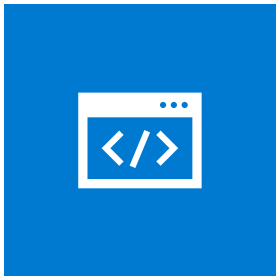
Application Note

Telenor IoT

telenor IoT

Quick Guide



Check APN

Make sure to use the correct APN. The default APN used for Telenor IoT services is “telenor.iot”.

Read application note

The Application Note should provide you with all the information you need to apply Telenor IoT sim cards.

Call us for IoT support

If you need further technical assistance, please contact our customer support on +45 72 12 86 17.

Contents

1. Introduction

1.1. Purpose

The purpose of this document is to describe the technical properties of the Telenor IoT connectivity product and offer guidance on how to use and integrate the connectivity service into the customers end-product.

1.2. Scope

The document describes the key parameters of the product, and how these should be handled by the customer. Basic modem procedures, allowing the customer device to attach and register with the Telenor network will be described for a selected number of chipsets.

The document is focused on the network and communication related aspects of using the IoT product. Issues associated with actual application and functionality of the customer devices are not addressed.

2. Product Description (One-IoT)

2.1. Radio technologies

The One-IoT product is offered on the following radio access technologies:

	Mobility	Data rates	Latency	Indoor penetrations	Battery life	Additional services
2G	Full	10/10 kbps	High (<10s)	Maximum	Short	SMS support Voice support
3G	Full	300/100 kbps	High (<2s)	Maximum	Short	SMS support Voice support
4G/NB-IoT	Limited	170/250 kbps	High (<10s)	Maximum	Maximum	
4G/LTE-M	Full	1/1 Mbps	High (<1s)	Very good	Very long	SMS support Voice support
4G/LTE	Full	(*)	High (<1s)	Good	Short	SMS support Voice support

(*) Theoretical Max Speed > 1 Gbps

2.2. Frequency Bands

With a few exceptions, the current Telenor implementation for NB-IoT and LTE-M is on Band 20 (L800). Other bands are L900, L1800, L2100 and L2600 for 4G, and 900 and 1800 layers for 2G coverage. Telenor Denmark's Coverage Map for IoT is available via this link: https://www.telenor.dk/erhverv/kundeservice/drift-og-dakning/dakning/dakningskort/

2.3. APN

The default APN used for Telenor IoT services is telenor.iot. This APN will direct traffic towards the open internet. The APN is pushed by the network and will be used if leaving the APN field empty in the AT command, but can also be manually selected (see further details in commands section). It is important to make sure that the device is not attempting to use an unsupported APN such as internet, which is the default APN in many other connectivity products.

For connecting the device to a customer specific network with a dedicated APN name, please contact Telenor at iot@telenor.dk for further information.

2.4. Features

The main NB-IoT and LTE-M features (3GPP Rel. 13 and 3GPP Rel. 14) are already implemented or are to be implemented within the coming months. Below is a list of the main features:

FEATURES		
Feature	**Network technology**	**Status**
Power Savings Mode (PSM)	NB-IoT and LTE-M (Rel. 13)	Implemented
eDRX	NB-IoT and LTE-M (Rel. 13)	2022
Multiple Coverage Levels	NB-IoT (Rel. 13)	Implemented
Multiple Coverage Levels	LTE-M (Rel. 13)	2021
Intra-frequency Idle Mode Mobility	NB-IoT (Rel. 13)	Implemented
Connected Mode Mobility Support (Intra-Freq Only)	LTE-M (Rel. 13)	Implemented
VoLTE Support	LTE-M (Rel. 13)	Implemented
Enhanced Cell ID-based Location Service (ECID)	NB-IoT (Rel. 14)	2022
Enhanced Cell ID-based Location Service (ECID)	LTE-M Rel. 14)	2022
Non-IP Data DELIVERY in Core Network (SCEF)	NB-IoT (Rel. 13)	Not supported
Non-IP Data DELIVERY in Core Network (SCEF)	LTE-M (Rel. 13)	Not supported
SMS on NB-IoT	NB-IoT (Rel. 13)	Not supported

2.5. Roaming

NB-IoT and LTE-M roaming is fairly new to many operators – hence currently with limited roll-out, but new agreements are continuously introduced. Please contact Telenor at iot@telenor.dk for latest information on NB-IoT and LTE-M roaming.

