GTI
NB-IoT Module Test Specification

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Contents

1 Scope

The present document specifies the NB-IoT module testing, including connectivity testing, power consumption testing, RF performance testing and positioning testing. For each test cases, the following information can be found in this document:

- the test purpose;
- the test configuration;
- the applicability of each test case;
- the test conditions; and
- the brief description of the test procedure and the expected result

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 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)	460001234567890
2	$EF_{HPLMNwAcT}$	(HPLMN selector with Access Technology)	CMCC China (460, 00)
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
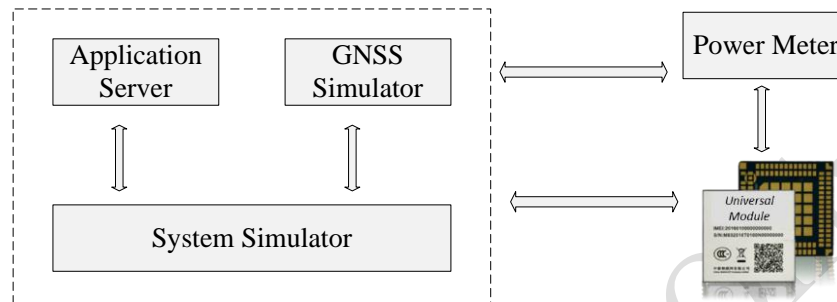
Figure 4-1 Common Test System Architecture

4.3 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 = 460-00
Standalone Operation.
Test Frequency   = 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*	**Check points:** **RRCConnectionSetupComplete** 1. "attachWithoutPDN-Connectivity-r13" in

		NAS: ATTACH REQUEST NAS: PDN CONNECTIVITY REQUEST	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 11.” 0016H (APN rate control support indicator)” is included in PCO 12. “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" 4. "Header compression for control plane CIoT EPS optimization supported" 5. "control plane CIoT EPS optimization accepted" 6." 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 RRC Connection Release Based on NAS Signaling (RAI)

5.2.1 Test Purpose

Verify UE supports RAI(release assistance indication) and that UE indicates SS to relsease RRC via the RAI IE in NAS message after data transmission.

5.2.2 Reference Specification

3GPP TS 24.301 6.6.4.2

5.2.3 Test Applicability;

This test applies to NB-IoT modules.

5.2.4 Test Conditions

[SS CONFIGURATION]
NB-IoT Cell A
Cell ID = 01, TAC = 01
MCC-MNC = 460-00
Standalone operation
Test frequency = 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]
SS：
- NB-IoT Cell A is active
- This test shall be performed under ideal radio conditions

UE：
- UE is equipped with a USIM containing default values.
- UE is switched off（state 1 in TS 36.508 ）

5.2.5 Test Procedure

PREAMBLE
1. Activate NB-IoT Cell A, with paging cycle of 2.56s.
2. Power on the UE

MAIN BODY
3. UE sends RRCConnectionRequest-NB for registration. SS replys RRCConnectionSetup-NB.

4. UE sends RRCConnectionSetupComplete-NB, containing ATTACH REQUEST and PDN CONNECTIVITY REQUEST.
5. UE performs registration. Steps (4) to (9) of the registration procedure described in Table 5-1 are performed on Cell A.
6. SS sends ATTACH ACCEPT 和 ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST.
7. UE replys ATTACH COMPLETE and ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT.
8. Trigger uplink UDP and the size is 200 octets and indicate UE via commands that the UDP pakage is the last data package.
9. Verify that UE contains "Release assistance indication" in   ESM DATA TRANSPORT.The last two fields are "01", which means the data is to be the last uplink data and no uplink and downlink data transmission is required.
10. SS sends RRCConnectionRelease-NB on recieving the field. UE goes into indle state.
11. trigger uplink UDP on UE and the size is 200 octets while indicating that the UDP data package is thae last uplink one, with one downlink package to follow up.
12. UE contains "Release assistance indication"in ESM DATA TRANSPORT, with the last two fields being "10",meaning the data is the last uplink one but a downlink transmission is still in need.
13. SS sends "RRCConnectionRelease-NB". UE enters indle state.
14. Deactivate NB-IoT Cell A.

5.2.6 Expected Result

In step 9, UE could contain correct RAI in ESM DATA TRANSPORT.
In step 12, UE could contain correct RAI in ESM DATA TRANSPORT.

5.3 RRC Connection Release Based on BSR Signaling (RAI)

5.3.1 Test Purpose

Verify that UE reports BSR=0 when no data in MAC buffer. Then SS releases RRC connection if RAI-activation is configured.

5.3.2 Reference Specification

3GPP TS 36.321 5.4.5
3GPP TS 36.331 6.7.3.2

5.3.3 Test Applicability

This test applies to NB-IoT modules.

5.3.4 Test Conditions

[SS configuration]

NB-IoT Cell A

Cell ID = 01,TAC = 01

MCC-MNC = 460-00

Standalone operation

Test Frequency = 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]

SS：

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

UE：

- UE is equipped with a USIM with default information.
- Power off UE.（state 1 in TS 36.508）

5.3.5 Test Procedure

PREAMBLE

1. Activate NB-IoT Cell A with paging cycle of 2.56s.
2. Power on UE.

Main body

3. UE sends "RRCConnectionRequest-NB" for registration. SS replys with "RRCConnectionSetup-NB".
4. UE sends "RRCConnectionSetupComplete-NB", containing "ATTACH REQUEST" and "PDN CONNECTIVITY REQUEST".
5. UE performs registration. Steps (4) to (9) of the registration procedure described in Table 5-1 are performed on Cell A. verify that UE contains "rai-Support-r14" in UE-Capability-NB. SS configuration activates MAC RAI function. (rai-Activation = TRUE)
6. SS sends ATTACH ACCEPT and ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST.

7. UE replys with ATTACH COMPLETE and ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT.

8. Trigger uplink UDP and donnot stop until completing the transmission of a 200-octet data package.

9. Verify that UE reports BSR=0 via MAC CE when the trasmixxion is over.

10. SS sends RRCConnectionRelease-NB on receiving BSR=0. UE enters idle state.

11. Deactivate NB-IoT Cell A.

Table 5-4 step 5 signaling configuration

Information	value	Note
MAC-MainConfig-NB ::= SEQUENCE {		
……		
rai-Activation-r14	TRUE	
……		
}		

5.3.6 Expected Result

In step 5, UE could support and report MAC RAI function. （rai-Support-r14）

In step 9, UE could report BSR=0 after data transmission.

5.4 PSM Configuration/ UL Transmission

5.4.1 Test Purpose

Verify that UE supports PSM function, including PSM Request, PSM activation and de-activation. Verify that UE could wake up from PSM state when there is uplink data transmission.

5.4.2 Reference Specification

3GPP TS 24.301

5.4.3 Test Applicability

This test applies to NB-IoT modules.

5.4.4 Test Conditions

 [SS Configuration]
NB-IoT Cell A
Cell ID = 01,TAC = 01

MCC-MNC = 460-00

standalone operation

test frequency = f1

NB-IoT uplink setting：

Bandwidth = 200kHz

Number of tones = 1

Sub-carrier spacing = 15kHz

NB-IoT downlink setting：

Bandwidth = 200kHz

Number of tones = 12

[Initial Conditions]

SS：

- NB-IoT Cell A is active.
- The test shall performed under ideal radio conditions.
- Switch on PSM, donnot switch on eDRX.

