]
Standalone Operation.
Test Frequency ID = f1

NB-IoT Uplink setting：
Channel Bandwidth = 200kHz
Number of Tones=1
Sub-carrier spacing=15kHz

NB-IoT Downlink setting：
Channel Bandwidth = 200kHz
Number of Tones=12
NRS EPRE = - 85dBm/15kHz (The power level is specified at the UE Rx antenna)

[Initial conditions]
System Simulator
- NB-IoT Cell A is active
- The test shall be performed under ideal radio conditions.

UE
- The UE is equipped with a USIM containing default values
- The UE is powered off

8.3.5 Test Procedure

PREAMBLE
1. Activate NB-IoT Cell A.
2. Set the output voltage of power consumption tester the same as UE nominal voltage.
3. Switch on power consumption tester and power on the UE.

MAIN BODY

4. The UE performs registration. Steps (1) to (13) of the registration procedure described in Table 5-1 are performed on Cell A. Check the points listed in Table 5-1.
5. GNSS simulator generate GPS signal. The visible satellites are configurable to simulate the test scenario of moving in the city with tall buildings blocks some satellites
6. Start power consumption measurement.
7. UE calculates the position information and report the data to location service server periodically
8. The GPS test software collect data and check accuracy
9. Stop power consumption measurement. Get the average current value.

POSTAMBLE

10. The SS sends DETACH REQUEST to initiate Detach procedure.
11. UE transmits DETACH ACCEPT
12. The SS transmits an RRCConnectionRelease-NB message
13. Deactive NB-IoT Cell A

8.3.6 Expected Result

Record the average current.

8.4 Positioning Service / Beidou / Power Consumption

8.4.1 Test Purpose

To verify UE could support Beidou positioning and report location information to server.

8.4.2 Reference Specification

BDS_ICD_2.1

8.4.3 Test Applicability;

This test applies to NB-IoT modules supporting Beidou positioning

8.4.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-04 [TBD]
Standalone Operation.

Test Frequency ID = f1

NB-IoT Uplink setting：
Channel Bandwidth = 200kHz
Number of Tones=1
Sub-carrier spacing=15kHz

NB-IoT Downlink setting：
Channel Bandwidth = 200kHz
Number of Tones=12
NRS EPRE = - 85dBm/15kHz (The power level is specified at the UE Rx antenna)

[Initial conditions]
System Simulator
- NB-IoT Cell A is active
- The test shall be performed under ideal radio conditions.

UE
- The UE is equipped with a USIM containing default values
- The UE is powered off

8.4.5 Test Procedure

PREAMBLE
1. Activate NB-IoT Cell A.
2. Set the output voltage of power consumption tester the same as UE nominal voltage.
3. Switch on power consumption tester and power on the UE.

MAIN BODY
4. The UE performs registration. Steps (1) to (13) of the registration procedure described in Table 5-1 are performed on Cell A. Check the points listed in Table 5-1.
5. GNSS simulator generate Beidou signal. The visible satellites are configurable to simulate the test scenario of moving in the city with tall buildings blocks some satellites
6. UE calculates the position information and report the data to location service server periodically
7. The Beidou test software collect data and check accuracy
8. Start power consumption measurement.
9. UE calculates the position information and report the data to location service server periodically
10. The GPS test software collect data and check accuracy
11. Stop power consumption measurement. Get the average current value.

POSTAMBLE
12. The SS sends DETACH REQUEST to initiate Detach procedure.

13. UE transmits DETACH ACCEPT
14. The SS transmits an RRCConnectionRelease-NB message
15. Deactive NB-IoT Cell A

8.4.6 Expected Result

Record the average current.

Annex A: Test Frequencies for In-band/Guard-Band

Table A-1: NB-IoT in-band Test frequencies for operating band 3

Test Frequency ID	N_{UL}	M_{UL}	Frequency of Uplink [MHz]	N_{DL}	M_{DL}	Frequency of Downlink [MHz]
f1	19206	-3	1710.5850	1206	-2	1805.5925
f2	19566	-3	1746.5850	1566	-2	1841.5925
f3	19944	3	1784.4150	1944	1	1879.4075
NOTE 1: Related to LTE channel BW 3 MHz NOTE 2: Defined for NB-IoT UL subcarrier spacing 15 kHz. Also applicable for 3.75 kHz UL sub-carrier spacing						

Table A-2: NB-IoT guard-band Test frequencies for operating band 3

Test Frequency ID	N_{UL}	M_{UL}	Frequency of Uplink [MHz]	N_{DL}	M_{DL}	Frequency of Downlink [MHz]
f1	19201	0	1710.1000	1201	1	1805.1075
f2	19551	0	1745.1000	1551	1	1840.1075
f3	19949	0	1784.9000	1949	-2	1879.8925
NOTE 1: Related to LTE channel BW 5 MHz NOTE 2: Defined for NB-IoT UL subcarrier spacing 15 kHz. Also applicable for 3.75 kHz UL sub-carrier spacing						

Table A-3: NB-IoT in-band Test frequencies for operating band 8

Test Frequency ID	N_{UL}	M_{UL}	Frequency of Uplink [MHz]	N_{DL}	M_{DL}	Frequency of Downlink [MHz]
f1	21456	-3	880.5850	3456	-2	925.5925
f2	21616	-3	896.5850	3616	-2	941.5925
f3	21794	3	914.4150	3794	1	959.4075
NOTE 1: Related to LTE channel BW 3 MHz NOTE 2: Applicable to either 3.75 kHz or 15 kHz UL sub-carrier spacing						

Table A-4: NB-IoT guard-band Test frequencies for operating band 8

Test Frequency ID	N_{UL}	M_{UL}	Frequency of Uplink [MHz]	N_{DL}	M_{DL}	Frequency of Downlink [MHz]
Low Range	21451	0	880.1000	3451	1	925.1075
Mid Range	21601	0	895.1000	3601	1	940.1075
High Range	21799	0	914.9000	3799	-2	959.8925
NOTE 1: Related to LTE channel BW 5 MHz NOTE 2: Applicable to either 3.75 kHz or 15 kHz UL sub-carrier spacing						

Annex B: Propagation Conditions

Refer to Annex B in 3gpp TS36.521-1.