As for the already available extensive roaming setup for 2G and 4G-LTE, please see our roaming map for complete overview:
https://www.telenor.dk/erhverv/shop/mobilabonnementer/roaming-usp/

2.6. IP Address Ranges

The assigned IP addresses are. IPv4. Telenor is utilizing CGNAT, where every device will be assigned an internal IP, and sharing public IP with other devices.

For managing the IP addresses, and for Radius support, please contact Telenor at iot@telenor.dk for further information.

2.7. Data overhead

All information transferred across the network is subject to measurement and will be rated according to the actual data plan. This includes IP and UDP header information, TCP, FTP and other protocol overhead, as well as the ordinary payload data.

Example: 100-byte payload data transferred in a single UDP packet, means a total of 128 bytes are assessed due to the IP+UDP header overhead.

Control plane traffic used for network attach, detach, etc. is not rated.

3. Basic Modem procedures

The procedures necessary to attach the modem to the Telenor network will be described in terms of the necessary AT commands and associated responses. Many chipset vendors offer proprietary commands in addition to the ETSI[1]command set. This document will offer some support to selected vendors, but it is highly recommended to seek this information from the different vendor support pages.

The following colour legend is applied in the following command tables:

ETSI and Vendor Proprietary AT Command Color Scheme				
uBlox	**Quectel**	**Simcom**	**Telit**	**ETSI**

3.1. SIM PIN code

The IoT SIM cards delivered from Telenor contains two PINs:

- PIN1 = 1234
- PIN2 = 0000 (NO PIN)

Status of the PIN can be:

[1] https://www.etsi.org/deliver/etsi_ts/127000_127099/127007/16.05.00_60/ts_127007v160500p.pdf

- **Disabled** means that PIN value is not needed. All files that have access set to PIN1 are open.
- **Random** means that value is being calculated randomly during data processing so each card during personalization gets its own unique random value. Those values can then be checked in output file.
- **Blocked** means that PIN2 value is not available and to give its value first it is needed to unblock it by giving correct value of PUK2. When providing value of PUK2 in APDU command new value for PIN2 is required so end user can set his own new value for PIN2.

Default value for the Telenor IoT SIM cards are **Disabled**.

If a PIN is assigned, it is not possible to access the SIM and Attach to the Network before the PIN has been applied.

SIM PIN code			
Command Action	**Command Syntax**	**Response**	**Description**
Check PIN	AT+CPIN?	> +CPIN: READY > OK	Check if a PIN is required: If the response is **'READY'** there is NO PIN required:
		`> +CPIN: SIM PIN > OK`	If a PIN is required, it will response with 'SIM PIN':
Provide the PIN	`AT+CPIN="1234"`	`> OK`	Provide the PIN to allow access to the SIM:
Remove the PIN	`AT+CLCK="SC",0,"0000",1`	`> OK`	After providing the 'PIN' It is possible to remove the 'PIN', for easy access in the future, by AT Command.
Request IMEI / IMSI	`AT+CIMI;+CGSN=1;`	`> <IMSI number> > OK > +CGSN: <IMEI number> > OK`	Obtain IMSI and IMEI information from SIM and device.

3.2. Attach

This is the essential first step to start with the IoT device, therefore being mandatory. The steps to be followed are:

1. Make sure that the SIM card is inserted correctly into the device and ready to work (i.e. SIM PIN procedure completed). Force the device towards the correct frequency band(s).
2. Force the device towards the correct operator and technology. It's also possible to run this step in Auto-Mode, and let the device choose operator and technology. However, in some cases this can lead to an incorrect choice, depending on the default behaviour of the device.
3. Force the device to attach.

