# GTI Test Solution for MIoT Terminal: Smart Smoke Detector

*GTI Test Solution for MIoT Terminal:*

*Smart Smoke Detector*

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## Document History

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Contents

# 1 Scope

This document defines the test solution for communication capability of NB-IoT smart smoke detector.

# 2 References

[1] GTI NB-IoT Terminal OTA Test Specification, 2018.10

# 3 Definitions, symbols and abbreviations

| Abbreviation | Definitions |
|---|---|
| NB-IoT | Narrow Band Internet of Things |
| DUT | Device under Test |
| RSRP | Reference Signal Received Power |
| SINR | Signal to Interference plus Noise Ratio |
| OTA | Over The Air |
| TRP | Total Radiated Power |
| TIS | Total Istropic Sensitivity |

# 4 Test Environment

The test environment defined in this specification consists of the following equipment.

- The wireless equipment and interfaces include eNB, an S1 interface between eNB and MME, an S1-U interface between eNB and S-GW.
- The core network equipment and interfaces include MMEs, S-GWs, P-GWs, SCEFs, HSSs, MSCs, SMSCs, OneNETs and ASs, and S6a, S11, S5, T6a, SGs, SGd.
- Data platform, including OneNET, AS and others.

The following figure shows NB-IoT network architecture for the logical entity

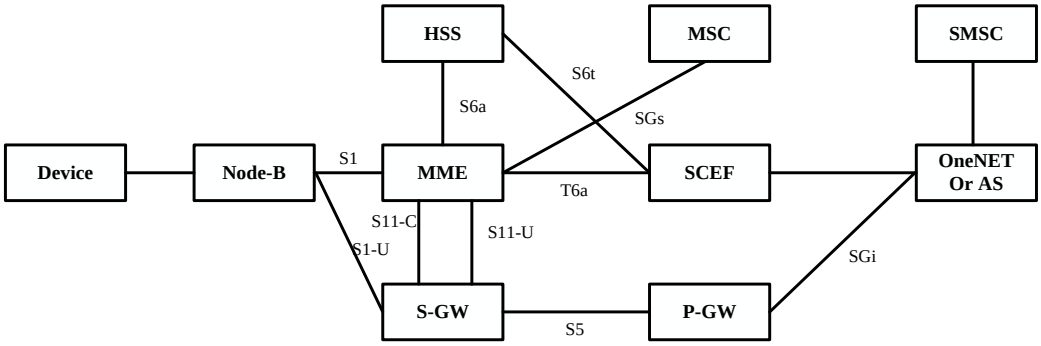


Figure4-1 NB-IoT network architecture

The following are the uplink test point selection principle in stand-alone, In-band and Guard-band Mode.

Stand-alone mode:

- Excellent Point: RSRP>-100dBm,
- Good Point: -105dBm >= RSRP >= -110dBm
- Middle Point: -115dBm >= RSRP >=-120dBm
- Poor Point: RSRP<-125dBm

In-band/Guard-band mode:

- Excellent Point: RSRP > -100dBm
- Good Point: -113dBm >= RSRP >= -118dBm
- Middle Point: -123dBm > = RSRP >= -128dBm
- Poor Point: RSRP < -133dBm

The downlink test point shall be selected accroding to NRS-SINR value. NRS-SINR=(|H0,0|^2+|H0,1|^2)／(2|ni|^2).

- Excellent Point: >10dB
- Good Point: 5~10dB
- Middle Point: 0dB~5dB
- Poor Point: -5dB~0dB

Or with reference to the 3GPP specification, the test points could be selected based on MCL (Maximum Coupling Losses), which is the difference between the eNB maximum transmit power and the receive sensitivity.