UE：

- UE is equipped with a USIM with default informantion.
- Power off UE（State 1 in TS 36.508）
- The UE is equipped with fake battery and connected to the power consumption test tool

5.4.5 Test Procedure

PREAMBLE

1. Activate NB-IoT Cell A and set the paging cycle in SIB2 to be 2.56s
2. The power consumption tester provides power and UE is switched on.

MAIN BODY

3. UE sends RRCConnectionRequest-NB for registration and SS replys with RRCConnectionSetup-NB.
4. UE sends RRCConnectionSetupComplete-NB,containing ATTACH REQUEST and DN CONNECTIVITY REQUEST. verify that UE includes "T3324 value"in ATTACH REQUEST to apply for PSM and "extended DRX parameters" for eDRX.
5. UE performs registration in Cell A, as is shown in table 5-1 step 4 to 9.
6. SS sends ATTACH ACCEPT and ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST.ATTACH ACCEPT does not contain "extended DRX parameters"but contains"T3324 value"and is set to be 30s.
7. UE replys with ATTACH COMPLETE and ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT.
8. SS sends RRCConnectionRelease-NB and UE eneters RRC_IDLE state.
9. SS sends paging message before the T3324 timer expires.

10. Verify that UE triggers random access procedure after recieving paging message.

11. SS sends RRCConnectionRelease-NB and UE eneters RRC_IDLE state.

12. SS sends paging messages after the T3324 timer expires.

13. Wait for 1 minute and verify that UE does not respond.

14. Verify that UE enters PSM according to the reading on the power consumption tester.(uA)

15. Trigger uplink UDP. The size of the package will be 200 octets. Verify that UE could be aroused from PSM to send uplink data.

16. SS sends RRCConnectionRelease-NB.

POSTAMBLE

17. Deactivate NB-IoT Cell A.

5.4.6 Expected Result

In step 10, UE should monitor paging during T3324 timer operation.

In step 13, UE could enter PSM and would not monitor paging.

In step 15, UE should be aroused from PSM to perform uplink data transmission.

5.5 eDRX Configuration/DL Trasmission

5.5.1 Test Purpose

Verify that UE supports eDRX function, and could apply eDRX during ATTACH procedure. Verify that UE monitor paging according to eDRX cycle in idle state and could recieve downlink data succussfully.

5.5.2 Reference Specification

3GPP TS 24.301

5.5.3 Test Applicability

This test applies to NB-IoT modules

5.5.4 Test Conditions

[SS configuration]

NB-IoT Cell A

Cell ID = 01,TAC = 01

MCC-MNC = 460-00

Standalone operation

Test Frequency = 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]
SS：
- NB-IoT Cell A is active.
- The test shall be performed under ideal radio conditions.
- Keep eDRX off while switching on PSM.

UE：
- UE is equipped with a USIM with default information.
- Power off UE.（state 1 in TS 36.508）

5.5.5 Test Procedure

PREAMBLE
1. Activate NB-IoT Cell A with paging cycle of 2.56s in SIB2.
2. Power on UE.

MAIN BODY
3. UE sends "RRCConnectionRequest-NB" for registration. SS replys with "RRCConnectionSetup-NB".
4. UE sends "RRCConnectionSetupComplete-NB", containing "ATTACH REQUEST" and "PDN CONNECTIVITY REQUEST".Verify that UE includes "T3324 value" in ATTACH REQUEST to apply for PSM and "extended DRX parameters" for eDRX.
5. UE performs registration. Steps (4) to (9) of the registration procedure described in Table 5-1 are performed on Cell A.
6. SS sends ATTACH ACCEPT and ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST. ATTACH ACCEPT includes"extended DRX parameters". And "Paging Time Window" is configured to be 5.12s, "eDRX value"20.48s. "T3324 value"is not included.
7. UE replys with ATTACH COMPLETE and ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT.
8. SS sends RRCConnectionRelease-NB.UE enters RRC_IDLE mode.
9. SS sends paging messages outside PTW.
10. Verify that UE has no response.
11. SS sends sends paging messages inside PTW.

12. Verify that UE responds to paging and accesses to Cell.
13. SS sends downlink UDP at the size of 200 octets. Verify that UE could receive downlink data successfully.
14. SS sends RRCConnectionRelease-NB

POSTAMBLE
15. Deactivate NB-IoT Cell A.

5.5.6 Expected Result

In step 10, UE does not respond to paging.
In step 12, UE responds to paging.
In step 13, UE could receive downlink data package successfully.

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 = 460-00
Standalone Operation.

Test Frequency = f1

NB-IoT Uplink setting：
Channel Bandwidth = 200kHz
Number of Tones=1
Sub-carrier spacing=15kHz
MCL 164, NPUSCH repetitions =128

NB-IoT Downlink setting：
Channel Bandwidth = 200kHz
Number of Tones=12
MCL 164, NPDSCH repetitions =256MCL 164, NPDCCH repetitions =256

[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. 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
TH1	15.6kbps
TH2	13.2kbps
TH3	0.15kbps

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)
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 = 460-00
Standalone Operation.
Test Frequency = f1

NB-IoT Uplink setting：
Channel Bandwidth = 200kHz
Number of Tones=1
Sub-carrier spacing=15kHz
MCL 164, NPUSCH repetitions =128

NB-IoT Downlink setting：
Channel Bandwidth = 200kHz
Number of Tones=12
MCL 164, NPDSCH repetitions =256
MCL 164, NPDCCH repetitions =256

[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 error rate at MAC layer for 2 minutes.
18. If the error rate is 5%, record the power level as P1
19. If the downlink error rate is less than 5%, keep decreasing the downlink signal level as well as testing and measuring until it exceeds or euqals 5%:if it equals, record the power level; if not, go to step 21.
20. If the error rate exceeds 5%, go to step
21. Increase downlink signal level with 0.5db step. Test and measure the error rate for 2 minutes until it is less than or equals 5% at certain power level. Record this level as P1
22. SS stops downlink transmission. SS releases RRC CONNECTION.
23. SS sends DETACH REQUES to trigger detach procedure.
24. UE sends DETACH ACCEPT.
25. SS sends RRCConnectionRelease-NB message.

POSTAMBLE
26. POWER OFF 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
TH1	21.25kbps
TH2	19.13kbps
TH3	1.2kbps

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: TestRequirement

Test Result	Expected Value
P1	-121dBm

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 = 460-00
Standalone Operation.
Test Frequency = 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 6-58.