ATTACH			
Steps	**Command Syntax**	**Response**	**Description**
Show NW Data	AT+CEREG=2	> OK	Enable to use CEREG to show Registration Status, TAC, Cell ID, RAT
Band Selection	AT+UBANDMASK=0,524290 AT+UBANDMASK=1,524290	> OK	0: LTE Cat M1. The second number indicates the bandmask for LTE bands 1 to 64. 1: LTE Cat NB1. The second number indicates the bandmask for LTE bands 1 to 64.
	AT+QCFG="band",…	> OK	AT+QCFG="band"[,<gsmbandval>,<catm1bandval>,<catnb1bandval>[,<effect>]]
	AT+CBANDSL= 1 / 0,band number,….	> OK	AT+CBANDSL= <enable>[,<band number>,<band1>[,<band2>[,<band3>[,<ban4>]]]]
	AT#IOTBND=…,…,…	> OK	AT#IOTBND=[<lte_m1_band_pref.bits_1_64>][,[<lte_m1_band_pref.bits_65_128>][,<lte_nb1_band_pref.bits_1_64>[,<lte_nb1_band_pref.bits_65_128>]]]
Operator and / or RAT Selection	AT+COPS=1,2,"23802",9	> OK	The last number in the AT Command Sequence is the radio access technology to be accessed, M1 = 8 and NB = 9.
	AT+URAT=X	> OK	RAT Selection only uBlox, M1 =7, NB = 8
Force Attach	AT+CFUN=1	> OK	Sets the MT to full functionality, e.g. from airplane mode or minimum functionality
Check NW Data	AT+CEREG?	+CEREG: 2,1,"36DB","2A45720",8	Check Registration Status, TAC, Cell ID, RAT

3.3. PDP context

The Packet Data Protocol (PDP) Context is needed to allow the device to transmit data (IP Packets).

It is necessary to make sure that the APN is correct. This must be done either by manually selecting and pushing the APN, or by letting the network push the default APN.

Telenor uses the default APN "telenor.iot" for IoT services.

PDP CONTEXT

Steps	Command Syntax	Response	Description
Define PDP Context	AT+CGDCONT=1,"IP", "telenor.iot" AT+QCGDEFCONT="IP","telenor.iot" AT*MCGDEFCONT="IP","telenor.iot"	> OK	Defines the connection parameters for creating and setup a PDP context for IP Data Transmission. Initially as specified by ETSI, The Access Point Name, can be, a string parameter, a logical name to select the GGSN or the external packet data network. If the value is 'null' or omitted by "", then the subscription value will be requested from the Network. The Proprietary Quectel BC66 and Simcom SIM7020 Commands stores the definition as 'Default' in the modem.
Verify PDP Context	AT+CGDCONT?	+CGDCONT: 1,"IP","telenor.iot","XX.XX.XX.XXX",0,0,0,0	Verify that the PDP context is created and have been assigned an 'IP' Address "XX.XX.XX.XXX"

3.4. Detach

This step is highly recommended before switching off the device to make sure that the network is aware of the device status.

DETACH			
Steps	**Command Syntax**	**Response**	**Description**
Force Detach	AT+CFUN=0	> OK	Sets the MT to minimum functionality (disable both transmit and receive RF circuits by deactivating both CS and PS services). It can be up to the manufacturer whether this command will affect the network registration. In negative case, use AT+COPS=2 in order to force the deregistration.
Check NW Status	AT+CEREG?	+CEREG: 2,1,<TAC>, <Cell ID>, B OK	Check Registration Status. Having CEREG previously set to 2 will show TAC, Cell ID, and RAT, with RAT that in case of deregistration will be equal to 'B'.

3.5. PSM

The Power Saving Mode Feature is based on 2 timers:

- T3412, Tracking Area Update Timer: It represents the PSM cycle duration, i.e. when it expires, the network is notified of the availability of the terminal.
- T3324, Active Timer: Duration during which the terminal is reachable for mobile-terminated data. It starts after transition from Connected to Idle, and when it expires the terminal enters the Power Saving Mode.