- Nomal Coverage: CE=0, MCL＜144dB
- Robust Coverage: CE=1, 144dB＜MCL＜154dB
- Extreme Coverage: CE=2, 154dB＜MCL＜164dB

# 5 Service Procedure

## 5.1 Service Procedure

### 5.1.1 Switching On

| | |
|---|---|
| TC NO. | 错误!未找到引用源。 |
| Test Case | |
| Test Purpose | To verify that DUT could access to the NB-IoT cell and register to service platform when switching on. |
| Initial configuration | 1. NB-IoT cell works well; |
| Test procedure | 1. Choose the excellent coverage point, DUT is in the coverage area of the test area<br>2. Power on the DUT.<br>3. DUT executes cell search, random access, RRC connection establishment and other attachment processes, DUT registers to the cell.<br>4. DUT registers to the service platform<br>5. Switch off the DUT<br>6. Repeat step 2-5 four more times |
| Check Point | 1. Step4, DUT could complete the registration to NB-IoT cell<br>2. Step5, DUT could complete the registration to service platform |
| Note | |

### 5.1.2 Periodic Status Report

| | |
|---|---|
| TC NO. | 5.1.2 |
| Test Case | Periodic Status Report |
| Test Purpose | 1. To verify that DUT could send status report to service platform periodically.<br>2. To verify that the status report includes RSRP/SINR/ECL/PCI<br>3. To verify that DUT could enter into PSM after reporting |
| Initial configuration | 1. NB-IoT cell works well<br>2. The Reporting period is set to 3 minutes |
| Test procedure | 1. Choose the excellent coverage point, DUT is in the coverage area of the test area<br>2. Power on the DUT.<br>3. DUT executes cell search, random access, RRC connection establishment and other attachment processes, DUT registers to the cell.<br>4. DUT registers to the service platform<br>5. Wait for 3 minutes. DUT sends periodic status report<br>6. Check that DUT enter into PSM when complete the reports<br>7. Wait for another 3 minutes. |
| Check Point | 1. Step 5, DUT could send the status report.<br>2. Step 5, the status report contains the information of RSRP/SINR/ECL/PCI<br>3. Step 6, DUT could enter into PSM<br>4. Step 7, DUT could send the status report |
| Note | |

### 5.1.3 Alarm Report

| | |
|---|---|
| TC NO. | 5.1.3 |
| Test Case | Alarm Report |
| Test Purpose | 1. To verify that DUT supports alarm report |
| Initial configuration | 1. NB-IoT cell works well |
| Test procedure | 1. Choose the excellent coverage point, DUT is in the coverage area of the test area<br>2. Power on the DUT.<br>3. DUT executes cell search, random access, RRC connection establishment and other attachment processes, DUT registers to the cell.<br>4. DUT registers to the service platform.<br>5. Simulate the simulation when DUT is out of order. Trigger DUT to send alarm report.<br>6. Simulate the simulation when the smoke detected. Trigger DUT to send alarm report. |
| Check Point | 1. Step 5, DUT could send alarm report.<br>2. Step 6, DUT could send alarm report. |
| Note | |

### 5.1.4 Configuration

| | |
|---|---|
| TC NO. | 5.1.4 |
| Test Case | Configuration |
| Test Purpose | 1.To verify that DUT supports the local pre-configuration of service parameters<br>2.To verify that DUT supports the remote configuration of service parameters from service platform |
| Initial configuration | 1. NB-IoT cell works well |
| Test procedure | 1. Choose the excellent coverage point, DUT is in the coverage area of the test area<br>2. Configuration the APN, service platform address and period of status report locally<br>3. Power on the DUT.<br>4. DUT executes cell search, random access, RRC connection establishment and other attachment processes, DUT registers to the cell.<br>5. DUT registers to the service platform.<br>6. Change the period of status report on service platform. |
| Check Point | 1. Step 2, the parameters are successfully configured and take effect<br>2. Step 6, DUT could receive the configuration information from service platform |
| Note | |

