ME310M1 NTN

Application Note

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1 Applicability Table

Table 1: Applicability Table

Products
ME310M1-W1 / ME310M1-W1N

2 Introduction

2.1 Scope

This document describes how to configure and operate the NB-IoT Non-Terrestrial Networks (NTN) feature on the ME310M1-W1 product, including Radio Access Technology (RAT) selection, band and APN configuration, UE positioning, and recommended URC monitoring for troubleshooting.

2.2 Audience

This document is intended for system integrators, application developers, and test engineers integrating the ME310M1-W1 module into products that require NB-IoT NTN connectivity.

2.3 Contact Information, Support

For technical support and general questions, e-mail:

- TS-EMEA@telit.com
- TS-AMERICAS@telit.com
- TS-APAC@telit.com
- TS-SRD@telit.com
- TS-ONEEDGE@telit.com
- TS-LOCATION@telit.com

Alternatively, use: https://www.telit.com/contact-us/

For Product information and technical documents, visit: https://www.telit.com

2.4 Conventions

Note:	Provides advice and suggestions that may be useful when integrating the module.
Danger:	This information MUST be followed, or catastrophic equipment failure or personal injury may occur.
Warning:	Alerts the user on important steps about the module integration.

All dates are in ISO 8601 format, that is YYYY-MM-DD.

2.5 Terms and Conditions

Refer to https://www.telit.com/terms-conditions/.

2.6 Disclaimer

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3 Summary

This section summarizes the main characteristics and configuration requirements of the NB-IoT NTN feature on ME310M1-W1.

- Support for 3GPP Rel-17 NB-IoT NTN enables satellite-based connectivity for service continuity in areas without terrestrial coverage.
- Only GEO satellites are supported (non-geostationary constellations are not covered in the current implementation).
- NTN operation relies on Timing Advance (TA) compensation and the reception of SIB31 satellite information; UE position is required to compute TA.
- NTN RAT selection via AT%RATIMGSEL=4 followed by a reset (ATZ) before applying NTN-specific configuration.
- Supported NTN bands: 255 (L-band), 256 (S-band), 252 (AWS-4), and 23 (Skylo); configurable with AT%GETCFG and AT%SETCFG.
- UE positioning modes: Static (persistent across reboot) or Manual (injected on request via POSREQ URC).
- Operator profile selection: DEFAULT (test equipment) and SKYLO via AT%NWOPER.
- Recommended URCs for monitoring: AT%NOTIFYEV="SIB31",1 and AT%NTNEV="TA",1.

3.1 Limitations

- DVT3990252859 - 48.00.013.1-B003 is the first beta version supporting the NTN feature
- FOTA is not supported for upgrades from this version to the next software version.
- Automatic positioning for NTN features is not yet supported
- The initial attach procedure may take several minutes to complete.

4 NB-IoT NTN Overview and Architecture

4.1 What is NTN

NB-IoT Non-Terrestrial Networks (NB-IoT NTN) is a cellular technology standardized starting with 3GPP Rel-17. It defines a way for satellites to provide telecommunication services with NB-IoT cellular modems, theoretically offering coverage anywhere in the world where there is an appropriate satellite overhead.

NTN is primarily used for service continuity, enabling cellular coverage where it is unfeasible through terrestrial networks (e.g., maritime or remote areas), as well as service ubiquity in situations where terrestrial infrastructure is unavailable or out-of-order (e.g., natural disasters).

4.2 How NB-IoT NTN Works

NB-IoT NTN works similarly to terrestrial NB-IoT, except the device telemetry data is sent to the eNB through a satellite communication channel. The following table summarizes satellite types:

Table 2: Satellite Types

Type	Orbit Altitude	RTT	Notes
GEO	35,786 km	≈541.46 ms	Circular equatorial orbit; motionless to observers
MEO	7,000–25,000 km	≈93.45 ms (10,000 km)	Medium altitude orbit
LEO	500–2,000 km	≈25.77 ms (600 km)	Low altitude orbit
HAPS	≈20 km	< 10 ms	Airborne vehicles (not orbital)
Terrestrial	–	≈1 ms	Reference: ground-based eNB

Note: Only GEO satellites are supported on the ALT1350/ME310M1-W1 platform.

4.3 NTN Challenge: Timing Advance

Each LTE UE is assigned a timeslot for transmission. Due to signal propagation delay, the UE must transmit ahead of time for the signal to reach the eNB at the requested time. Timing Advance (TA) represents the Round-Trip Delay—twice the one-way propagation delay.