Table 6-8: NRSRP measurement accuracy requirements

Test Results	Expected Value	Tolerance
T0	-88	±2
T1	-112	±2
T2	-132	±2

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 = 460-00
Standalone Operation.
Test Frequency = 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	±2
T1	-112	±2
T2	-132	±2

The average SINR 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	±2
T1	0dB	±2
T2	-5dB	±2

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 = 460-00
Standalone Operation.
Test Frequency = f1

NB-IoT Cell B
Cell Id=02 TAC = 01
MCC-MNC = 460-00
Standalone Operation.
Test Frequency = 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	±2
T1	-112	±2
T2	-132	±2

The average SINR 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	±2
T1	0dB	±2
T2	-5dB	±2

6.6 Uplink Throughput Testing Supporting Rate Enhancement

6.6.1 Uplink Throughput Testing Supporting Rate Enhancement /15K ST

6.6.1.1 Test Purpose

To verify UE could well support the R14 enhanced data rate and to measure uplink throughput in different coverage with uplink 15K single tone

6.6.1.2 Reference Specification

3GPP TS 24.301, TS 36.331

6.6.1.3 Test Applicability

This test applies to NB-IoT modules supporting R14 rate enhancement

6.6.1.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-00
Standalone Operation.
Test Frequency = 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 disabled

UE：

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

6.6.1.5 Test Procedure

Table 6-1:Time of cell power level

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-87	CE0
T1			-97	CE0
T2			-124	CE2

Table 1-16: Parameter Configuration for uplink transmission

time	npdcch-NumRepetitions (Rmax)	NPDCCH Repetitions (R)	NPUSCH Repetitions	UL MCS	Resource Assignment (Iru/Nru)	UL HARQ PROCESS
T0	1	1	1	10/QPSK	7/10	2
T1	1	1	1	10/QPSK	7/10	2
T2	32	16	8	10/QPSK	7/10	2

PREAMBLE

1. Activate NB-IoT Cell A. NRS EPRE value is defined in Table 6-15 T0,Set the data transmission parameters at Table 6-16 T0,The default paging cycle in SIB2 is set to 2.56s.
2. Power on the UE.

MAIN BODY

3. The UE transmits RRCConnectionRequest-NB to perform registration. SS transmits RRCConnectionSetup-NB.

4. UE transmits an RRCConnectionSetupComplete-NB message containing an ATTACH REQUEST and a PDN CONNECTIVITY REQUEST.

5. Steps (4) to (9) of the registration procedure described in Table 5-1 are performed on Cell A.

6. SS tranmits an ATTACH ACCEPT message and an ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message.

7. UE transmits an ATTACH COMPLETE message and an ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT message.

8. The SS transmits an RRCConnectionRelease-NB message.UE enters into RRC_IDLE state.

9. Trigger uplink data transmission in UDP layer. The data size is 200 octets. Verify UE transmit power is 0dBm.

10. Measure the average upstream throughput of UDP layer for 3 minutes. Record the throughput test results for TH1, the BER is Bler1.

11. The SS transmits an RRCConnectionRelease-NB message.

12. Decrease DL signal level of Cell A. Set NRS EPRE and other transmission parameters according to Table 6-15 T1.

13. Trigger uplink data transmission in UDP layer.

14. Measure the average upstream throughput of UDP layer for 3 minutes. Record the throughput test results for TH2, the BER is Bler2

15. Stop Uplink Data Transmission.

16. The SS transmits an RRCConnectionRelease-NB message.

17. Decrease DL signal level of Cell A. Set NRS EPRE and other transmission parameters according to Table 6-15 T2.

18. Trigger uplink data transmission in UDP layer.

19. Measure the average upstream throughput of UDP layer for 3 minutes. Record the throughput test results for TH3, the BER is Bler3.

20. Stop Uplink Data Transmission.

21. SS sends DETACH REQUEST to trigger detach procedure.

22. UE sends DETACH ACCEPT.

23. SS sends RRCConnectionRelease-NB.

POSTAMBLE
24. Deactive NB-IoT Cell A.

6.6.1.6 Expected Result

Record the test results in Table 6-17.

Table 6-17: Test Results

Test point	Test Results	
	Throughput TH	BER
1		
2		
3		

6.6.2 Uplink Throughput Testing Supporting Rate Enhancement /15K MT

6.6.2.1 Test Purpose

To verify UE could well support the R14 enhanced rate and to measure the uplink throughput in different coverage with uplink 15K multi-tone.

6.6.2.2 Reference Specification

3GPP TS 24.301, TS 36.331

6.6.2.3 Test Applicability

This test applies to NB-IoT modules supporting R14 rate enhancement

6. 6. 2. 4 Test Conditions

The same as 6.6.1.4 except the following uplink setting

NB-IoT Uplink setting：
Number of Tones=6
Sub-carrier spacing=15kHz

6. 6. 2. 5 Test Procedure

The same as 6.6.1.5 except the following configuration

Table 6-18: Time of cell power level

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-79	CE0
T1			-89	CE0
T2			-124	CE2

Table 6-19: Parameter Configuration for uplink transmission

time	npdcch-Num Repetitions (Rmax)	NPDCCH Repetitions (R)	NPUSCH Repetitions	UL TBS Index	Resource Assignment (Iru/Nru)	UL HARQ PROCESS
T0	1	1	1	13/QPSK	7/10	2
T1	1	1	1	13/QPSK	7/10	2
T2	32	16	8	13/QPSK	7/10	2

6. 6. 2. 6 Expected Result

Record the test results in Table 6-20

Table 6-20: Test Results

Test point	Test Results	
	Throughput TH	BER
1		
2		
3		

6.6.3 Uplink Throughput Testing Supporting Rate Enhancement /3.75K

6.6.3.1 Test Purpose

To verify UE could well support the R14 enhanced rate and to measure the uplink throughput in different coverage with uplink 3.75K.

6.6.3.2 Reference Specification

3GPP TS 24.301, TS 36.331

6. 6. 3. 3 Test Applicability

This test applies to NB-IoT modules supporting R14 rate enhancement

6. 6. 3. 4 Test Conditions

The same as 6.6.1.4 except the following uplink setting.

NB-IoT Uplink setting:
Sub-carrier spacing=3.75kHz

6. 6. 3. 5 Test Procedure

The same as 6.6.1.5 except the following configuration

Table 6-21: Time of cell power level

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-93	CE0
T1			-103	CE0
T2			-124	CE2

6. 6. 3. 6 Expected Result

Record the test results in Table 6-22

Table 6-22: Test Results

Test point	Test Results	
	Throughput TH	BER
1		
2		
3		

6.7 Downlink Throughput Testing Supporting Rate Enhancement

6.7.1 Test Purpose

To verify UE could well support the R14 enhanced data rate and to measure the downlink throughput in different coverage.

6. 7. 2 Reference Specification

3GPP TS 24.301, TS 36.331

6. 7. 3 Test Applicability

This test applies to NB-IoT modules supporting R14 rate enhancement

6. 7. 4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-00
Standalone Operation.
Test Frequency = 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 disabled

UE

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

6.7.5 **Test Procedure**

Table 6-23: Time of cell power level

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-87	MCL 120
T1			-97	MCL 144
T2			-124	MCL 164

Table 6-24: Parameter Configuration for Downlink Transmission

time	npdcch-Num Repetitions (Rmax)	NPDCCH Repetitions(R)	NPDSCH Repetitions	DL MCS	Resource Assignment(Isf /Nsf)	DL HARQ PROCESS
T0	1	1	1	13/QPSK	7/10	2
T1	1	1	1	13/QPSK	7/10	2
T2	32	16	16	13/QPSK	7/10	2

PREAMBLE

1. Activate NB-IoT Cell A, Set to the NRS EPRE value defined in Table 6-23 T0,Set the data transmission parameters at Table 6-23 T0,The default paging cycle in SIB2 is set to 2.56s.
2. Power on the UE

MAIN BODY

3. The UE transmits RRCConnectionRequest-NB to perform registration. SS transmits RRCConnectionSetup-NB.
4. UE transmits an RRCConnectionSetupComplete-NB message containing an ATTACH REQUEST and a PDN CONNECTIVITY REQUEST.
5. Steps (4) to (9) of the registration procedure described in Table 5-1 are performed on Cell A.
6. SS tranmits an ATTACH ACCEPT message and an ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message.
7. UE transmits an ATTACH COMPLETE message and an ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT message.
8. The SS transmits an RRCConnectionRelease-NB message.UE enters into RRC_IDLE state.