# 6 Service Capability

## 6.1 Network Accesses Capability

| TC NO. | 6.1 |
|---|---|
| Test Case | Network Accesses Capability 错误!未找到引用源。 |
| Test Purpose | To verify that DUT could access to the NB-IoT cell and register to service platform in the coverage of CE0 and CE1 |
| Initial configuration | 1. NB-IoT cell works well; |
| Test procedure | 1. Choose the test point in CE 1 coverage\<br>2. DUT is in the coverage area of the test area<br>3. Power on the DUT.<br>4. DUT executes cell search, random access, RRC connection establishment and other attachment processes, DUT registers to the cell.<br>5. DUT registers to the service platform<br>6. Switch off the DUT<br>7. Repeat step 3-6 four more times. |
| Check Point / Data Record | 1. Step4, DUT could complete the registration to NB-IoT cell<br>2. Step5, DUT could complete the registration to service platform<br>3. Record the duration of step 4 and step 5. Get the average value of 5 times |
| Note | |

## 6.2 Delay Performance of Periodic Report

| TC NO. | 6.2 |
|---|---|
| Test Case | Delay Performance of Periodic Report 错误!未找到引用源。 |
| Test Purpose | To verify that DUT could meet service core KPI, such as 30s end-to-end delay, in the coverage of CE0 and CE1 |
| Initial configuration | 1. NB-IoT cell works well; |
| Test procedure | 1. Choose 4 areas: RSRP: >-95dBm、RSRP: -105dBm～-100dBm、RSRP: -120dBm～-115dBm、RSRP: <-125dBm；<br>2. Choose more than 3 different test points in each area;<br>3. DUT is located in the ith test point of test area jth；(i=1~3; j=1~4)<br>4. DUT triggers a periodic report;<br>5. The service platform receives the periodic report;<br>6. Repeat step 4-5 20 more times;<br>7. Repeat step 3-6, until i=3,j=4; |
| Check Point / Data Record | 4. Start point: DUT triggers a periodic report;<br>5. End point: the service platform receives the periodic report;<br>6. Record the duration of step 4 and step 5. Get the average value of 20 times<br>7. Record RSRP/SINR/Service success rate of every test point; |
| Note | |

# 7Battery Life

## 7.1 Power Consumption Performance

### 7.1.1 Power Consumption of Switching On

| | |
|---|---|
| TC NO. | 7.1.2 |
| Test Case | Switch on |
| Test Purpose | Test the average current and duration when the terminal switches on |
| Initial configuration | 1. NB-IoT cell works well;<br>2. The DUT is equipped with fake battery and connected to the power consumption tester via power line |
| Test procedure | 1. Choose the excellent coverage point, DUT is in the coverage area of the test area<br>2. Set the output voltage of power consumption tester the same as DUT nominal voltage<br>3. Switch on power consumption tester and power on the DUT.<br>4. Start power consumption measurement .Measure and record the average current and duration during DUT registration. The registration procedure is defined as the period from DUT switches on to DUT completes the registration at service platform and enters into idle mode again.<br>5. Stop power consumption measurement.<br>6. Switch off the DUT<br>7. Repeat step 3-5 twice more. Get the average current and duration values of three times. |
| Check Point / Data Record | Record the voltage (V), average current ($I_{SwitchOn}$) and duration ($T_{SwitchOn}$) while registration. |
| Note | |

### 7.1.2 Power Consumption during Standby

| | |
|---|---|
| TC NO. | 错误!未找到引用源。 |
| Test Case | Standby |
| Test Purpose | Test the average current when terminal is in standby mode (The voltage is fixed) |
| Initial configuration | 1. NB-IoT cell works well;<br>2. The DUT is equipped with fake battery and connected to the power consumption tester via power line |

| | |
|---|---|
| Test procedure | 1. Choose the excellent coverage point, DUT is in the coverage area of the test area<br>2. Set the output voltage of power consumption tester the same as DUT nominal voltage<br>3. Switch on power consumption tester and power on the DUT.<br>4. DUT executes cell search, random access, RRC connection establishment and other attachment processes, DUT registers to the cell<br>5. DUT registers to the service platform<br>6. DUT enters into standby mode<br>7. Start power consumption measurement .Measure the average current for 5 minutes while DUT is in standby mode. Record the test results<br>8. Stop power consumption measurement. |
| Check Point / Data Record | Record the voltage (V) and average current ($I_{Standby}$) in step 7. |
| Note | |