In NTN, the challenge is for the UE to pre-compensate for the long propagation delay. TA computation is based on three key inputs:

- UE position – Derived from GNSS position or manually injected by the host application.
- Satellite position – Received in the NTN-specific SIB31 broadcast (ephemeris data).
- TAcommon – Feeder link RTT received in SIB31, representing the propagation delay between Gateway and Satellite.

4.4 NTN Typical Operation Flow

To establish an NTN connection, the following sequence occurs:

1. The UE scans the configured NTN bands to check if NTN cells are available.
2. Once an NTN cell is found, the UE retrieves SIB31 containing satellite ephemeris and timing information.
3. UE position is obtained (via static configuration or manual injection; automatic iGNSS retrieval is not supported in the current version).
4. Using SIB31 data and UE position, the UE computes the initial Timing Advance (TA).
5. The UE uses the computed TA to establish an RRC connection.
6. The eNB may estimate the TA error and provide a Timing Advance Command (TAC) for the UE to correct its TA.
7. The UE uses the corrected TA for uplink data transmission.
8. This procedure repeats when validity parameters expire (SIB31 ephemeris validity, UE velocity, or UE elevation angle).

5 Configuration and Setup

5.1 Prerequisites

- The ME310M1-W1 module must use software baseline DVT3990252859 – 48.00.013.1-B003 or later.
- Ensure the AT command reference (AVAS AT Guide) matches the software version used.
- NTN RAT must be selected and a module reset applied before any NTN-specific configuration.
- Note: The NTN-capable variant is designated ME310M1-W1N (P/N: 3990252862). Verify your module supports NTN.

5.2 NTN RAT Selection

To select NTN RAT on the ME310M1-W1, use the AT%RATIMGSEL command followed by a module reset:

```
AT%RATIMGSEL=4
OK
ATZ
OK
```

All subsequent NTN configurations must be performed after NTN RAT is selected and the module has been reset.

5.3 APN Configuration

Configure the APN for NB-IoT NTN. Examples:

```
AT+CGDCONT=1,"IPV4V6","skylo.ip"
OK
AT+CGDCONT=1,"non-IP","telit.poc"
OK
```

Important: PDN parameters are stored in a dedicated NBNTN APN Table and must be provisioned separately, even if already configured for Cat-M or NB-IoT RAT.

5.4 NTN Band Configuration

The following NTN bands are supported (3GPP Releases 17 & 19):

Table 3: Supported NTN Bands

Band	Name	DL Freq. (MHz)	UL Freq. (MHz)
255	L-band (NTN 1.6 GHz)	1525–1559	1626.5–1660.5
256	S-band (NTN 2 GHz)	2170–2200	1980–2010
252	AWS-4	2180–2200	2000–2020
23 (Skylo)	Same as Band 252	Same as Band 252	Same as Band 252

By default, all four bands are configured. Verify with:

```
AT%GETCFG="BAND"
Bands: 255 ,256 ,23 ,252
OK
```

To configure specific bands:

```
AT%SETCFG="BAND","<band1>","<band2>",...
OK
```

5.5 UE Positioning

UE positioning is mandatory for NTN operation. In the current implementation, automatic positioning from iGNSS is not supported. Two manual injection modes are available.

5.5.1 Set the module in debug mode

Ask Telit technical support to receive OTP value, providing IMEI and +CGMR response.

```
AT%SRVCHANGE="debug","<OTP>"
OK
ATZ
OK
```

5.5.2 Static UE Position (persistent across reboot)

Stores UE position in non-volatile memory. Suitable for fixed installations.

```
AT%SETCFG="NTN_UE_POS_MODE","1"
OK
AT%SETCFG="NTN_UE_STATIC_POS","<lat>","<lon>","<alt>"
OK
```

Where <lat> and <lon> are in decimal degrees, and <alt> is altitude in meters.

5.5.3 Manual UE Position (injected on request)

The UE requests position from the host before each transmission when the current position expires. Autoconnect must be disabled.

```
AT%SETCFG="NTN_UE_POS_MODE","3"
OK
AT%SETACFG="modem_apps.Mode.AutoConnectMode","false"
OK
```

Enable position request URC:

```
AT%NTNEV="POSREQ",1
OK
```

When %NTNEVU: "POSREQ" is received, inject position:

```
AT%NTNCMD="POS","<lat>","<lon>","<alt>",20
OK
```

Note: 600 m position accuracy is sufficient (≈66 µs RTT error, negligible per 3GPP). Inject position before any command triggering transmission (AT+CGATT, AT+CFUN=4, AT+CSODCP, AT+CMGS, etc.).