9. Trigger downlink data transmission in UDP layer.
10. The downlink data transmission test lasted for 3 minutes. Average Rate and Bit Error Rate in Recording Downlink Data Transmission.
11. Stop Downlink Data Transmission。
12. Decrease DL signal level of Cell A. Set NRS EPRE and other transmission parameters according to Table 6-23 T1.
13. Repeat step 9~step 10. Record the test results.
14. Decrease DL signal level of Cell A. Set NRS EPRE and other transmission parameters according to Table 6-23 T2.
15. Repeat step 9~step 10. Record the test results.
16. SS sends DETACH REQUEST to trigger detach procedure.
17. UE sends DETACH ACCEPT.
18. SS sends RRCConnectionRelease-NB.

POSTAMBLE
19. Deactive NB-IoT Cell A.

6.7.6 Expected Result

Record the test results in Table 6-25

Table 6-25: Test Results

MCL (dB)	Test Results	
	Average Data Transfer Rate	BER
120		
144		
164		

7 Power Consumption

7.1 Power Consumption in Idle State/PSM

7.1.1 Power Consumption in Idle State/PSM/ Good Coverage

7.1.1.1 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 under good coverage.

7.1.1.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.1.1.3 Test Applicability;

This test applies to NB-IoT modules

7.1.1.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-00
Standalone Operation.
Test Frequency = 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.

7.1.1.5 Test Procedure

PREAMBLE
1. Activate NB-IoT Cell A. The default paging cycle in SIB2 is set to 2.56s. Refer to Table 7-2

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 7-2: 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	
npdcch-NumRepetitionPaging-r13	r32	
}		
}		

7.1.1.6 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 test results in Table 7-3.

Table 7-3: Test Results

Status	Voltage (V)	Average Current(mA)
RRC_IDLE (Current1)		
Active Time (Current2)		
PSM (Current3)		

7. 1. 2 Power Consumption in Idle State/PSM/ Normal Coverage

7. 1. 2. 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 under normal coverage

7. 1. 2. 2 Reference Specification

3GPP TS 24.301, TS 36.331

7.1.2.3 Test Applicability;

This test applies to NB-IoT modules.

7.1.2.4 Test Conditions

The same as 7.1.1.4 except following configuration
NRS EPRE = -97dBm/15kHz

7.1.2.5 Test Procedure

The same as 7.1.1.5

7.1.2.6 Expected Result

Record the test results in Table7-3

Table 7-3: Test Results

Status	Voltage (V)	Average Current(mA)
RRC_IDLE (Current1）		
Active Time (Current2）		
PSM (Current3)		

7.1.3 Power Consumption in Idle State/PSM/ Weak Coverage

7.1.3.1 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 under weak coverage.

7.1.3.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.1.3.3 Test Applicability;

This test applies to NB-IoT modules

7. 1. 3. 4 Test Conditions

The same as 7.1.1.4 except the following configuration
NRS EPRE = -124dBm/15kHz

7. 1. 3. 5 Test Procedure

The same as 7.1.1.5

7. 1. 3. 6 Expected Result

Record the test results in Table7-4

Table 7-4: Test Results

Status	Voltage (V)	Average Current(mA)
RRC_IDLE（Current1）		
Active Time（Current2）		
PSM（Current3）		

7.2 Power Consumption in Idle State with eDRX

7.2.1 Power Consumption in Idle State with eDRX/ Good Coverage

7.2.1.1 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 under good coverage.

7.2.1.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.2.1.3 Test Applicability;

This test applies to NB-IoT modules

7.2.1.4 Test Conditions

[SS configuration]
NB-IoT Cell A

Cell Id=01 TAC = 01

MCC-MNC = 460-00

Standalone Operation.

Test Frequency = 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.

7.2.1.5 Test Procedure

PREAMBLE

1. Activate NB-IoT Cell A. The default paging cycle in SIB2 is set to 2.56s. Refer to Table 7-

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 81.92s. 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 81.92s 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, 81.92s and 655.36s. 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 7-5: 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	
npdcch-NumRepetitionPaging-r13	r32	
}		
}		

7.2.1.6 Expected Result

Record the test results in Table 7-6.

Table 7-6: Test Results

eDRX Cycle	Voltage (V)	Average Current(mA)
30 seconds		
2 minutes		
10 minutes		

7. 2. 2 Power Consumption in Idle State with eDRX/ Normal Coverage

7. 2. 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 under normal coverage.

7. 2. 2. 2 Reference Specification

3GPP TS 24.301, TS 36.331

7. 2. 2. 3 Test Applicability;

This test applies to NB-IoT modules

7. 2. 2. 4 Test Conditions

The same as 7.2.1.4 except the following configuration
NRS EPRE = -97dBm/15kHz

7. 2. 2. 5 Test Procedure

The same as 7.2.1.5

7.2.2.6 Expected Result

Record the test results in Table 7-7

Table 7-7: Test Results

eDRX Cycle	Voltage (V)	Average Current(mA)
20.48秒		
81.92秒		
655.36秒		

7.2.3 Power Consumption in Idle State with eDRX/ Weak Coverage

7.2.3.1 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 under weak coverage.

7.2.3.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.2.3.3 Test Applicability;

The same as 7.2.1.4 except the following configuration
This test applies to NB-IoT modules

7.2.3.4 Test Conditions

NRS EPRE = -124dBm/15kHz
The same as 7.2.1.4 except the uplink setting

7.2.3.5 Test Procedure

The same as 7.2.1.5

7.2.3.6 Expected Result

Record the test results in Table 7-8

Table 7-8: Test Results

eDRX Cycle	Voltage (V)	Average Current(mA)

20.48秒		
81.92秒		45
655.36秒		

7.3 UL UDP Service Power Consumption Test

7.3.1 UL UDP Service/ Power Consumption/15K ST

7.3.1.1 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 with uplink 15K single tone.

7.3.1.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.3.1.3 Test Applicability;

This test applies to NB-IoT modules

7.3.1.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-00
Standalone Operation.
Test Frequency = 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.

7.3.1.5 Test Procedure

Table 7-9: Time of cell power level

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-87	CE 0
T1			-97	CE 0
T3			-124	CE 2

Table 7-10: Parameter Configuration for uplink transmission

Time	npdcch-NumRepetitions (Rmax)	NPDCCH Repetitions (R)	NPUSCH Repetitions	UL MCS	Resource Assignment (Isf/Nsf)
T0	1	1	1	10/QPSK	5/6
T1	1	1	1	10/QPSK	5/6
T2	32	16	8	10/QPSK	5/6

PREAMBLE

1. Activate NB-IoT Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 7-9 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. Start power consumption measurement .