PSM			
Command Action	**Command Syntax**	**Response**	**Description**
Check PSM Status	AT+CPSMS?	+CPSMS:0,,,"00011000","00001010" OK	Verify that PSM is not enabled, '0' Indicate that PSM is not active
Enable PSM	AT+CPSMS=1,,,"00000000","00000000"	AT+CPSMS=1,,,"10100011","00100001" > OK	Enable PSM, first Timer is T3412 (Total), second Timer is T3324 (Active)
Check PSM Status	AT+CPSMS?	+CPSMS:1,,,"10000110","00011110" OK	Verify that PSM is enabled and that the Timers are correct, '1' Indicate that PSM is active
Disable PSM	AT+CPSMS=0	> OK	Disable PSM. Defined Timers are kept if re-enabling it
Check PSM Status	AT+CPSMS?	+CPSMS:0,,,"00011000","00001010" OK	Verify that PSM is now disabled, '0' Indicate that PSM is not active

3.5.1. PSM Timers

PSM TIMERS

T3412 (Total); first 3 Bits are the Multiplication Factor:

000	10 Minutes
001	1 Hour
010	10 Hours
011	2 Seconds
100	30 Seconds
101	1 Minute
110	320 Hours
111	Deactivate

T3324 (Active); first 3 Bits are the Multiplication Factor:

000	2 Seconds
001	1 Minute
010	6 Minutes
011	-
100	-
101	-
110	-
111	Deactivate

4. Proprietary commands explained

4.1. Quectel BG96

Quectel BG96 AT Commands

Quectel BG96	
AT+QCFG="band" – Band Configuration	
Write Command **AT+QCFG="band"[,<gsmbandval>,<catm1bandval>,<catnb1bandval>[,<effect>]]**	Response If configuration parameters are all entered, configure the frequency bands allowed to be searched: **OK** If there is an error related to ME functionality, response: **+CME ERROR: <err>** If there is any other error, response: **ERROR**
	Other possible Parameters: **<nwscanmode>** Number format. RAT(s) to be searched. **0** Automatic, **1** GSM only, **3** LTE only **<effect>** Number format. When to take effect. **0** Take effect after UE reboots, **1** Take effect immediately
Read Command AT+QCFG="band"	Response Return the current configuration: +QCFG:"band", <gsmbandval>,<catm1bandval>, <catnb 1bandval> **OK**

4.2. Simcom 7000

Simcom 7000	
AT+CBANDSL Set Modem NB-IOT Search Prefer Band List	
Test Command T+CBANDSL= ?	Response +CBANDSL: (list of supported <enable>s), (list of supported <band number>s) ,(list of supported <band>s) **OK**
	Parameter See Write Command
Write Command **AT+CBANDSL=** **<enable>[,<band number>,<band 1>[,<band2>[,<band3>[,<band4>]]]]**	Response OK If error is related to ME functionality: +CME ERROR: <err>
	Parameter <enable> Integer value indicating search prefer band list enable or disable 0 Disable 1 Enable <band number> Integer value indicating search prefer band number. Valid values: 1,2,3,4 <bandn> Integer value indicating current search prefer NB-IOT band. Valid values: 1,2,3,5,8,11,12,13,17,18,19,20,21,25,26,28,31,66,70

Read Command **AT+CBANDSL?**	Response +CBANDSL: <band> OK
	Parameters See Write Command
Parameter Saving Mode	AUTO_SAVE