5.6 Operator-Specific Configuration

ALT1350 supports two NTN operator configurations:

- DEFAULT – No specific feature enabled; intended for use with test equipment.
- SKYLO – Enables Skylo-specific features as required by the Skylo compliance matrix.

Configure with AT%NWOPER:

```
/* TN operator = default, NTN operator = default */
AT%NWOPER="default",,"default"
OK

/* TN operator = default, NTN operator = skylo */
AT%NWOPER="default",,"skylo"
OK
```

5.7 eDRX Configuration for NTN

Extended Discontinuous Reception (eDRX) can be configured for NTN RAT using AT+CEDRXS (3GPP Rel-18):

```
AT+CEDRXS=<mode>,<AcT-type>[,<Requested_eDRX_value>]
OK
```

Set <AcT-type> to 6 (satellite E-UTRAN NB-S1 mode) for NTN eDRX. This enables independent eDRX settings for NTN and terrestrial NB-IoT.

5.8 URC Configuration for Monitoring

The following URCs are recommended for monitoring NTN operation:

```
AT%NOTIFYEV="SIB31",1     // SIB31 reception notification
AT%NTNEV="TA",1           // Timing Advance reporting
AT+CEREG=2                // Network registration with location
info
```

These URCs provide real-time visibility into the NTN connection state and are essential during integration and field testing.

6 Usage Examples

This section provides step-by-step examples demonstrating common NTN operation scenarios.

6.1 Example: Static UE Position Mode

Complete NTN connection procedure using static UE positioning.

Step 1 – Configure APN:

```
AT+CGDCONT=1,"IPV4V6","skylo.ip"
OK
Or
AT+CGDCONT=1,"non-IP","telit.poc"
OK
```

Step 2 – Enable NB-IoT NTN RAT and reset:

```
AT%RATIMGSEL=4
OK
ATZ
OK
```

Step 3 – Check NTN bands:

```
AT%GETCFG=”BAND”
Bands: 255 ,256 ,23 ,252
```

Step 4 – Optionally set single NTN bands:

```
AT%SETCFG="BAND",255,256"
OK
```

Step 5 – Set the module in debug mode

```
AT%SRVCHANGE="debug","<OTP>"
OK
ATZ
OK
```

Step 6 – Configure static UE position:

```
AT%SETCFG="NTN_UE_POS_MODE","1"
OK
AT%SETCFG="NTN_UE_STATIC_POS","48.825972","2.267738","85"
OK
```

Step 7 – Configure URCs, enable radio, and wait for registration:

```
AT+CFUN=4
OK
AT%NOTIFYEV="SIB31",1
OK
AT+CEREG=2
OK
AT%NTNEV="TA",1
OK
```

```
AT+CFUN=1
OK

+CEREG: 2
+CEREG: 0
+CEREG: 2
%NOTIFYEV: "SIB31"
%NTNEVU: "TA","RACH",512,9123,697459
%NTNEVU: "TA","TAC",1,156,697618
+CEREG: 1,"0FAB","0010D88B",9
```

6.2 Example: Manual UE Position Mode

NTN connection with manual UE position injection.

Step 1 – Configure APN:

```
AT+CGDCONT=1,"IPV4V6","skylo.ip"
OK
Or
AT+CGDCONT=1,"non-IP","telit.poc"
OK
```

Step 2 – Enable NB-IoT NTN RAT and reset:

```
AT%RATIMGSEL=4
OK
ATZ
OK
```

Step 3 – Set the module in debug mode

```
AT%SRVCHANGE="debug","<OTP>"
OK
ATZ
OK
```

Step 4 – Configure manual UE positioning and disable autoconnect:

```
AT%SETCFG="NTN_UE_POS_MODE","3"
OK
AT%SETACFG="modem_apps.Mode.AutoConnectMode","false"
OK
ATZ
OK
```

Step 5 – Configure URCs (POSREQ is mandatory):

```
AT+CFUN=4
OK
AT%NOTIFYEV="SIB31",1
OK
AT%NTNEV="TA",1
OK
AT%NTNEV="POSREQ",1
OK
AT+CEREG=2
OK
```