11. Trigger uplink data transmission in UDP layer. The data size is 200 octets. Verify UE transmit power is 0dBm.

12. SS transmits an RRCConnectionRelease-NB message.UE enters into RRC_IDLE state .

13. Stop power consumption measurement. Record the average current value and duration of sending a 200 octets UDP package

14. Repeat step 10 to 13 ten times. Record the average of 10 current values as Current 1. Record the average of 10 durations as Duration 1.

15. Decrease DL signal level of Cell A. Set NRS EPRE and other transmission parameters according to Table 7-9 T1

16. Repeat step 10 to 13 ten times. Record the average of 10 current values as Current 2, the average of 10 durations as Duration 2.

17. Decrease DL signal level of Cell A. Set NRS EPRE according to Table 7-9 T2

18. Repeat step 10 to 13 ten times. Record the average of 10 current values as Current 3, the average of 10 durations as Duration 3.

19. SS sends DETACH REQUEST to trigger detach procedure

20. UE sends DETACH ACCEPT.

21. SS sends RRCConnectionRelease-NB.

POSTAMBLE

22. Deactivate NB-IoT Cell A.

Table 7-11: Parameter Configuration for Power Control

Information Element	Value	Comment
UplinkPowerControlCommon-NB-r13 ::= SEQUENCE {		
p0-NominalNPUSCH-r13	-105	
alpha-r13	al1	
}		

7.3.1.6 Expected Result

Record the test results in Table 7-12

Table 7-12: Test Results

Voltage (V)	TX Power	Test Results			
		I_{WAKEUP}	T_{WAKEUP}	Current1/2/3	Duration1/2/3
	0dBm				
	10dBm				
	23dBm				

7.3.2 UL UDP Service/ Power Consumption//15K MT

7.3.2.1 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 with uplink 15K multi-tone.

7.3.2.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.3.2.3 Test Applicability;

This test applies to NB-IoT modules

7.3.2.4 Test Conditions

The same as 7.3.1.4 except the uplink setting.

NB-IoT Uplink setting:
Channel Bandwidth = 200kHz
Number of Tones=6
Sub-carrier spacing=15kHz

7.3.2.5 Test Procedure

The same as 7.3.1.5 except the following configuration

Table 7-13: Time of cell power level

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-79	CE0
T1			-89	CE0
T2			-124	CE2

Table 7-14: Parameter Configuration for uplink transmission

Time	npdcch-NumRepetitions (Rmax)	NPDCCH Repetitions(R)	NPUSCH Repetitions	UL MCS	Resource Assignment (Isf/Nsf)
T0	1	1	1	10/QPSK	5/6
T1	1	1	1	10/QPSK	5/6

T2	32	16	8	10/QPSK	5/6

7.3.2.6 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 test results in Table 7-15 .

Table 7-15: Test Results

Voltage (V)	TX Power	Test Results			
		I_{WAKEUP}	T_{WAKEUP}	Current1/2/3	Duration1/2/3
	0dBm				
	10dBm				
	23dBm				

7.3.3 UL UDP Service/ Power Consumption//3.75K

7.3.3.1 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 with uplink 3.75K.

7.3.3.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.3.3.3 Test Applicability;

This test applies to NB-IoT modules

7.3.3.4 Test Conditions

The same as 7.3.1.4 except the uplink setting.

NB-IoT Uplink setting:
Channel Bandwidth = 200kHz
Sub-carrier spacing=3.75kHz

7.3.3.5 Test Procedure

The same as 7.3.1.5 except the following configuration

Table 7-16: Time of cell power level

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-93	CE0
T1			-103	CE0
T2			-124	CE2

Table 7-17: Parameter Configuration for uplink transmission

Time	npdcch-NumRepetitions (Rmax)	NPDCCH Repetitions(R)	NPUSCH Repetitions	UL MCS	Resource Assignment (Isf/Nsf)
T0	1	1	1	10/QPSK	5/6
T1	1	1	1	10/QPSK	5/6
T2	32	16	4	10/QPSK	5/6

7.3.3.6 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 test results in Table 7-18.

Table 7-18: Test Results

Voltage (V)	TX Power	Test Results			
		I_{WAKEUP}	T_{WAKEUP}	Current1/2/3	Duration1/2/3
	0dBm				
	10dBm				
	23dBm				

7.3.4 UL UDP Service/ Power Consumption/15K ST/ Rate Enhancement

7.3.4.1 Test Purpose

To verify UE could well support the enhanced data rate and to measure the power consumption of UL service in different coverage with uplink 15K.

7.3.4.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.3.4.3 Test Applicability

This test applies to NB-IoT modules supporting R14 rate enhancement.

7.3.4.4 Test Conditions

The same as 7.3.1.4

7.3.4.5 Testing Procedures

The same as 7.3.1.5 except the following Cell power consumptipn and data transission paramters.

Table7-19:Parameter Configuration for uplink transmission

time	npdcch-NumRepetitions (Rmax)	NPDCCH Repetitions (R)	NPUSCH Repetitions	UL MCS	Resource Assignment (Iru/Nru)
T0	1	1	1	10/QPSK	7/10
T1	1	1	1	10/QPSK	7/10
T2	32	16	8	10/QPSK	7/10

7.3.4.6 Expected Results

Record the test results in Table 7-20

Table7-20 Test Results

Voltage (V)	TX Power	Test Results	
		(Current1/2/3)	(Duration1/2/3)
	0dBm		
	10dBm		
	23dBm		

7.3.5 UL UDP Service/ Power Consumption/15K MT/ Rate Enhancement

7.3.5.1 Test Purpose

To verify UE could well support the enhanced data rate and to measure the power consumption of UL service in different coverage with uplink 15K.

7.3.5.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.3.5.3 Test Applicability

This test applies to NB-IoT modules supporting R14 rate enhancement

7.3.5.4 Test Conditions

The same as 7.3.1.4

7.3.5.5 Testing Procedures

The same as 7.3.2.5 except the following configurations.

Table7-21: Parameter Configuration for uplink transmission

time	npdcch-NumRepetitions (Rmax)	NPDCCH Repetitions (R)	NPUSCH Repetitions	UL TBS Index	Resource Assignment (Iru/Nru)	UL HARQ PROCESS
T0	1	1	1	13/QPSK	7/10	2
T1	1	1	1	13/QPSK	7/10	2
T2	32	16	8	13/QPSK	7/10	2

7.3.5.6 Expected results

Record the average current in Table 7-22.

Table7-1: Test Results

Voltage (V)	TX Power	Test Results	
		(Current1/2/3)	(Duration1/2/3)
	0dBm		
	10dBm		
	23dBm		

7.3.6 UL UDP Service/ Power Consumption/3.75K/ Rate Enhancement

7.3.6.1 Test Purpose

To verify UE could well support the enhanced data rate and to measure the power consumption of UL service in different coverage with uplink 3.75K.。

7.3.6.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.3.6.3 Test Applicability

This test applies to NB-IoT modules supporting R14 rate enhancement.