4.3. Telit ME910

Telit ME910	
CAT-M1 & NB-IoT Band Setting - AT#IOTBND	
Write Command **AT#IOTBND=[<lte_m1_band_pref.bits_1_64>][,[<lte_m1_band_pref.bits_65_128>][,<lte_nb1_band_pref.bits_1_64>[,<lte_nb1_band_pref.bits_65_128>]]]**	Response #IOTBND: <lte_m1_band_pref.bits_1_64>,<lte_m1_band_pref.bits_65_128> ,<lte_nb1_band_pref.bits_1_64> ,<lte_nb1_band_pref.bits_65_128>
	Parameter <lte_m1_band_pref.bits_1_64> integer - indicates the lower (1-64) CAT-M1 supported bands, expressed as the sum of Band number (1+2+8 ...); see #BND command <lte_m1_band_pref.bits_65_128> integer - indicates the higher (65-128) CATM1 supported bands, expressed as the sum of Band number (0 meaning "no high band selected"); see #BND command <lte_nb1_band_pref.bits_1_64> integer - indicates the lower (1-64) NB-IoT supported bands, expressed as the sum of Band number (1+2+8 ...); see #BND command <lte_nb1_band_pref.bits_65_128> integer - indicates the higher (65-128) NB-IoT supported bands, expressed as the sum of Band number (0 meaning "no high band selected"); see #BND command
Read Command AT#IOTBND?	Read command returns the current parameters setting for #IOTBND command in the format: #IOTBND: <lte_m1_band_pref.bits_1_64>,<lte_m1_band_pref.bits_65_128> ,<lte_nb1_band_pref.bits_1_64> ,<lte_nb1_band_pref.bits_65_128>
Test Command AT#IOTBND=?	Test command reports the supported range of values for parameters: <lte_m1_band_pref.bits_1_64>,<lte_m1_band_pref.bits_65_128> , <lte_nb1_band_pref.bits_1_64>,<lte_nb1_band_pref.bits_65_128 >

4.4. uBlox

uBlox	
Band selection bitmask AT+UBANDMASK	
Write Command AT+UBANDMASK=<RAT>, <bitmask1>[,<bitmask2>]	Response AT+UBANDMASK=0,2074 OK Parameter <RAT> Number Indicates the Radio Access Technology (RAT): • 0: LTE Cat M1 • 1: LTE Cat NB1 <bitmask1> Number Indicated the bandmask for LTE bands 1 through 64. Each bit enables/disables a band: • Bit 0: band 1 • Bit 1: band 2 • Bit 2: band 3 • Bit 3: band 4 • .. • Bit 63: band 64 <bitmask2> Number Indicated the bandmask for LTE bands 65 through 128. Each bit enables/disables a band: • Bit 0: band 65 • Bit 1: band 66 • Bit 2: band 67 • Bit 3: band 68 • .. • Bit 63: band 128
Read Command -> AT+UBANDMASK?	+UBANDMASK: <RAT>, <bitmask1>[,<bitmask2>][,<RAT>, <bitmask1>[,<bitmask2>]] OK Parameters See Write Command
Test Command -> AT+UBANDMASK=?	+UBANDMASK: (list of the supported <RAT>s),<bitmask1>, <bitmask2> OK Parameters See Write Command

4.5. Quectel BC66

Quectel BC66	
AT+QCGDEFCONT Set Default PSD Connection Settings	
Test Command AT+QCGDEFCONT=?	Response +QCGDEFCONT: (list of supported <PDP_type>s) OK
Read Command AT+QCGDEFCONT?	Response +QCGDEFCONT: <PDP_type>,<APN>,<username>,<password> OK
Write Command AT+QCGDEFCONT=<PDP_type>[,<APN>[,<username>[,password]]]	Response OK If there is any error: ERROR or +CME ERROR: <err>
Max Response Time	300ms

	Parameter AT+QCGDEFCONT Set Default PSD Connection Settings Test Command AT+QCGDEFCONT=? Response +QCGDEFCONT: (list of supported <PDP_type>s) OK Read Command AT+QCGDEFCONT? Response +QCGDEFCONT: <PDP_type>,<APN>,<username>,<password> OK Write Command AT+QCGDEFCONT=<PDP_type>[,<APN>[,<username>[,password]]] Response OK If there is any error: ERROR or +CME ERROR: <err> Maximum Response Time 300ms <PDP_type> String type. Specify the type of packet data protocol: "IP" Internet Protocol (IETF STD 5) "IPV6" Internet Protocol version 6 (IETF RFC 2460) "IPV4V6" Dual IP stack (see 3GPP TS 24.301) "Non-IP" Transfer of Non-IP data to external packet network (see 3GPP TS 24.301)