Step 6 – Enable radio, inject position, and register:

```
AT+CFUN=1
OK

+CEREG: 2
+CEREG: 0

AT+CGATT=1
ERROR    --> UE position is required

+CEREG: 2
%NTNEVU: "POSREQ"    --> UE Position requested
%NOTIFYEV: "SIB31"

AT%NTNCMD="POS","48.825972","2.267738","85",20
OK
AT+CGATT=1
OK

%NTNEVU: "TA","RACH",512,2776,176147
%NTNEVU: "TA","TAC",1,160,176376
+CEREG: 1,"0FAB","0010D88B",9
```

6.3 Example: Non-IP Data Transfer

Non-IP data exchange using AT%CSODCP commands:

```
// Enable data transfer notification
AT%CSODCP="NOTIFY",1
OK

// Send data (hex-encoded payload)
AT%CSODCP="SEND",1,100,"01020304...0a",1,0
%CSODCP: 1
OK

// UE Position requested (manual mode)
%NTNEVU: "POSREQ"

AT%NTNCMD="POS","48.825972","2.267738","85",20
OK

%NTNEVU: "TA","RACH",511,30149,523067
%NTNEVU: "TA","TAC",1,156,523276

// Data sent successfully
%CSODCPU: 0,1
```

7 Troubleshooting

For advanced debug capabilities, contact Telit Technical Support. Provide module IMEI (AT+CGSN) and firmware version (AT+CGMR) when requesting assistance.

Table 4: Common URCs and their interpretation

URC	Description
%NOTIFYEV: "SIB31"	SIB31 received. Module has satellite ephemeris data.
%NTNEVU: "TA","RACH",<sf>,<ta>,<earfcn>	TA computed during RACH. <ta> is TA value in Ts units.
%NTNEVU: "TA","TAC",<step>,<ta>,<earfcn>	TA correction from eNB. <step> is TAC step size.
%NTNEVU: "POSREQ"	UE position required (manual mode). Inject via AT%NTNCMD="POS".
+CEREG: 1,"<TAC>","<CI>",9	Registered on NTN cell (AcT=9: E-UTRAN NB-IoT NTN).
+CEREG: 0	Not registered. Check band config, APN, UE position.

8 SIB1 and SIB31 Reference

8.1 SIB1 NTN Fields

3GPP Rel-17 introduced new fields into SIB1 for NTN cells. An NTN cell sets cellBarred to active, so legacy terrestrial devices skip NTN cells. SIB1 also carries SIB31 scheduling information.

8.2 SIB31 Fields

SIB31 contains the following fields critical for NTN operation:

Table 5: Critical SIB31 Fields

Field	Description
Satellite ephemeris	Orbital parameters of the serving satellite for position computation.
TAcommon	Propagation delay between Gateway and Satellite (feeder link RTT).
Koffset	Timing offset parameter for UL/DL frame alignment.
Kmac	MAC-layer timing parameter. Note: not yet supported on Amarisoft.
ul-SyncValidityDuration	Validity duration of SIB31; determines when UE must re-acquire SIB31.

9 Acronyms and Abbreviations

Table 6: Acronyms and Abbreviations

Acronym	Definition
APN	Access Point Name
BS	Base Station
EARFCN	E-UTRA Absolute Radio Frequency Channel Number
eDRX	Extended Discontinuous Reception
eNB	Evolved Node B (LTE Base Station)
FOTA	Firmware Over The Air
GEO	Geostationary Equatorial Orbit
GNSS	Global Navigation Satellite System
HAPS	High Altitude Platforms
iGNSS	Internal Global Navigation Satellite System
LEO	Low Earth Orbit
LTE	Long Term Evolution
MDOP	Modem Device Operational Parameters
MEO	Medium Earth Orbit
NB-IoT	Narrowband Internet of Things
NTN	Non-Terrestrial Networks
PDN	Packet Data Network
RACH	Random Access Channel
RAT	Radio Access Technology
RRC	Radio Resource Control
RTT	Round-Trip Time
SIB	System Information Block
TA	Timing Advance
TAC	Timing Advance Command
UE	User Equipment
URC	Unsolicited Result Code

10 Related Documents

For current documentation and downloads, refer to https://dz.telit.com/.

Table 7: Related Documents

S.no	Doc Code	Document Title
1	1VV0301897	ME310M1 Hardware Design Guide
2	3GPP 22.261	Service requirements for the 5G system (NTN architecture)
3	3GPP 36.102	E-UTRA UE radio transmission and reception (NTN bands)

11 Document History

Table 8: Document History

Revision	Date	Changes
0	2026-05-19	Initial Release – ME310M1-W1 NB-IoT NTN Application Note covering NTN overview, architecture, configuration, usage examples, troubleshooting, and SIB reference.

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Technical Documentation