### 7.1.3 Power Consumption of Periodic Status Report

| | |
|---|---|
| TC NO. | 7.1.3 |
| Test Case | Power Consumption of Periodic Status Report 错误!未找到引用源。 |
| Test Purpose | Test the average current and time duration during periodic status report |
| Initial configuration | 1. NB-IoT cell works well;<br>2. The DUT is equipped with fake battery and connected to the power consumption tester via power line |
| Test procedure | 1. Choose the excellent coverage point, DUT is in the coverage area of the test area<br>2. Set the output voltage of power consumption tester the same as DUT nominal voltage<br>3. Switch on power consumption tester and power on the DUT.<br>4. DUT registers to the cell<br>5. DUT completes the registration to service platform and enters into standby mode<br>6. Trigger DUT to send periodic status report<br>7. Start power consumption measurement. Measure and record the average current and duration during periodic status report.<br>8. Stop power consumption measurement after DUT completes the report and enters into standby mode again.<br>9. Repeat step 6-8 twice more. Get the average current and duration values of three times. |
| Check Point / Data Record | Record the voltage (V), average current ($I_{PSR}$) and duration ($T_{PSR}$) where PSR means Periodic Status Report. |
| Note | |

### 7.1.4 Power Consumption of Alarm Report

| | |
|---|---|
| TC NO. | 7.1.4 |
| Test Case | Power Consumption of Alarm Report 错误!未找到引用源。 |
| Test Purpose | Test the average current and time duration during alarm report |

| | |
|---|---|
| Initial configuration | 1. NB-IoT cell works well;<br>2. The DUT is equipped with fake battery and connected to the power consumption tester via power line |
| Test procedure | 1. Choose the excellent coverage point, DUT is in the coverage area of the test area<br>2. Set the output voltage of power consumption tester the same as DUT nominal voltage<br>3. Switch on power consumption tester and power on the DUT.<br>4. DUT registers to the cell<br>5. DUT completes the registration to service platform and enters into standby mode<br>6. Trigger DUT to send alarm report<br>7. Start power consumption measurement. Measure and record the average current and duration during alarm report.<br>8. Stop power consumption measurement after DUT completes the report and enters into standby mode again.<br>9. Repeat step 6-8 twice more. Get the average current and duration values of three times. |
| Check Point / Data Record | Record the voltage (V), average current ($I_{AR}$) and duration ($T_{AR}$) where AR means Alarm Report. |
| Note | |

## 7.2 Calculation of Battery life

This section describes how to calculate the bettery life based on the power consumption test results in 8.1

The battery lifetime measure is the following:

1) Record the battery capacity of DUT as $C$, the unit is $mAh$

2) Record the frequency of Periodic Status Report as $f_{PSR}$, which means $f_{PSR}$ times per Day

3) Estimate the frequency of Alarm Report as $f_{AR}$, which means $f_{AR}$ times per Day

4) Estimate the times of starting up per day as $f_{SwitchOn}$ which may be Decimals less than 1

5) Calculate the Battery life according to following formula:

$$Battery\ life = C / C_{Day}$$

Where $C_{Day} = f_{PSR} I_{PSR} T_{PSR} + f_{AR} I_{AR} T_{AR} + f_{StartUp} I_{SwitchOn} T_{SwitchOn} + I_{Standby} T_{Standby}$

$$I_{Standby} = 24\ hours - (f_{PSR} T_{PSR} + f_{AR} T_{AR} + f_{SwitchOn} T_{SwitchOn})$$

# 8 OTA Performance

## 8.1 TRP

Refer to TC 5.2 in GTI NB-IoT Terminal OTA Test Specification

## 8.2 TRS

Refer to TC 5.4 in GTI NB-IoT Terminal OTA Test Specification