7.3.6.4 Test Condition

The same as 7.3.3.4

7.3.6.5 Testing Procedures

The same as 7.3.3.5 except the following parameters

Table7-23: Parameter Configuration for uplink transmission

time	npdcch-NumRepetitions (Rmax)	NPDCCH Repetitions (R)	NPUSCH Repetitions	UL MCS	Resource Assignment (Iru/Nru)
T0	1	1	1	10/QPSK	7/10
T1	1	1	1	10/QPSK	7/10
T2	32	16	8	10/QPSK	7/10

7.3.6.6 Expected results

Record the average current in Table 7-24

Table7-24: Test Results

Voltage (V)	TX Power	Test Results	
		(Current1/2/3)	(Duration1/2/3)
	0dBm		
	10dBm		
	23dBm		

7.4 DL UDP Service / Power Consumption

7.4.1 DL UDP Service / Power Consumption

7.4.1.1 Test Purpose

To verify UE could well support DL UDP transmission. To measure its power consumption of DL service

7.4.1.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.4.1.3 Test Applicability;

This test applies to NB-IoT modules

7.4.1.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-00
Standalone Operation.
Test Frequency = 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 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.

7.4.1.5 Test Procedure

Table 7-4: Time of cell power level

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-87	MCL 120
T1			-97	MCL 144
T3			-124	MCL 164

Table 7-5: Parameter Configuration for Downlink Transmission

Time	npdcch-NumRepetitions (Rmax)	NPDCCH Repetitions(R)	NPDSCH Repetitions	DL MCS	Resource Assignment(Isf/Nsf)
T0	1	1	1	10/QPSK	3/4
T1	1	1	1	10/QPSK	3/4
T2	32	16	16	10/QPSK	3/4

PREAMBLE

1. Activate NB-IoT Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 7-4 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" and "Extended DRX parameters" are not included in ATTACH ACCEPT.
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. SS sends a Paging message to page UE.

11. Verify that UE perform RACH as the response to paging message.

12. SS sends one UDP packet to UE. downlink . The data size is 200 octets. T SS releases RRC connection after the transmission.

13. Stop measuring power consumption. Record the average current and data transmission duration during DL trasmssion process.

14. Repeat step 10 to 14 ten times. Record the average current and duration for 10 times .

15. Decrease DL signal level of Cell A. Set NRS EPRE according to table 7-25 T1

16. Repeat step 10~step 15. Record the test results

17. Decrease downlink signal level of Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 7-4 Time T2

18. Repeat step 10~step 15. Record the test results.

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

7.4.1.6 Expected Result

Record the test results in Table 7-6.

Table 7-6 Test Results

MCL (dB)	Voltage (V)	Test Results	
		Data Transmission Current (mA)	Data Transmission Duration (ms)
120			
144			
164			

7.4.2 DL UDP Service/ Power Consumption Test/Rate Enhancement

7.4.2.1 Test Purpose

To measure the power consumption of downlink data transmission of UE that supports throughput enhancement.

7.4.2.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.4.2.3 Test Applicability;

This test applies to NB-IoT modules supporting R14 rate enhancement.

7.4.2.4 Test Conditions

The same as 7.4.1.4

7.4.2.5 Test Procedure

The same as 7.4.1.5 except the following configurations.

Table 7-28: Parameter Configuration for Downlink Transmission

time	npdcch-NumRepetitions (Rmax)	NPDCCH Repetitions(R)	NPDSCH Repetitions	DL MCS	Resource Assignment(Isf/Nsf)	DL HARQ PROCESS
T0	1	1	1	13/QPSK	7/10	2
T1	1	1	1	13/QPSK	7/10	2
T2	32	16	16	13/QPSK	7/10	2

7.4.2.6 Expected Result

Record the test results in Table 7-29

Table 7-29 Test Results

MCL (dB)	Voltage (V)	Test Results	
		Data Transmission Current (mA)	Data Transmission Duration (ms)
120			
144			
164			

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 =460-00
Standalone Operation.
Test Frequency = 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 7-30: 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 7-300 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 7-3030 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 7-30 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 test results in Table 7-31.

Table 7-31: Test Results

MCL (dB)	Voltage (V)	Test Results	
		Data Transmission Current (mA)	Data Transmission Duration (ms)
120			
144			
164			

7.6 Uplink Data Transmission in MAC Layer / Power Consumption

7.6.1 Uplink Data Transmission in MAC Layer/ Power Consumption/15K ST

7.6.1.1 Test Purpose

To measure UE power consumption of uplink data transmission in MAC layer in different coverage with uplink 15K single tone.

7.6.1.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.6.1.3 Test Applicability;

This test applies to NB-IoT modules

7.6.1.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-00
Standalone Operation.
Test Frequency = 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.

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.

7.6.1.5 Test Procedure

Table 7-32: Time of cell power level

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-87	CE 0
T1			-97	CE 0
T2			-124	CE 2

Table 7-33: Parameter Configuration for uplink transmission

Time	npdcch-NumRepetitions (Rmax)	NPDCCH Repetitions (R)	NPUSCH Repetitions	UL MCS	Resource Assignment (Isf/Nsf)
T0	1	1	1	10/QPSK	5/6
T1	1	1	1	10/QPSK	5/6
T2	32	16	8	10/QPSK	5/6

PREAMBLE

1. Activate NB-IoT Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 7-32 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.

6. Steps (4) to (9) of the registration procedure 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.

8. UE transmits an ATTACH COMPLETE message and an ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT message.

9. SS triggers uplink data transmission in MAC layer.

10. Verify that UE transmit power is 0dBm

11. Start power consumption measurement. Measure the power consumption of data transmission for 5 minutes

12. Stop power consumption measurement. Get the average current value, uplink data rate and BER(Bit Error Rate).

13. Stop uplink data transmission in MAC layer. SS transmits an RRCConnectionRelease-NB message. UE enters into RRC_IDLE state.

14. Decrease downlink signal level of Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 7-32 Time T1

15. SS sends a Paing message to page UE. SS triggers uplink data transmission in MAC layer.

16. Verify that UE transmit power is 10dBm

17. Start power consumption measurement. Measure the power consumption of data transmission for 5 minutes

18. Stop power consumption measurement. Get the average current value, uplink data rate and BER(Bit Error Rate).

19. Stop uplink data transmission in MAC layer. SS transmits an RRCConnectionRelease-NB message. UE enters into RRC_IDLE state.

20. Decrease downlink signal level of Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 7-32 Time T2

21. SS sends a Paing message to page UE. SS triggers uplink data transmission in MAC layer.

22. Verify that UE transmit power is 10dBm

23. Start power consumption measurement. Measure the power consumption of data transmission for 5 minutes

24. Stop power consumption measurement. Get the average current value, uplink data rate and BER(Bit Error Rate).

25. Stop uplink data transmission in MAC layer. SS transmits DETACH REQUEST message. UE responds with DETACH ACCEPT.

26. SS transmits an RRCConnectionRelease-NB message.

POSTAMBLE

27. Deactive NB-IoT Cell A

7.6.1.6 Expected Result

Record the test results in Table 7-34

Table 7-34: Test Results

TX Power	Voltage (V)	Test Results		
		Average Current	Uplink Data Rate	BER
0dBm				
10dBm				
23dBm				

7.6.2 Uplink Data Transmission in MAC Layer/ Power Consumption/15K MT

7.6.2.1 Test Purpose

To measure UE power consumption of uplink data transmission in MAC layer in different coverage with uplink 15K multi-tone.