4.6. Simcom SIM7020

Simcom SIM7020	
AT*MCGDEFCONT Set Default PSD Connection Settings	
Test Command AT*MCGDEFC ONT=?	Response *MCGDEFCONT: (list of supported <PDP_type>) OK Parameters See Write Command
Read Command AT*MCGDEFC ONT?	Response *MCGDEFCONT: <PDP_type>[,<APN>,<username>,<password>] OK Parameters See Write Command
Write Command AT*MCGDEFC ONT=<PDP_typ e>[,<APN>[,<use rname>[,<passw ord>]]]	Response OK If error is related to wrong AT syntax: +CME ERROR: <err>

Max Response Time	Parameter <PDP_type> (Packet Data Protocol type) a string parameter which specifies the type of packet data protocol : IP Internet Protocol (IETF STD 5) IPV6 Internet Protocol, version 6 (IETF RFC 2460) IPV4V6 Virtual <PDP_type) introduced to handle dual IP stack UE Capability (see 3GPP TS 24.301). Non-IP Transfer of Non-IP data to external packet data Network (see 3GPP TS 24.301). <APN> (Access Point Name) a string parameter that is a logical name that is used to select the GGSN or the external packet data network. If the value is null or omitted, then the subscription value will be requested. <username> String value. Username for the connection to the service provider. <password> String value. Password for the connection to the service provider AUTO_SAVE_REBOOT

5. Other Commands and Information

OTHER HANDY AT COMMANDS TO KNOW			
Command action	**Command syntax**	**Response**	**Description**
Check if GPRS attached	AT+CGATT?	+CGATT: <state> > OK	Check if the Device is attached to the mobile network or not. <state> values: 0: Detached from network 1: Attached to network
Check signal strength	AT+CSQ	+CSQ: <signal_power>,<qual> OK	Request signal_power and qual. On many Chip Sets, qual will always be 99. The mapping between signal_power and RSSI dBm is -113 + (signal_power * 2). Example response: +CSQ: 25,99 RSSI = (-113 + (25 * 2)) = -63 dBm
Get time/clock	AT+CCLK?	+CCLK: "YY/MM/DD,HH:MM:SS+ZZ" OK	Fetches the Device internal time/clock, which may be sync, to the IoT network Time
Enable automatic timezone update	AT+CTZU=1	> OK	Enable automatic time zone update via NITZ (network identity and time zone)

5.1. Frequency Search and Roaming

If a device is only to be used in Denmark, then we can limit the network search to band 20 only. If the device roams, then we can advantageously limit it to frequency (s) known to be used in the country (s), but with a conditional statement that allows for searching on several bands if the device has not been able to connect for 24/36 hours.

It is recommended to limit NB-IoT radio frequencies in the device to get the most optimal power consumption, without risking losing connection if a roaming provider changes frequency in the future.

6. Troubleshooting

6.1. Checklist

- General description of the issue
- Is the issue consistent and reproduceable, and if so, under which conditions?
- MSISDN, IMSI or ICCID of the SIM
- Timestamp of the observation
- Location of the observation
- Radio Access Type used (2G, LTE, LTE-M, NB-IoT)
- Services used (Voice, SMS)
- Which chipset is being used (HW & FW version)
- Does the chipset/device observe the same behavior, when using the procedures described in this document?
- Provide full AT command and response trace, including information on any pre-conditions.

6.2. Contact

Please contact Telenor at iot@telenor.dk with the information above.

6.3. Advanced services

For advanced troubleshooting or product verification cases, Telenor offers a dedicated Lab service. Please contact Telenor at iot@telenor.dk for information about available services.