7.6.2.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.6.2.3 Test Applicability;

This test applies to NB-IoT modules

7.6.2.4 Test Conditions

The same as 7.6.1.4 except the uplink setting.

NB-IoT Uplink setting:
Channel Bandwidth = 200kHz
Number of Tones=6
Sub-carrier spacing=15kHz

7.6.2.5 Test Procedure

The same as 7.6.1.5 except the following configurations

Table 7-35: Time of cell power level

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-79	CE0
T1			-89	CE0
T2			-124	CE2

Table 7-36: Parameter Configuration for uplink transmission

Time	npdcch-NumRepetitions (Rmax)	NPDCCH Repetitions(R)	NPUSCH Repetitions	UL MCS	Resource Assignment (Isf/Nsf)
T0	1	1	1	10/QPSK	5/6
T1	1	1	1	10/QPSK	5/6
T2	32	16	8	10/QPSK	5/6

7.6.2.6 Expected Result

Record the test results in Table 7-37.

Table 7-37: Test Results

TX Power	Voltage (V)	Test Results		
		Average Current	Uplink Data Rate	BER
0dBm				
10dBm				
23dBm				

7.6.3 Uplink Data Transmission in MAC Layer/ Power Consumption/3.75K

7.6.3.1 Test Purpose

To measure UE power consumption of uplink data transmission in MAC layer in different coverage with uplink 3.75K

7.6.3.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.6.3.3 Test Applicability;

This test applies to NB-IoT modules

7.6.3.4 Test Conditions

The same as 7.6.1.4 except the uplink setting.

NB-IoT Uplink setting:
Channel Bandwidth = 200kHz
Sub-carrier spacing=3.75kHz

7.6.3.5 Test Procedure

The same as 7.6.1.5 except the following configurations

Table 7-38: Time of cell power level

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-93	CE0
T1			-103	CE0

Time			-124	CE2
T2			-124	CE2

Table 7-39: Parameter Configuration for uplink transmission

Time	npdcch-NumRepetitions (Rmax)	NPDCCH Repetitions(R)	NPUSCH Repetitions	UL MCS	Resource Assignment (Isf/Nsf)
T0	1	1	1	10/QPSK	5/6
T1	1	1	1	10/QPSK	5/6
T2	32	16	4	10/QPSK	5/6

7.6.3.6 Expected Result

Record the test results in Table 7-40

Table 7-40: Test Results

TX Power	Voltage (V)	Test Results		
		Average Current	Uplink Data Rate	BER
0dBm				
10dBm				
23dBm				

7.6.4 Uplink Data Transmission in MAC Layer/15K ST/Rate enhancement

7.6.4.1 Test Purpose

To measure UE power consumption of uplink data transmission in MAC layer under different coverage with uplink 15K single tone.. Rate enhancement is supported

7.6.4.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.6.4.3 Test Applicability;

This test applies to NB-IoT modules supporting R14 rate enhancement

7.6.4.4 Test Conditions

The same as 7.6.1.4

7.6.4.5 Test Procedure

The same as 7.6.1.5 except the following configurations

Table 7-41: Parameter Configuration for uplink transmission

time	npdcch-NumRepetitions (Rmax)	NPDCCH Repetitions(R)	NPUSCH Repetitions	UL MCS	Resource Assignment (Iru/Nru)	UL HARQ Process
T0	1	1	1	10/QPSK	7/10	2
T1	1	1	1	10/QPSK	7/10	2
T2	32	16	8	10/QPSK	7/10	2

7.6.4.6 Expected Result

Record the test results in Table 7-42

Table 7-42: Test Results

TX Power	Voltage (V)	Test Results		
		Average Current	Data Rate	BER
0dBm				
10dBm				
23dBm				

7.6.5 Uplink Data Transmission in MAC Layer/15K MT/Rate enhancement

7.6.5.1 Test Purpose

To measure UE power consumption of uplink data transmission in MAC layer under different coverage with uplink 15K multi-tone.. Rate enhancement is supported

7.6.5.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.6.5.3 Test Applicability;

This test applies to NB-IoT modules supporting R14 rate enhancement

7.6.5.4 Test Conditions

The same as 7.6.2.4

7.6.5.5 Test Procedure

The same as 7.6.2.5 except the following configurations

Table 7-43: Parameter Configuration for uplink transmission

time	npdcch-NumRepetitions (Rmax)	NPDCCH Repetitions (R)	NPUSCH Repetitions	UL TBS Index	Resource Assignment (Iru/Nru)	UL HARQ PROCESS
T0	1	1	1	13/QPSK	7/10	2
T1	1	1	1	13/QPSK	7/10	2
T2	32	16	8	13/QPSK	7/10	2

7.6.5.6 Expected Result

Record the test results in Table 7-44

Table 7-44: Test Results

TX Power	Voltage（V）	Test Results		
		Average Current	Data Rate	BER
0dBm				
10dBm				
23dBm				

7.6.6 Uplink Data Transmission in MAC Layer/3.75K/Rate enhancement

7.6.6.1 Test Purpose

To measure UE power consumption of uplink data transmission in MAC layer under different coverage with uplink 3.75k. Rate enhancement is supported

7.6.6.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.6.6.3 Test Applicability;

This test applies to NB-IoT modules supporting R14 rate enhancement

7.6.6.4 Test Conditions

The same as 7.6.3.4

7. 6. 6. 5 Test Procedure

The same as 7.6.3.5 except the following configurations

Table 7-45: Parameter Configuration for uplink transmission

time	npdcch-NumRepetitions (Rmax)	NPDCCH Repetitions (R)	NPUSCH Repetitions	UL MCS	Resource Assignment (Iru/Nru)	UL HARQ PROCESS
T0	1	1	1	10/QPSK	7/10	2
T1	1	1	1	10/QPSK	7/10	2
T2	32	16	8	10/QPSK	7/10	2

7. 6. 6. 6 Expected Result

Record the test results in Table 7-46.

Table 7-46: Test Results

TX Power	Voltage （V）	Test Results		
		Average Current	Data Rate	BER
0dBm				
10dBm				
23dBm				

7.7 Downlink Data Transmission in MAC Layer / Power Consumption

7.7.1 Downlink Data Transmission in MAC Layer / Power Consumption

7.7.1.1 Test Purpose

To measure UE power consumption of downlink data transmission in MAC layer in different coverage.

7.7.1.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.7.1.3 Test Applicability;

This test applies to NB-IoT modules

7.7.1.4 Test Conditions

[SS configuration]

NB-IoT Cell A

Cell Id=01 TAC = 01

MCC-MNC = 460-00

Standalone Operation.

Test Frequency = 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.

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.

7.7.1.5 Test Procedure

Table 7-47: Time of cell power level

Time	Parameter	Unit	Cell A	Note
T0	NRS EPRE	dBm/15kHz	-87	MCL 120
T1			-97	MCL 144
T2			-124	MCL 164

Table 7-48: Parameter Configuration for Downlink Transmission

Time	npdcch-NumRepetitions (Rmax)	NPDCCH Repetitions(R)	NPDSCH Repetitions	DL MCS	Resource Assignment(Isf/Nsf)
T0	1	1	1	10/QPSK	3/4
T1	1	1	1	10/QPSK	3/4
T2	32	16	16	10/QPSK	3/4

PREAMBLE

1. Activate NB-IoT Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 7-47 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.

6. Steps (4) to (9) of the registration procedure 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.

8. UE transmits an ATTACH COMPLETE message and an ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT message.

9. SS triggers downlink data transmission in MAC layer.

10. Start power consumption measurement. Measure the power consumption of downlink data transmission for 5 minutes.

11. Stop power consumption measurement. Record the average current value, downlink data rate and BER (Bit Error Rate).

12. Stop downlink data transmission

13. Decrease downlink signal level of Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 7-47 Time T1.

14. Repeat step 9-12. Record the test results.

15. Decrease downlink signal level of Cell A. Set the Downlink signal level to the NRS EPRE value defined in Table 7-47 Time T2.

16. Repeat step 9-12. Record the test results.

17. The SS sends DETACH REQUEST to initiate Detach procedure. UE responds with DETACH ACCEPT

18. The SS transmits an RRCConnectionRelease-NB message

POSTAMBLE

19. Deactive NB-IoT Cell A

7.7.1.6 Expected Result

Record the test results in Table 7-49.

Table 7-49: Test Results

MCL (dB)	Voltage (V)	Test Results		
		Average Current	Downlink Data Rate	BER
120				
144				

164				

7.7.2 Downlink Data Transmission in MAC Layer / Power Consumption / Rate Enhancement

7. 7. 2. 1 Test Purpose

To measure UE power consumption of downlink data transmission in MAC layer in different coverage. Rate enhancement is supported

7. 7. 2. 2 Reference Specification

3GPP TS 24.301, TS 36.331

7. 7. 2. 3 Test Applicability;

This test applies to NB-IoT modules supporting R14 rate enhancement

7. 7. 2. 4 Test Conditions

The same as 7.7.1.4

7. 7. 2. 5 Test Procedure

The same as 7.7.1.5 except the following configurations

Table 7-50: Parameter Configuration for Downlink Transmission

time	npdcch-NumRepetitions (Rmax)	NPDCCH Repetitions(R)	NPDSCH Repetitions	DL MCS	Resource Assignment(Isf/Nsf)	DL HARQ PROCESS
T0	1	1	1	13/QPSK	7/10	2
T1	1	1	1	13/QPSK	7/10	2
T2	32	16	16	13/QPSK	7/10	2

7. 7. 2. 6 Expected Result

Record the test results in Table 7-51.

Table 7-7: Test Results

MCL (dB)	Voltage (V)	Test Results		
		Average Current	Downlink Data Rate	BER

120				
144				
164				

7.8 Power Consumption of Registration

7.8.1 Test Purpose

To measure power consumption of UE registration.

7.8.2 Reference Specification

3GPP TS 24.301, TS 36.331

7.8.3 Test Applicability;

This test applies to NB-IoT modules

7.8.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-00
Standalone Operation.
Test Frequency = 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

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

7.8.5 Test Procedure

PREAMBLE

1. Activate NB-IoT Cell A. 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.

MAIN BODY

3. Switch on power consumption tester
4. Power on the UE.
5. The UE transmits RRCConnectionRequest-NB to perform registration. SS transmits RRCConnectionSetup-NB.
6. UE transmits an RRCConnectionSetupComplete-NB message containing an ATTACH REQUEST and a PDN CONNECTIVITY REQUEST.
7. Steps (4) to (9) of the registration procedure in Table 5-1 are performed on Cell A.
8. SS tranmits an ATTACH ACCEPT message and an ACTIVATE DEFAULT EPS BEARER CONTEXT REQUEST message.
9. UE transmits an ATTACH COMPLETE message and an ACTIVATE DEFAULT EPS BEARER CONTEXT ACCEPT message.
10. Stop power consumption measurement once SS receive ATTACH COMPLETE. Record the average power during registration. Record the registration duration. Note: Registration procedure is from step 4to step 9.
11. The SS sends DETACH REQUEST to initiate Detach procedure. UE responds with DETACH ACCEPT
12. The SS transmits an RRCConnectionRelease-NB message
13. Power off the UE
14. Repeat step3-13 twice.

POSTAMBLE

15. Deactive NB-IoT Cell A

7.8.6 Expected Result

Record the test results in Table 7-52

Table 7-52: Test Results

NO.	Voltage (V)	Test Results	
		Average Current (mA)	Registration Duration (ms)

1			
2			
3			

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 = 460-00
Standalone Operation.
Test Frequency = 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/BDS

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 = 460-00
Standalone Operation.
Test Frequency   = 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 = 460-00
Standalone Operation.
Test Frequency   = 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. Test for 5 minutes. 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 / BDS / Power Consumption

8.4.1 Test Purpose

To measure the average current when UE performs BDS positioning and reports GPS 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 = 460-00
Standalone Operation.
Test Frequency   = 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. Test for 5 minutes. 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 Communication Suite

A.1 Test Architecture for Communication Suite

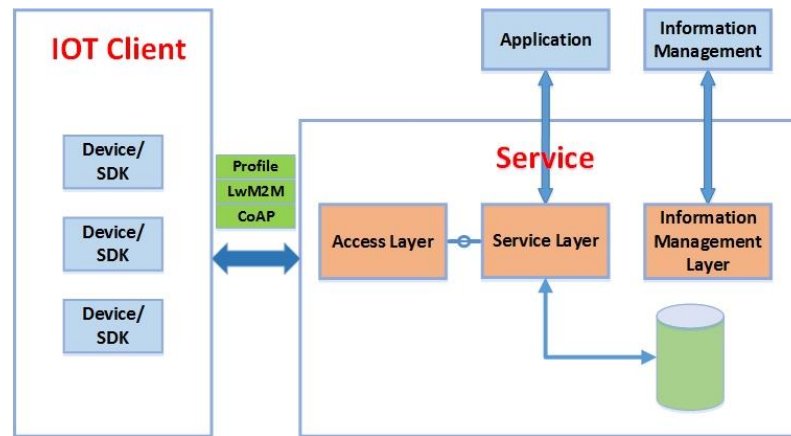Figure 4-2 Test Architecture for Communication Suite

The interface between communication suite in device and OneNET platform is defined in <China Mobile NB-IoT Technical specification - Data and Message Exchange Center > . The communication protocol in data transport layer is CoAP. The communication protocol in application layer is compatible with LwM2M and extended the Object/Resource based on the profile defined by IPSO.

A.2 Communication Suite

A.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 >

A.2.2 Reference Specification

< The Technical Solution for NB-IOT Service Layer>

<The Communication Protocol and Format between Device and OneNET >

A.2.3 Test Applicability

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

A.2.4 Test Conditions

[SS configuration]
NB-IoT Cell A
Cell Id=01 TAC = 01
MCC-MNC = 460-00
Standalone Operation.
Test Frequency = 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

A.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

A.2.6 Expected Result

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

Annex B Propagation Conditions

Refer to Annex B in 3gpp TS 36.521-1.